W 92

PROCUREMENT

PROCUREMENT - A KEY TO INNOVATION
LA MAÎTRISE D'OUVRAGE - CLÉ DE L'INNOVATION

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Procurement - a Key to Innovation

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La maîtrise d'ouvrage - clé de l'innovation

Articles présentés au Symposium International de la Commission W92 du Conseil international du bâtiment pour la recherche, l'étude et la documentation - CIB, organisé à la Faculté de l'aménagement, Université de Montréal, du 20 au 23 mai, 1997.

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Davidson, Prof. Colin H., and Dr. Tarek Abdel Meguid (eds.). (1997). *Procurement - a Key to Innovation*, Montreal, IF Research Corporation, 850pp.

Abstract:

The 1997 Symposium of Working Commission W92 of the International Council for Building Research, Studies and Documentation (CIB) was held at the Université de Montréal; the theme was "Procurement - a Key to Innovation". Approximately 80 papers were accepted and are published - which addressed the general area of contemporary procurement from a number of points of view.

As well as discussing the relationship between procurement (the set of strategic decisions made by the building owner) and the scope for innovation, procurement is also examined in the contexts of the globalization of commerce (with the cultural shocks often induced), of the increasing privatization of investment initiatives and of sustainable development. Contractual inter-enterprise relationships and obligations are presented, with reference to partnering and the equitable spread of risks among project participants, and to the adoption of procurement strategies which impact on the habitual separation of design, construction and maintenance. Lessons are drawn from other industries, their contracting methods and their structures.

RÉFÉRENCE BIBLIOGRAPHIQUE

Davidson, Prof. Colin H., et Dr. Tarek Abdel Meguid. (réds.). (1997). *La maîtrise d'ouvrage - clé de l'innovation*, Montréal, Société de recherche IF, 850pp.

Résumé:

Le Symposium de la Commission W92 du Conseil international du bâtiment pour la recherche, l'étude et la documentation (CIB) a eu lieu à l'Université de Montréal en mai; le thème portait sur «La maîtrise d'ouvrage - clé de l'innovation». Environ 80 articles ont été acceptés et publiés; ils présentent différentes façons d'aborder le sujet de la maîtrise d'ouvrage.

Les auteurs discutent non seulement la relation entre la maîtrise d'ouvrage (l'ensemble des décisions stratégiques prises par le maître d'ouvrage) et la possibilité d'innover, mais aussi l'impact de la mondialisation du commerce (en tenant compte des chocs culturels qui peuvent en découler), de la privatisation accrue des investissements immobiliers et du développement durable sur la maîtrise d'ouvrage. Les relations et les obligations contractuelles inter-entreprises sont présentées, en se référant au partenariat et au partage équitable des risques entre les participants d'un projet. Certaines stratégies modifient la séparation traditionnelle entre le design, la construction et la maintenance. Des leçons concernant méthodes contractuelles et structures sont tirées de quelques autres industries.

PROGRAMME

The programme includes the following invited presentations:

May 20, 1997 **Gérard Blachère**: "Innovation and Procurement"
David Haviland: "Procurement strategy - key to quality for building owners"
Ezra Ehrenkrantz: "Procurement and innovation - some successful strategies"

May 21, 1997 **Dennis Cahill**: "The learning organization - application to building firms"
Ed Wundram: "Design-Build: a successful procurement option"

May 22, 1997 **Christophe Gobin**: "Performance-based Procurement - the Contractor's View"
Lorna Tardif: "Procurement: Communicate - or Else... "

May 23, 1997 **Round Table**: "From Research to Practice: Perspectives and Opportunities"
Alain Dagenais: "Procurement and Legal Responsibility"
Sir Michael Latham: "Procurement - the Present and Future Trends"

PROGRAMME

Le programme inclut les présentations suivantes:

le 20 mai 1997 **Gérard Blachère**: «L'innovation et la maîtrise d'ouvrage»
David Haviland: «Procurement strategy - key to quality for building owners»
Ezra Ehrenkrantz: «Procurement and innovation - some successful strategies»

le 21 mai 1997 **Dennis Cahill**: «The learning organization - application to building firms»
Ed Wundram: «Design-Build: a successful procurement option»

le 22 mai 1997 **Christophe Gobin**: «La maîtrise d'ouvrage 'performancielle' - le point de vue de l'entrepreneur»
Lorna Tardif: «La maîtrise d'ouvrage: communiquez ... sinon!»

le 23 mai 1997 **Table ronde**: «De la recherche à la pratique: perspectives et opportunités»
Alain Dagenais: «Maîtrise d'ouvrage et résponsabilité légale»
Sir Michael Latham: «Procurement - the Present and Future Trends»

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PREFACE

Presentation of the theme:

Procurement - the development of a system of strategic decisions by the intending building owner - sets the rules for all subsequent collaborators and contracting parties: architects, engineers, manufacturers and building contractors. Procurement therefore determines the limits imposed on how they design, manufacture and build. This symposium explored the relationship between procurement decisions and the scope for innovation. The underlying assumptions were: (i) that better building can be attained by choosing procurement strategies more systematically, and (ii) that the scope for innovation is a matter of concern on the contemporary building scene.

Hypotheses:

The symposium enabled the following working hypothesis to be explored:

> "the procurement strategy adopted by any one building owner, particularly if he/she is a major player, directly affects the scope for innovation in the response by the building industry, in design, manufacture and construction; collectively, improved procurement enables major innovations to occur."

The first question that was debated therefore was: in conformity with this view, what recommendations should be given to the building owners?

or the following counter hypothesis:

> "contemporary building owners are only concerned with the quality and effectiveness of the building being acquired, and do not wish to be involved in the building process in any way; consequently, innovation is the responsibility of designers, manufacturers and builders (i.e. of the 'industry') and is independent of procurement strategies."

The second question that was debated therefore was: how can the industry be helped to assume this responsibility to innovate in order to satisfy the up-front expectations of the building owners?

Orientation:

The symposium, designed to encourage debate of these and related questions, and to produce guidance to building owners, brought together experts from several continents. The symposium was specifically designed to establish links between research and practice for mutual benefit, through a planned sequence of plenary sessions and workshops addressing the following aspects of the procurement question: legal (including liability and risk sharing), organizational (including structures and decision-making), financial (including cost-benefits) or functional (including quality and performance).

PRÉFACE

Présentation du thème:

La maîtrise d'ouvrage - proposition d'un ensemble de décisions stratégiques par le maître d'ouvrage - établit les règles que doivent respecter tous les intervenants subséquents: concepteurs, fabricants et entrepreneurs. La maîtrise d'ouvrage définit le cadre régissant les procédures de conception, fabrication et construction. Ce symposium a permis d'explorer la relation entre les décisions prises par le maître d'ouvrage d'une part et l'adoption des innovations d'autre part. Les prémisses de base suggèraient: (i) que l'amélioration de la qualité de la construction découle d'un meilleur choix des stratégies de maîtrise d'ouvrage, et (ii) que la possibilité d'introduire l'innovation technologique est une préoccupation majeure pour l'industrie de la construction contemporaine.

Hypothèses:

Le symposium a fourni l'occasion de discuter les hypothèses suivantes:

Dans le premier cas, la stratégie adoptée par le maître d'ouvrage, surtout s'il possède un grand portefeuille de projets, affecte directement la possibilité d'innover pour les intervenants lors de la conception, de la fabrication ou de la construction; dans l'ensemble, une amélioration de la maîtrise d'ouvrage ouvre la porte à de grandes innovations.

La question à débattre était donc: que faut-il suggérer aux maîtres d'ouvrage?

Dans le second cas, les maîtres d'ouvrage d'aujourd'hui ne sont préoccupés que par la qualité et l'efficience de leurs édifices et évitent de s'impliquer dans le processus de construction; en conséquence, l'innovation reste entièrement sous la responsabilité de l'industrie et de ses concepteurs, fabricants et entrepreneurs, quelle que soit la stratégie des maîtres d'ouvrage.

La question à débattre était donc: comment peut-on aider l'industrie à assumer cette responsabilité afin de satisfaire les attentes des maîtres d'ouvrage?

Orientation:

Le symposium était conçu pour encourager le débat autour de ces questions afin de faire des recommandations destinées aux maîtres d'ouvrage. Des experts provenant de plusieurs continents se sont réunis pour établir des liens mutuellement avantageux entre la recherche et la pratique; à cette fin, une série de sessions plénières et des ateliers ont été prévus, pour permettre d'aborder la problématique de la maîtrise d'ouvrage selon différents points de vue: légal (y compris la responsabilité et le partage des risques), organisationnel (y compris les structures et la prise de décisions), financier (y compris le rapport coût/bénéfice) et fonctionnel (y compris la qualité et la performance).

ACKNOWLEDGEMENTS

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FOREWORD

This forward develops our earlier review of the published work of W92 (McDermott and Jaggar, 1997). In attempting to identify achievements to date. and to identify the main themes being discussed, we drew heavily upon the proceedings of the earlier symposia. These themes serve to expose areas for further research work which may, in turn help in constructing a new paradigm. The identified themes explored here are: Industry Development; Competition and Privatisation, Culture - Trust and Institutions, Classification and Choice of Procurement Systems, Conceptualisation of Procurement, Conflict, Project Culture, Contractual Arrangements and Forms of Contract, and Procurement Sustainability.

Much of the work of the commission is complementary not only to that of W55 and W65, but also to that of TG 15 (Construction: Conflict Management and Dispute Resolution), W82 (Future Studies in Construction) and the newly formed task group on Culture and Construction.

Procurement - Industry Development, Competition and Privatisation

Our earlier review (McDermott and Jaggar 1997) concluded that even amongst W92 members there was no common understanding or agreement on the meaning of the term "Procurement". As a starting point, we take the working definition of procurement developed by CIB W92 at its meeting in 1991:

> *"...the framework within which construction is brought about, acquired or obtained".*

This definition is broad and it encourages a strategic interpretation; furthermore, it is not only applicable to developed, market economies.

During the 1980's the technical and academic press reflected client concerns about project performance in construction, with much debate concerning international comparability and the standardisation of contracts and contract procedures. This corresponded to an environment of significant changes in the legal, economic and social structures of states in both developing and developed countries. Privatisation, in its many guises, had been implemented, not only in Europe and North America, but also in Eastern Europe (through the transition from socialist to capitalist systems), and in Africa and Asia (through Structural Adjustment Programs).

Jackson and Price (1995) have detailed how the process of market liberalisation has conflicted with developmental goals worldwide. The conflict is evidenced in practice, policy and ideology. In both the construction industry and procurement research, the emphasis has been predominantly on practice and policy. We have documented the range of research being conducted by W92 members on this broad subject, including for example, the impact of compulsory competitive tendering for design professionals in the U.K. and the effect of Structural Adjustment Programs in Africa (McDermott and Jaggar, 1997). The

emerging concern with broader developmental goals suggests that procurement systems which take into account more than speed, quality, price competition, certainty and risk transfer are needed.

Procurement systems must be appropriate to the circumstances; for example, Martins and Taylor (1996, informal communication) in the context of the new South Africa argued that they should encourage appropriate, people-intensive technology and processes, and also open the way for learning and skill development. In these circumstances, the process of the procurement of processes assumes status greater than it is normally afforded. The process-related goals become as important as the product-related goals.

Within the so-called developed world, much attention is focused on narrower procurement and contractual relationships. For example, in the U.K. Sir Michael Latham, through a joint government/industry review (Latham, 1994), was given a brief *"to consider current procurement and contractual relations...and in so doing to examine the structure of the industry..."*.

A current debate in the U.K. concerns the extent to which Latham is succeeding in changing the adversarial culture of construction. The traditional procurement and contractual procedures which have been swept aside by market liberalisation, need to be replaced by other control mechanisms. Weak forms of control, such as reliance upon craftsmanship and professionalism, had been replaced with strong forms, such as contract enforcement and litigation. The Latham review endorsed initiatives, such as Alternative Dispute Resolution (ADR) and partnering, as a means to replace the culture of contentiousness and to re-build trust.

> The potential role for W92 is to help identify the "framework within which construction is brought about...". It is not easy from a cursory glance at some procurement literature to understand how construction is "brought about". W92 can provide the conceptual framework which will help to distinguish, between the process of procurement and its products, between the *causes* of procurement and contractual change and their *effects*.

Procurement - the Influence of Culture - Trust and Institutions

Our review of the work of W92 (McDermott and Jaggar, 1997) exposed the extent to which culture (to which two dimensions of trust and institutions are attributed) has influenced procurement. This was evidenced regardless of the economic or political system

Fukuyama (1995) has argued that the ability of nations to compete is conditioned by one pervasive cultural characteristic - the level of trust in society. Trust was seen by Latham (1993) as the gatekeeper to any real progress in improving procurement and contractual relations in the U.K. construction industry.

Culture can be distinguished *conceptually* from social structure. Culture in this sense is restricted to meanings, symbols, values, religion, ideology. Social structure.... concerns concrete social organisations such as the family, clan, legal system, or nation (Fukuyama, 1995, p.34). The capability of communities to form new associations and to co-operate, Fukuyama calls "spontaneous sociability".

The potential for spontaneous sociability is dependent upon a network of social and political institutions. Hutton (1994, p.20), in identifying areas of weakness, argued that "the degree to which an economy's institutions succeed in underpinning trust and continuity is the extent to which long term competitive strength can be sustained". A major thrust of the Latham Review (Latham, 1994) has been the attempt to re-build trust in the construction industry. This has been attempted both through the advocation of partnering at project level, and through encouraging the re-structuring and re-aligning of the existing client, contractor, sub-contractor, supplier and consultant institutions.

Intermediate institutions have been given a developmental role in establishing procurement policy and practice in both developed and developing countries [McDermott and Quinn (1995), Ng Wing Fai (1994, pp251[1]), Martins and Taylor (1996), Walker (1996), Allin (1990, pp8), and Ofori and Pin (1996, pp473)]. Ofori and Pin summarise the advantages of such intermediate institutions in developing nations since they encourage the public sector to package projects in suitable sizes for participation by small, local contractors; the use of locally developed materials, and the formulation of contract procedures and documents which are easy to use by the local industry.

The extent to which governments can artificially stimulate "spontaneous" sociability is debatable. Hutton (1995, p.25) argues for constitutional reform and suggests that: "if markets require boundaries and rules of the game they must be set by public agency - but if such intervention is disqualified by the belief that any public action necessarily fails, then the initiative cannot even reach first base. The state must act to assert common purpose".

The direct involvement of governments in determining procurement policy and practice in construction has been documented by Aziz and Ofori (1996, pp1), Mustapha *et al* (1996, pp221), Mukalula (1996, pp419), and Torkornoo (1991, pp19). The transition of formally centrally planned economies to a free market economy and to market relations in the construction sector, are detailed by Klimov *et al* (1990, pp121) and Vukovic and Marinic (1994, pp335).

The procurement regulations of various trading blocks and international agencies have been reviewed by Craig (1996, pp83), Lloyd-Schut (1991), Hodgson (1994, pp125), and Lavers (1991). Whilst most regulations are designed to promote competitive tendering and to prevent the use of technical standards as non-tariff barriers, only WTO/GATT encourages positive discrimination on behalf of developing countries.

1 Citations in which the page number is preceded by 'pp.' (as opposed to 'p') refer to papers published in previous CIB W92 symposium proceedings of the year indicated in the 'References' at the end of the Foreword.

The European Community (Atkins, 1994), in a proposal for a strategy for the European construction industries, put forward the fundamental thesis that "the characteristics of the construction process and its output are such that competitive market forces do not of themselves create an efficient industry". The report called for a legal and institutional framework which permits customers to choose from a range of procurement processes, and for an industry structure "which combines the flexibility of many small specialist and local firms with a number of large world-beating EC firms". Institutions to support improvements in the performance of sub-contractors and the self-employed are also called for.

> W92 has brought together examples of wide-ranging cultural research, with identifiable themes of trust and institutions. It should seek to continue this role, in association with other CIB groupings, but place emphasis upon - the manifestation of trust in procurement and contractual relations, identifying the significant role that governments play even in market economies, comparing and benchmarking the procurement regulations of the various trading blocks and international agencies, and, researching and debating roles for institutions charged with construction industry development.

Classification and Choice of Procurement Systems

In our review of the work of W92, (McDermott and Jaggar, 1997) we found the use of many different classification systems concerning procurement. Although a large number of variables have been identified which are associated with procurement systems, it is possible to determine three generic types of procurement system: traditional (or conventional); design build; and management (Sidwell, 1985; Rowlinson, 1989; Ireland, 1983).

These three generic classes of systems can be used to identify the organisational form adopted in procurement but they do not uniquely describe each procurement system. Although Ireland (1984) was of the opinion that the distinctions between procurement systems were virtually meaningless, this has not really proved to be the case. A key issue concerns the variables which determine the difference between each procurement system. Rowlinson (1989) has identified eight key variables which include payment system, selection procedures, leadership and funding sources.

Walker (1996b, pp614) identified a different set of variables; and more generally the conclusion that can be drawn is that there is a broad range and variety of variables which affect procurement systems. Hence, the choice of an optimum procurement system for any particular project is not feasible. However, it is possible to draw some general conclusions about the fit of procurement systems to particular set of requirements; a "contingency" approach seems reasonable.

Skitmore and Marsden (1984) and NEDO (1987) attempted to produce a deterministic approach to the selection of procurement systems by the use of a series of criteria such as the criticalness of time, the need for variations, price certainty and other related variables.

Although such algorithms are interesting, they cannot give a definitive answer as there are so many variables involved in procurement systems and each has its own objective and subjective effect on project performance.

> The role for W92 is to continue to develop and publish research which builds more reliable contingency models.

The Conceptualisation of Procurement

McDermott and Jaggar (1997) attempted to summarise and make explicit the assumptions underlying the approach of researchers and practitioners within W92. Green (1994, pp89) pointed out that the approaches to procurement referred to above are a reflection of the functionalist paradigm of sociology. The recognition that clients are pluralistic and design is a social process leads on to the paradigm of social constructivism. Green contends that the recognition of such alternative sociological paradigms should have an important influence on procurement systems.

Jennings and Kenley (1996, pp239) take this issue and point out that procurement systems go beyond technical logistics and it is the perception and response to project objectives by organisations which is a key determinant of procurement system suitability. Liu (1994, pp301) takes this further and discusses a cognitive model of the procurement system where the goal-performance relationship is paramount. Liu uses conjoint analysis as a means of illustrating this.

Kumaraswamy (1994, pp143) discussed the appropriateness of developed countries' procurement systems when applied to less developed countries and argued that a sustainable and synergistic procurement strategy must be developed in such situations. The "power paradigm" suggests that selection criteria for procurement systems are less important than the realisation that "procurement paths create power structures which dramatically affect the ultimate success of the project" (Newcombe, 1994, pp243). Using this paradigm, Newcombe criticises the fragmentation and friction evident in the traditional system. This is further supported by Walker (1994, pp343) who draws the conclusion that project construction speed is strongly determined by how well clients relate to the project team.

> The role for W92 is to encourage researchers to expose and explore their theoretical frameworks and conceptualisation, and, to support practitioners in conceptualising their problems.

Conflict

The study of procurement and contractual relations has inevitably focused on the influence of procurement form on construction disputes and conflict (Abdel Meguid and Davidson, 1996, pp11; Conlin *et al*, 1996, pp66; Loosemore, 1994, pp187). These authors use different

paradigms to analyse the prevalence of conflict in different procurement systems. It may well be that the paradigms outlined above will provide the means for explaining such attitudes. Edwards and Bowen (1996, pp120) describe the situation in South Africa and point out that communication is a key element in determining success in a newly developing economy. This reflects the emphasis on culture which is well explained in the work of Liu (1996, pp301).

> The role for W92 is to provide the forum for exchange of methodologies and results for the current work. The emphasis on understanding of conflict contrasts with the emphasis of TG 15 on the need for adjudication.

Project Culture

It is evident that research in the area of procurement systems has moved from a hard, technical systems approach into a much more soft systems based set of paradigms which appear to have strong potential for explaining the differences in performance across projects. The concept of culture has become an important issue in analysing procurement systems (Rowlinson and Root, 1997; Rooke, 1996).

Rowlinson and Root (1997) were surprised to find that the impact of conditions of contract on performance was very limited. The explanation seems to be that project pre-history and prior working relationships (and, to a certain extent, the procurement form adopted) have the most significant impact on project culture. The view often has been expressed that the conditions of contract are only necessary when a dispute arises and that good working relationships can avoid this scenario. Thus, development of a positive project culture, even before a contract is let, is the best means of ensuring a smoothly running project. If each participant comes to the table at the first meeting with an agenda of pre-project grievances, then the conditions of contract will only mark out the battle lines; they will not change attitudes. "Paying a fair price for a good job" is the only way to ensure a cooperative and proactive project team.

> Although there has long been some evidence that procurement systems are not pure technical and organisational subsystems but are a much more complex social interaction, the role for W92 is to ensure that this latter aspect is not neglected by research or by practice. The essence of this paradigm is that, although structure is an aspect of procurement, it is inevitable that the social interactions which exist in project teams are seen as a key determinant of success.

Contractual Arrangements and Forms of Contract

The original focus of W92 at its debut was on contractual arrangements and forms of contract. McDermott and Jaggar (1997) found that this still formed a substantial proportion of the proceedings. Although W92 has broadened its' mandate, these subjects are still

central to its work, with emphasis on subjects such as the decision to tender, contractor assessment and central contractors' registration schemes, tendering practice, sub-contracting arrangements, and the use of knowledge-based systems in contracts.

> In spite of the range of work submitted to the Commission there is still research required into identifying international best practice and appropriate implementation procedures. Particular areas which may reward further research are the development of flexible, modularised contracts, and the definitions of "Procurement Assessment Criteria" which are broader than cost, time and quality.

Procurement and Sustainability

Organisational and managerial considerations are now firmly embedded in the mindset of researchers and, to a large extent, of practitioners as well. There has been little work within W92 concerning the concepts of procurement and sustainability.

> To ensure that the work in these two areas begin to converge it is important that commission members not only engage with these concepts, but also with colleagues from the CIB task groups working in this area.

Conclusion : The Future Work of the Commission

We have demonstrated that since its establishment seven years ago, W92 had seen "greatly increased international participation; a move from reviewing 'what is' to discussing applied research methodologies and findings; an expansion from reporting only on contractual arrangements and their legal implications to discussions of procurement systems and their economic, social and political environment." (McDermott and Jaggar, 1997).

Whilst this maturing of the Commission bodes well for helping to understand construction procurement and its role in serving societies throughout the world, W92 needs to reflect and debate what has been achieved and how a research agenda might be defined, particularly if the CIB objectives of technology transfer and the W92 objectives of exploring, explaining and influencing procurement processes are to be met.

Dr. Peter McDermott
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Professor David Jaggar

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RISK PRIORITISATION OF PRIVATE SECTOR FINANCE OF PUBLIC SECTOR PROJECTS

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Abstract

The Private Finance Initiative (PFI) is a recent development in the UK by which private sector finances public sector projects. The equivalent of this Initiative outside the United Kingdom include DBFO (Design, Build, Finance, Operate), BOO (Build, Own, Operate) and turnkey projects. The Initiative is expected to bring the private sector's finance, management skills and expertise into projects which would normally be undertaken by the public sector. Two important considerations for a project to receive an approval for the initiative are: firstly, the project must represent value for money and, secondly, there must be sufficient transfer of risk to the private sector. This paper, based on a questionnaire survey, provides the perceptions of clients, contractors and financial institutions on risk associated with PFI. The analysis shows that risk associated with design changes, the level of information on functional, performance and output requirements for PFI schemes, payment and cost structure mechanisms, and tendering cost are of a major concern to the parties involved in this procurement route.

INTRODUCTION

Managing risk has always been an integral part of the construction procurement process. Private Finance Initiative (PFI) has, however, placed formal responsibility for risk management on the UK construction industry. PFI is currently one of the Government's main instruments for delivering public services in the UK. "Its aim is to bring the private sector more directly into the provision of public services, with the public sector as an enabler and, where appropriate, guardian of the interests of the users and customers of public services. It is not simply about the financing of capital investment in services, but about exploiting the full range of private sector management, commercial and creative skills" (Private Finance Panel, 1995).

The Initiative is expected to offer benefit to both public and private sectors by: securing better projects and better value for money through better allocation of risk; better incentives to perform; close integration of service need with design and construction; a clearer focus on the respective responsibilities; a continuing commercial incentive; and more potential for efficiencies.

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Risk allocation and sharing is paramount to PFI. According to Landers (1996), PFI requires a substantial transfer of risk to the private sector, both through the design, planning, and construction phases and, in operation, through a combination of payment mechanisms and specific contract conditions. The recent Treasury guidelines has recognised that the principle that would govern risk transfer in PFI projects is that the risk should be allocated to whoever is best able to manage it, and through this provides best value for money. With this new development it may be possible to allocate risk into three general categories: those which are best absorbed and most efficiently managed by the private sector; those which should remain wholly with the Government Department; and those which should be shared between the government and the private sector.

This paper presents some results of the on-going research, at Glasgow Caledonian University on PFI issues, on the major types of risk associated with private sector financing of public sector projects; and on the prioritisation of these risks for clients, contractors and financial institutions.

THE RESEARCH SURVEY

The current research concentrates on three categories of respondents: client (Government Departments), construction contractors and lending/financial institutions. A questionnaire was mailed to an equal number of clients, contractors and lenders. A total of 113 questionnaires were sent to these three parties. A convenient sampling technique was adopted by mailing the questionnaire to companies and government departments/agencies involved in PFI schemes. This sampling strategy was necessary because not many organisations are currently involved in PFI.

The primary aim of the questionnaire was to research the perceptions of clients, contractors and financial institutions on risk associated with PFI and how they determine their approach to PFI schemes.

The research analysis is based on 41 positive responses constituting a 36% response rate. This level of response rate is not unexpected considering that PFI is a new construction procurement culture in the UK.

Table 1 shows that a majority of the respondents held positions of authority within their establishments. A majority of the respondents within the clients' establishments that responded to the questionnaire are heads of department responsible for strategic projects, PFI procurements, finance and investment planning, policy development and resources, commercial services for major projects etc. The clients' establishments that responded to the questionnaire included railway operators, government agencies, regional PFI Units, and Local and Transport Authorities.

The respondents from project funding establishments (banks and insurance institutions) are mainly managers and heads of departments. They all have involvement in administration of

financing and funding of construction capital projects. The respondents from the contractors are managers and directors.

Table 1. Positions held by the Respondents

Position Held	Category of Respondents							
	Contractor		Client		Lender		ALL	
	No	%	No	%	No	%	No	%
Directors	6	43	2	14	2	15	10	24
Heads of Department			7	50	2	15	9	22
Managers	7	50	3	21	9	70	19	47
Partners	1	7					1	2
Advisers			2	14			2	5
TOTAL	14	100	14	100	13	100	41	100

ANALYSIS OF RISK ASSOCIATED WITH PFI

The respondents were provided with a list of probable risks associated with PFI for them to assess the level important to their establishments. The questionnaire provided the respondents with the description of the individual risk to ensure that these risk factors are interpreted in a similar manner by all the respondents. The list of PFI risks were compiled from various sources including Private Finance Panel publications (1995, 1996a): 'Private Opportunity, Public Benefit' and 'Risk and Reward in PFI Contracts' respectively; McLellan (1994); Roskrow (1994); Symon (1995); Woodward (1995); Hurrel and Grandage (1996); Leitch (1996) etc.

The respondents were asked to rate the level of importance on a Likert scale of 1 to 5; 5 denotes most important and 1 denotes least important. A relative importance index, based on the level of importance, was calculated (after Kometa *et al.*, 1994). Table 2 presents the importance ranking of the risk factors by the contractors, clients and lenders and all the respondents combined.

A general observation taken from the table is that the respondents tended to rate the risk factors which are paramount to their business objectives, as being most important. For the contractors the most important risks are those that will threaten their profit level, with design risk ranked as being most important. This is followed by construction cost risk, cost overrun risk, performance risk, contractual risk, tendering cost risk etc. The top-most ranked risks for the clients are those which threaten the time availability and performance (including quality) of the asset, the commissioning risk ranked highest followed in turn by performance risk, delay risk, operating and maintenance risk, design risk, etc. The most important risk factors to the lenders are those that threaten their ability to recover the capital invested and expected

interest; payment risk being the most important risk, followed by volume risk, cost overrun risk, credit risk, etc.

Table 2. Prioritisation of risk factors by the respondents

PFI Related Risks.	ALL		Contractors		Clients		Lenders	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Design Risk	0.765	1	0.786	1	0.738	5	0769	10
Construction Cost Risk	0.750	2	0.771	2	0.677	6	0.800	6
Performance Risk	0.746	3	0.700	4	0.757	2	0.785	8
Delay Risk	0.740	4	0.671	7	0.738	5	0.800	7
Cost Overrun Risk	0.735	5	0.700	3	0.662	9	0.846	3
Commissioning Risk	0.720	6	0.571	17	0.785	1	0.815	5
Volume Risk	0.715	7	0.657	8	0.646	10	0.846	2
Operating / Maintenance Risk	0.690	8	0.657	9	0.738	4	0.677	13
Payment Risk	0.688	9	0.643	10	0.586	14	0.846	1
Tendering Cost Risk	0.670	10	0.686	6	0.554	17	0.769	9
Contractual Risk	0.668	11	0.686	5	0.643	11	0.677	15
Legal Risk	0.635	12	0.643	11	0.554	19	0.708	12
Market Risk	0.620	13	0.600	14	0.554	16	0.708	11
Residual Value Risk	0.615	14	0.571	16	0.600	12	0.677	14
Planning Risk	0.585	15	0.629	13	0.554	18	0.569	19
Environmental Risk	0.585	16	0.586	15	0.671	8	0.492	23
Safety Risk	0.575	17	0.486	21	0.677	7	0.569	20
Financial Risk	0.570	18	0.629	12	0.492	22	0.586	18
Credit Risk	0.565	19	0.457	25	0.400	24	0.846	4
Possible change in government	0.560	20	0.500	20	0.523	20	0.662	16
Project Life Risk	0.525	21	0.543	19	0.600	13	0.431	26
Changes in European legislation	0.525	22	0.471	24	0.569	15	0.538	22
Development Risk	0.517	23	0.543	18	0.514	21	0.492	24
Bankers Risk	0.490	24	0.486	23	0.354	26	0.631	17
Debt Risk	0.475	25	0.486	22	0.385	25	0.554	21
Land Purchase Risk	0.430	26	0.400	26	0.415	23	0.477	25

The ten most important risk factors base on the table are related to design, construction cost, performance, construction delay, cost overrun, commissioning, operating and maintenance, payment and tendering cost (these are discussed hereafter). The table also shows that all these ten risk factors were ranked among the ten most important risks by each group with the exceptions of operating and maintenance risk which was ranked at 13th position by the lenders and commissioning risk ranked 17th by the contractors. The credit risk which was ranked highly by the lenders' group ranked 19th overall. Environmental risk and safety risk which were ranked 16th and 17th overall respectively were among the most important risk factors to the client.

The consistently least important risk factors overall and within the groups are associated with land purchase, debt, bankers, development, changes in European legislation, project life and possible change in government. Contrary to expectation, political risk in the form of European legislation and possible change in government were ranked lower; this is probably because the Labour Party (UK opposition party) is committed to the principle behind PFI (Court, 1996).

Design risk

The private sector is responsible for the design of the asset in PFI and it is necessary in any PFI proposal to specify output and performance targets, in addition to physical requirements (Hornagold, 1995). The asset design should meet the performance requirement specified by the client. The less detailed the output specification, the higher the probability of providing innovative design and service solutions by the promoter. It is not surprising that this is of a major importance to both contractors and clients.

For the client the risk of design changes is an important one. If there are several design changes instituted by a statutory authority, the client would be expected to pay for them. Design changes are critical to contractor's budget estimate and overall progress.

Although, PFI schemes are mostly designed by the PFI consortium, in which case the contractor (where the consortium is led by a contractor) has overall control of the design, the contractors claimed this was the most important risk factor. Public sector projects have been usually procured by 'traditional procurement'; in which the client (public sector) bears the design risk. This change in design culture for public sector projects may have constituted a shock to contractors with an attendant high ranking of design risk. Design risk is one important risk that the public sector is willing to transfer to the private sector. Although the lenders ranked the risk at tenth position, this may be due to their lack of experience of construction projects and process.

Construction cost risk.

Costs associated with PFI, including the cost of construction, repairs, operating and maintenance, need to be evaluated in weighing up the risks and rewards of PFI projects. Added to this is the uncertainty of tax treatment, as certain tax assumptions have to be made when preparing a bid, and these assumptions which cannot be altered if they turn out to be incorrect (Willetts, 1996). Construction cost is a major part of these costs.

Construction cost risk is concerned with the reliability and 'accuracy' of tender estimate for construction. This is a major concern to all the parties. This cost is usually taken into account in modelling the cost of services that the asset provides. The contractors ranked it second with an index of 0.771. Contractors will be extremely concerned about their cash flow and will attempt to judge reasonably accurately the contract financial position.

Public sector's intensity of use of construction facilities do change over time, it important that the risk associated with these changes is reflected in the construction cost. This is also important to the financial institutions that provide working capital for contractors. It is obvious that the PFI project financiers would want to be assured that the cost is accurately

determined by the contractor and that the revenue structure of the project can cope with the construction cost. Design risk is directly linked to construction cost risk; design changes during the work progression can affect the overall construction cost structure.

Performance risk.
A PFI business case or proposal must specify both the functional and performance requirements for the scheme. The performance risk is related to definition of inappropriate output requirements or changes to output needs by the client.

Since the PFI projects are procured on the basis of output specifications, client performance risk will include failure of the asset provided by service provider (Concession Company or the Special Purpose Vehicle) to meet the specified requirements of the client. The client would obviously be concerned at all stages of the project development about the ability of the facility to meet the expected requirements. Contractors concerns would include the possibility of the facility not meeting the client's need. Considering this, it is expected that PFI contractors would adopt some form of quality assurance and control strategy to ensure that the contract develops without major problems. The lenders' primary objective is to retrieve the capital invested with a profit, where possible. It is in the lenders interest therefore to monitor the contract and the contractors performance and to ensure that the scheme runs smoothly.

Project delay risk
This relates to the possibility of the asset and consequently the services not being available at the scheduled time for use by the client. Both the contractor and the lender would not be paid anything until the facility is completed with the possibility of penalties being applied, if the delay is attributable to the actions of the PFI consortium. The delay could also affect the client's programme. Delay risk could also be as result of delay in PFI contract negotiation. This position is corroborated by the Contract Journal and Knowles (1996) survey on PFI which reported that the private sector wants clients to speed-up PFI contract letting, but clients are reluctant to commit to negotiating timetables to speed up PFI.

The client would obviously be eager to have the service delivered as expediently as possible; and delayed provision of the facility could cause extensive financial harm and affect the client's programme. The risk is important to both contractors and lenders as an delay in provision of the asset may affect the project revenue and cash flow regime.

Project cost overrun risk
A project cost overrun would obviously have an impact on the profit margin of the PFI consortium. Such an overrun could be as a result of innumerable factors including lack of effective risk management, misunderstanding of the balance of risk, poor design and cost information, unrealistic construction programme, etc. Any of these could result in the overall cost of the project being exceeded. Whatever the source of cost overrun, this risk is of major concern to the PFI parties. To the contractors any overrun in cost could have effect on profit margin including additional finance charges on the capital borrowed.

However, it is expected that any increased costs arising from poor initial cost estimates, delays in design and construction, or failure to meet specified requirements should in principle be

wholly met by the private sector operator/service provider (Private Finance Panel, 1996a) as the private sector operator has overall control and is responsible for the design and construction of the asset.

Commissioning risk.
Commissioning risk relates to the possibility of the asset and service commissioning taking longer than planned and to how the asset is to be used upon its completion. Delays in commissioning the asset may result from time overrun in design and construction of the asset. These delays in commissioning against schedule may affect the client's programme. However, the Private Finance Panel (1996a) expects that responsibility for the commissioning of the asset with its associated risk should lie with the private sector operator.

The client would want the asset commissioned within an agreed period and would be concerned with the delivery and asset performance. The lenders would obviously be concerned with how quickly the asset they have funded is going to be used; any delay in asset commissioning may have impact on the recovery of the capital invested.

Volume or Demand risk.
Volume risk is associated with the future use (frequency of use) of the facility and it determines the payment stream by the client for the service that the facility provides. Although transfer of volume risk to the private sector is an important feature of most PFI projects, the most important aspect of demand is the extent to which it can be forecast and allow the degree of risk to be assessed with some confidence. This is generally agreed upon as being difficult to achieve. In relation to Prison contracts, the position has been clarified; the public sector is expected to bear volume risk associated with prison schemes as the number of prisoners is outside the control of the private sector and it cannot assume volume risk for this (Private Finance Panel, 1996b; Landers, 1996).

There are many factors that could determine the future use of the facility. For example, Martin (1996) identified unpredictability in road tax, petrol prices or the advent of competition (another new road or railway) as factors that could determine the future volume of traffics for DBFO road projects. Volume risk could also depend on advances in technology which can made the use of the facility obsolete before the expiration of the contract period.

The risk has a direct impact on payment for the services provided by the asset and consequently the recovery of capital invested by the lender.

Operating and maintenance risk.
The PFI consortium is expected to operate, effect repairs and maintain the asset throughout the contract period to an agreed quality standard and to ensure continuity and quality of service of the asset. The main risk associated with PFI maintenance is associated with determination of how often, over the contract period, major repairs and maintenance of the asset will be undertaken. This information will have some bearing on the costs of building, repairing and maintaining the asset.

The clients ranked this risk highly; even though the public sector is expected to retain as little operational control and responsibility as possible on the asset (Private Finance Panel, 1996a). The clients' high ranking of the risk factor perhaps reflects concern as to how the asset operation and maintenance together with the associated costs would develop after construction is completed and the asset is in use, and perhaps also due to the public sector's inexperience of PFI schemes. Where a contractor lacks appropriate facility operation and management capability within its establishment, it is important to bring into the consortium a facility management group. Since most contractors usually lack the experience of delivering a facility management service for a long contract period, it is not surprising that this risk is ranked important to the contractors. Inaccuracy in the prediction of the both operating and maintenance cost will affect the possibility of the project lenders recouping their capital investment when due. Because PFI schemes are a relative novelty it is very difficult for lenders to predict how these costs associated with operating and maintaining PFI schemes will perform.

Payment risk.

The pricing and payment structure for PFI schemes are agreed between the client and the facility provider at the outset of the contract. Payments relate to performance and availability of the facility (Allen, 1995). The Scottish office (1996) has classified the payment mechanism into four types: availability charge, performance charge, usage charge and final payment for sale at the end of a service agreement. Availability payment is not paid until the construction is completed and the flow of services commences; and performance payment is not paid in full if the facility fails to meet agreed standards with the client. Usage payment is not received fully if the levels of usage of the facility falls below the expected level; and the final payment for sale anticipated at the beginning of the service agreement may not be realised due to technological change or changes in market conditions. No payments will be due until the facility is up and running, delivering the specified output. In essence, payment risk is determined by a combination of design, construction, operation, volume and technological change risks. To mitigate some of the sources of payment risk it is essential that the revenue streams associated with PFI project be clearly identifiable.

Special contract conditions are drafted for each PFI contract and may contain different payment terms compared with that of the traditional conditions. Lenders would be concerned due to possibility of payment not forthcoming as a result of the various risks associated with payment. The reasons why the contractors might have ranked the risk tenth and lenders' first could be any of the following: the contractors have traditionally worked for public sector clients and they find them reliable in honouring contract payments; contractors have less to lose than lenders if payment is not forthcoming; financial institutions' inexperience of direct public sector funding; complexity of PFI payment mechanism; the excessive length of the PFI contract period for PFI and capital investment recovery; etc.

Tendering cost risk.

The Akintoye and Dick (1996) survey showed that bidding cost is recognised by 85% of the contractors surveyed as a major problem in PFI. This is supported by a more recent survey by Contract Journal and Knowles (1996) which showed that respondents rated both the cost of bidding and unsatisfactory bid process at 8 out of a scale of 10 as reasons why PFI is

unattractive to them. Their findings showed that the respondents would like to see partial reimbursement of tendering costs as a key method of overcoming the shortfall of risk capital. Travers (1996) reckoned that the costs of preparing a PFI bid could be as much as £0.5m depending on the size of the job; as a result 'even the biggest contractors would baulk at risking such sums time after time with no guarantee of a payback'.

Many contractors have refused to get involved in PFI contracts because of the risk associated with tendering (Akintoye and Dick, 1996). Though the clients ranked the risk very low, it is important for them to recognise that high tendering costs would have impact on competition for PFI schemes with fewer competitive tenders being submitted; this may lead to less choice and higher costs for the client.

The lenders ranked this risk fairly high; however, Contact Journals and Knowles (1996) surveys showed that the financial institutions are likely to supply funds needed to bid for PFI schemes to a lesser extent compared with either contractors, industrialists or PFI operators. This tends to suggest that lenders are more likely to fund successful PFI schemes rather that being involved as a member of a consortium in tendering for PFI projects.

SUMMARY AND CONCLUSION

Private Finance Initiative represents a cultural change in the way the public sector procures service delivery through the private sector asset provision. The procurement method is new in a formal sense within the UK as a process for management and provision of public services. Also this study would be one of the earliest researches into this procurement method. Through a process of questionnaire survey of 41 respondents comprised of contractors, public sector group and financial institutions, the perception of the respondents on risk allocation, one of the two cardinals of PFI, was investigated. Although the response rate and the number of respondents, when divided into the three groups, is low, this is not unconnected with the fact that not many organisations are currently involved in PFI schemes; whilst it was the intention of the study to involve only those with operational knowledge of PFI.

Several results emanated from the analysis of the survey. The respondents tended to regard the risk factors that are paramount to their business objectives as being most important. To the contractors the most important risks identified are those that will threaten their profit level with design risk ranked as being most important. The top-most factors to the clients are those that threaten the timely availability and performance (including quality) of the asset with commissioning risk ranked highest. The most important risk factors to the lenders are those threatening their ability to recover the capital invested and expected interest; payment risk being the most important risk.

Overall, the ten most important risk factors are design, construction cost, performance, construction delay, cost overrun, commissioning, operating and maintenance, payment and tendering cost. The consistently least important risk factors overall and within the groups are associated with land purchase, debt, bankers, development, changes in European legislation, project life and possible change in government.

It is also evident, from the survey, that the three parties have adopted different methods and techniques in dealing with risk assessment of PFI schemes. They also approach risks associated with PFI in different ways, and it is not surprising that this is producing different and conflicting results. The overall feeling from the comments provided by the clients, the contractors and the financial institutions is that not enough is known by them to ensure the success of PFI, at least not in a co-ordinated readily available form.

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A MODEL FOR ASSESSING THE PERFORMANCE OF SENIOR STAFF HOUSING SCHEME IN QATAR

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Abstract:

This paper is based on ongoing research at the University of Glamorgan. The research investigates the overall performance of two approaches (schemes) to housing provisions in the State of Qatar, namely, Senior Staff Housing (SSH) and Private Housing (PH). A model is proposed to compare the performance of these two approaches. The suggested model assumes the measurement of performance of the schemes both objectively, in terms of time and cost; and subjectively, in terms of quality and households satisfaction. Underlying this research is the need to establish how the implementation of the government policies may have an impacts on the overall performance of the schemes. The paper introduces the model and its development process and the outcome of its testing programme will be reported later. It reviews the SSH policy in Qatar as well as the existing models of selecting procurement methods. It is anticipated that such a model will assist in understanding how performance is effected by policy and how scheme performance can be enhanced. It is important to note that the research model has been developed to meet the conditions and the cultural needs of Qatari households but that it maybe applied in a different set of conditions with the appropriate alteration and adjustment, and hence have universal application.

INTRODUCTION:

The Government of the State of Qatar issued a decree on the 14th of February 1977 to regulate and control the financing of building housing projects for senior officials that work for the Government. The law was entitled "Senior Staff Housing Project" (SSH). The first article of the decree states "the aim of the law is to provide houses to senior staff by granting real estate loans." Every fiscal year the Treasury Department will assign a budget for SSH projects. Qatar National Bank manage this budget, as well as representing the Government in the contract. Upon signing the contract, the Bank will finance the client with a free interest loan of 600,000 Qatari Riyals (approximately $165,000/Dec. 1996) to build a house. The client will return this loan on a monthly basis for a period of about 25 years.

From 1977 till January 1996 more than 6500 clients had benefited from this legislation through which the Government had spent more than Q.R. 3.5 billions. In January 1996 there were about 500 housing projects under construction while there are more than 1200 clients

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awaiting their turn. Of these 1200, 800 clients expected to begin building their houses in the fiscal year 1996/97. The number of clients who will benefit from the law depends upon the amount of money that the Government assign to the SSH projects' budget. In the fiscal year of 1995/96 about 830 clients were eligible to sign their contracts with the Bank and begin their projects.

The Marathon of SSH:

For a typical client, it will take him eight to ten years from the day he applies for land from the government to the day he receive the keys of his house. Figure 1 shows the SSH procedure.

Figure 1. The process of SSH

Applying for Land:

The SSH decree states that every beneficiary has to have land for building the house. In this matter, the decree requires everyone who qualifies for the SSH funds to apply for land from the Department of Lands. In order to get the land, the qualified person will have, generally, to wait from three to four years. This is because the amount of land that the government can provide is less than the number of the applicants necessitates. In order overcome this problem the government gave the qualified persons the right to buy land and would provide the owner with a lump sum of Q.R. 100,000, provided that the land to be purchased is not less than 900 sq. m. Which ever of these ways the land is obtained, the owner of the land cannot resell it for ten years.

The Funding Phase:

After obtaining the land the client will apply for a loan from the bank. The SSH decree gives the bank the right to issue the laws that regulate the funding procedures, supervise the payments process, make sure that the money is used for its proper purpose, and collecting the instalments. In this aspect the bank requires from the client to pawn the title deed of the land. The client, then, has to wait for his turn, which usually takes a further three years.

The Design Phase:

The SSH decree requires that the applicant for the loan provides the complete set of drawings of the house before the acceptance of funding the project is given. This means the separation of the design phase from the construction phase. When the client's turn comes he will employ a designer to design the house. Upon completion of the drawings the designer will go to the Urban Planning Department at the Ministry of Municipality to obtain the building permission.

The Construction Phase:

When building permission has been reward the client will enter into the tender phase. The client will choose the contractor by either selected tender or open tender. After the selection of the contractor the client will sign the contract with the contractor. The client will take all the drawings together with the contract of the construction of the project to the bank so that it can be reviewed by the bank's engineer with a view to securing for approval. Upon approval by the bank, the client will sign the contract of funding for the project with the bank. The loan will be given to the client through twelve payments during a period of three years, and these payments are subjected to the completion of the different phases of the construction of the project and upon the approval of the bank's engineer. The client can choose any applicable method for constructing the house, as long as there is a separation between the design phase and the construction phase[1]. This includes traditional, construction management, or management contracting approaches. During the construction phase, the role of the designer and the resident engineer will depend upon the selected method of procurement. Figure 2 shows the functional and contractual relationship between the different parties involved in the process.

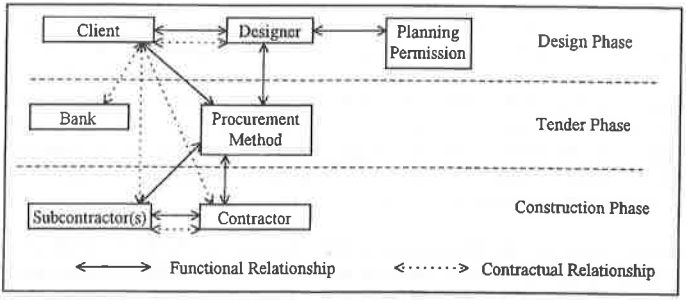

Figure 2. Functional and Contractual Relationships of SSH Project

THE PRIVATE HOUSING:

Private housing (PH) projects in Qatar diversify in sizes from large palaces to small homes, and from villas to apartments, for commercial and/or private use. PH building process is very similar to the SSH process, except that there PH projects are not influenced by SSH and funding regulations, as well as PH clients can use the design and build procurement approach.

[1] The bank requires all the drawings to be available before signing the contract with the client.

THE PROBLEM:

Institutional weaknesses is increasingly being recognised as a leading impediment to housing in developing countries (Njoh, 1996). It is believed that SSH regulations have a major influence in the overall performance of the projects which reflects on the satisfaction of the clients. SSH regulations apply a complete separation between design and construction policy which means that clients are limited in choosing the procurement method they want to select for building their homes. Another major influence of the SSH regulations is the funding procedure. A lot of SSH clients expressed that the long periods between payments had increased the uncertainty among the contractors which increased the overall cost of the projects. On the other hand, the problems associated with the building process have been considered in relation to separation of design from construction (Emmerson 1974), poor communication (Tavistock 1965), lack of integration (Sidwell, 1982), uncertainty (Tavistock, 1966), and increasing project complexity (Bennet and Fine, 1980).

These problems, together with economical factors, such as inflation and recession, have led to a reduction in the performance of the construction industry, in general, and housing projects in specific. In order to overcome these problems, the construction industry professionals offered alternative methods of procurement that have been used in the West. These alternative methods that have been recently used in Qatar include management contracting, design and build, and project management. It is axiomatic that a project may be regarded as successful if the building is delivered at the right time, at the appropriate price and quality standard, as well as achieving a high level of client satisfaction (Naoum, 1991). Increasingly, the achievement of these criteria has been associated with the means of procurement. Much research and the views of practitioners confirm that the selection of the appropriate method may shape the success of the project (Naoum, 1991; Latham, 1994; Mustapha *et al.*, 1994; Mohsini *et al.*, 1995)

This research will assess the effectiveness of SSH projects and Private Housing projects (PH), which are at the same level of SSH and are not influenced by the SSH regulations, in the State of Qatar that were completed between 1991 and 1996. This will be achieved by constructing a model to measure the performance of SSH and PH projects in terms of satisfaction and quality. Satisfaction exist when needs are being provided for and fulfilled (Mustapha *et al.*, 1995). Effectiveness can be defined as the relationship between the actual standards of the built dwelling (within its total context) and the level of satisfaction with it, set against the objectives and goals set down prior to building (within its cost and time limits). Much research and the views of practitioners related to measuring effectiveness confirms the view that it should be a multi-determined measure (which includes objective and subjective measurement tools). Consequently, this paper attempts to measure the effectiveness of housing projects by combining both objective and subjective indicators. Therefore, an in-depth analysis of these indicators is essential before any attempt to build such a research model.

LITERATURE REVIEW:

Numerous studies have evaluated construction projects performance objectively (time and cost), and subjectively (quality and client satisfaction). Most studies assess project performance by considering objective or subjective measures, and few studies combined both.

Factors affecting construction time and cost performance:

A review of the literature has established that construction time and cost performance are determined by numerous factors. Much of the literature has concentrated upon project scope as a useful predictor of construction time. Bromilow's seminal work (Bromilow *et al.*, 1980) is widely cited and his ideas have been developed and extended by those developing construction time prediction models. While previous models have explained construction time by project scope measured by construction cost or gross floor area and numbers of floors (Ireland, 1986; Nahapiet and Nahapiet, 1985) there wide spread acceptance that other factors must be considered.

A number of researchers have linked non-scope factors to construction time performance. Sidwell (1982) studied the impact of client decision-making upon the construction process and project success and Ireland (1983) investigated the impact of managerial actions upon time, cost and quality performance in building. Both identified influences upon cost and project time performance from inception to completion and concluded that client experience, form of building procurement, and project organisational structure are elements of a complex causal model of project time and cost performance.

In reporting results from a study of 69 project Naoum (1991) concludes that "the major factors that affect cost and time overruns are the procurement method adopted and the designer's experience..." (p. 31), however, Bresnen *et al.* (1990) in a study of 138 projects concludes that there was only slight association between type of project or type of client, and construction time performance. Insignificant association was found between contract type and construction time performance. Walker (1995) developed a model which describes factors affecting construction time performance. In a 33 case study investigations he concludes that good construction time is primarily dependent upon the construction manager's aptitude to overcome environmental challenges of a physical and economic nature and problems emanating from communication breakdowns between the design team and the client's representative and construction manager.

Beside the above factors, Hashim (1996) stated other factors that affect construction project performance. In a survey of 45 projects he stated that construction time was affected by location of site, delay in approval by the statutory bodies, inadequate detail designs by the consultants, long tender process (for traditional projects), approval for loans, purchase of land, and land conversion. Cost of construction was affected by types of projects, size, nature of construction, level of quality standard of the building materials and complexity of the design.

Client satisfaction:

Client is defined as the one who pays the bills. The term satisfaction is defined as the result of some comparison process in which expectations are compared with what is actually received (Czepiel, 1985). There are few established methods to measure client satisfaction in the construction industry. Ashley *et al.* (1987) investigated the determinants of construction project success. In their pilot study, they concluded that successful projects emphasised planning effort, project-manager goal commitment, project-team motivation, project-manager technical capabilities, scope and work definition, and control systems. Six criteria to measure success were budget, schedule, client satisfaction, functionality, contractor satisfaction, and project-manager/team satisfaction.

A study by Wilemon and Baker (1983), in human factors of project management, shows that to attain high levels of perceived success (including client satisfaction), effective co-ordination and relations patterns are extremely important. Moreover, success criteria salience and consensus between client and project team are crucial. Ahmed and Kangari (1995) developed a model to predict factors affecting client satisfaction. In a survey of 101 client companies they have identified six factors: cost, time, quality, client orientation, communication skills, and response to complaints. In investigating design and build procurement system, Ndekugri and Turner (1994) developed a client satisfaction index (CSI) which compares the client's satisfaction with cost and quality at the end of the project.

Post-Occupancy Evaluation:

Post-occupancy evaluation (POE) is a formal evaluation of a building by its occupants after it is completed (Becker and Sims, 1990). The focus is on user satisfaction. In recent years a number of researchers and facilities management practitioners have begun to see the value of having standardised tools and measures that were valid and reliable and would allow for comparisons with other buildings (Preiser 1994; Preiser, Rabinowitz, and White 1988).

Quality:

Most of the studies mentioned in the previous paragraphs assess quality by level of client's satisfaction which is a subjective indicator. Therefore, an objective measure of housing quality is essential to complete the research model. Quality is a more subjective parameter. It can, however be divided into two separate components, namely aesthetic quality (the art in the design) and technical quality (as determined by the performance specification).

Aesthetic quality:

The use of *mathematical formula* to arrive at an overall figure for aesthetic criteria is used as the basis for the Caudhill, Rowlett and Scott model for building appraisal (Brandon and Powell, 1984). This system is currently used by the Building Design Partnership (1980) for internally assessing projects at five stages of the design process. The basis of this system uses the criteria of *function*, *form* and *economy* to assess schemes on a scale of 1 to 10. By the use

of a *quality quotient* formula this converted into a single figure. There are assessment processes which incorporate some judgement of aesthetic elements as part of a more global assessment of the scheme. Such techniques as *value management*, *cost benefit analysis* and *whole life cycle costing* should include some aesthetic judgement (Ormerod, 1996). This research model will adopt the mathematical formula technique for assessing the aesthetic quality of houses projects under investigation.

Technical quality of housing:

Duncan (1971) presented a number of different models for measuring housing quality in the UK and USA. These vary considerably in their origins and scope. To encompass a more flexible and practical approach, Duncan (1971) developed the housing and environment defects index (HEDI) which has been used in the Scottish Development Department. He categorised three dimensions to housing quality which are: *basis of the house interior schedule*; *basis of the house exterior schedule*; and *basis of the environment schedule*. This method involves a weighting scheme to distinguish between defects of greater and lesser significance so that the cumulative result can be meaningful and capable of comparison. Another objective method was noted by Morris *et al.* (1972). They also classified three areas of technical housing quality, which are: *structural quality*, *service quality* and *the state of maintenance and caretaking*. Duncan's method will be used in the current research with the necessary adaptations to fit the conditions in Qatar. This is achieved through pilot studies conducted in Qatar to validate the indices developed by Duncan (1971).

TOWARDS ESTABLISHING THE RESEARCH MODEL:

It is evident that some of the variables discussed above should be measured by objective means, some by subjective means and some will include both forms of measurements. The research model (see Figure 3) clearly shows that the effectiveness of SSH and PH schemes in Qatar is established by combining satisfaction with economy and adequacy (the major assumption in the definition of effectiveness) and includes the basic elements by which subjective and objective measurements are linked. The building process is made up of five separate variables: Land acquisition; Funding arrangements; Contractual arrangements; Design characteristics; and Construction characteristics. The feedback loop presented by the left side arrows of the model in Figure 3, indicates that the effectiveness of a housing scheme is subject to change when one of the elements of the model at a given time and place and in a given environment is changed. The flow of the right side arrows indicates that the scheme may have a direct effect on effectiveness beyond the control of other variables in the model. Thus housing effectiveness is dependent on a wide range of interrelated variables and any change in one of these variables will change the housing effectiveness.

Implicit in the model is the notion that satisfaction with housing scheme is related to the evaluation of many variables. The satisfaction level is expressed by households' subjective evaluation of their housing scheme. The objective evaluation of building adequacy, however, will be assessed by measuring the actual condition of the buildings (quality assessment) and this will be done by the researcher (H. Al-Derham) who is a Qatari national.

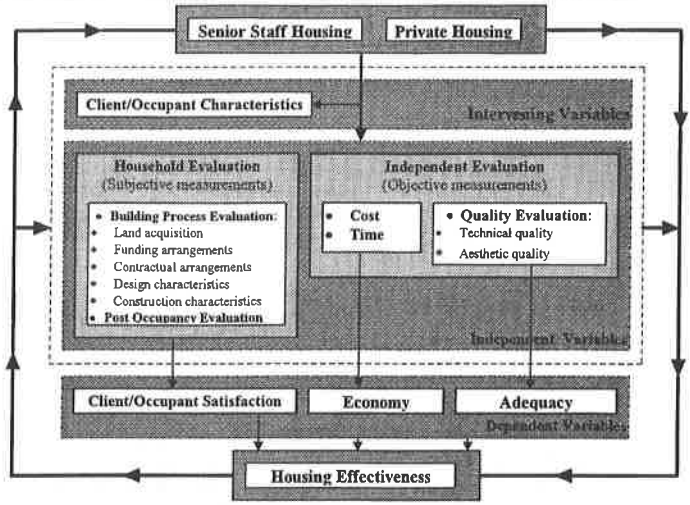

Figure 3. The research Model

Research tools and measurement methods:

Subjective measurements of the building process and post occupancy evaluation will be made using a questionnaire to obtain the household's assessment of the building process and post occupancy of their houses and their level of satisfaction. In the post occupancy matter, the households will only evaluate their housing units. The same questionnaire will be used to identify the client/occupant characteristics. The variables identified in the literature survey as the major determinants of satisfaction have been adopted to fit with the cultural characteristics of Qatari environment and these have been established through a pilot study which took place in Qatar.

Objective measurements of the building process will be made using cost and time analysis for measuring housing project economy. Actual cost and time of the building will be obtained from the households and then will be compared against the average cost and time of the same level of housing projects in Qatar. Duncan's (1971) technique for measuring housing quality and the Building Design Partnership (1980) for measuring the aesthetic quality will be used with the necessary adaptation to fit with Qatar. This measurement will be carried out by the researcher in a number of surveys and will be used for assessment of housing adequacy. This will involve the actual condition of the house, form and function. Combining client/occupant satisfaction (subjective measure) with economy and adequacy (objective measures) will then produce a measure of housing effectiveness (see Figure 3) as defined in the previous sections. These three indicators will have different weighing factors depending on the average weighs for every indicator given by the households.

CONCLUSION:

The research is ongoing and the current paper reports only on the procedures for building the main model to assess the effectiveness of SSH and PH in Qatar. The research model was built after an in-depth analysis of the existing project and housing satisfaction and housing adequacy (quality) assessment studies. A set of variables have been established and developed to fit the conditions of Qatar. Effectiveness measurement of SSH and PH schemes will be achieved by combining both subjective and objective measures.

It is anticipated that the established research model will be an effective tool in assessing the level of effectiveness of each housing scheme under investigation in Qatar, and will consequently show how the implementation of the government policies may have an impact on the overall performance.

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COMPETITIVE PARTNERING -

A LINK BETWEEN CONTRACTOR AND SUBCONTRACTOR

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Abstract

The paper examines the hypothesis that both main contractors and subcontractors will benefit from competitive partnering. Competitive partnering is defined as "limited competition between selected subcontractors who have satisfied stringent requirements from a contractor and who are committed to reducing a contractors clients costs and improving service."

Reasons for change are investigated, stressing how the industry conceives the concept of partnering. Current partnering arrangements are examined together with any possible future effects.

It is noted that the principles of partnering are not new to the construction industry. Banwell in 1964 recommended that many of the principles of partnering be adopted and Latham in 1996 has gone further and specifically suggested that partnering is one of the ways in which the industry could become more competitive. Several companies in the UK have stated that they are, or will be, adopting a partnering relationship with their subcontractors to improve service and to reduce costs.

A final conclusion will be made on whether or not the industry is ready to adopt partnering. But as partnering is about working as teams to improve common goals in a non-adversarial manner, much will depend on the industry agreeing to such innovative procurement methods.

Key words: Partnering, contracting, competition, subcontracting, change.

INTRODUCTION

There are many different definitions of the term 'partnering', but there is agreement that it is a voluntary relationship set up to achieve the project and business objectives of each party involved.

> "A long term commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resource." (Mills, 1995)

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"All parties working together to improve the product for the client for the mutual benefit of all." (Ridout, 1994)

"Partnering involves two or more organisations working together to improve performance." (Bennett and Hayes, 1995)

Partnering between client and main contractor is not new and many large clients are using such an arrangement. A good example of partnering in the UK is that between a fast food chain and a modular builder; in the past five years, the cost of a new building has reduced by 60 % and the construction time reduced from 115 to 15 days. This would indicate that the partnering approach can work in specific circumstances.

Partnering between main contractor and subcontractor is a relatively new concept. The Latham Report (1994) gives an insight into how relations between contractor and subcontractor may develop:

"Some main contractors have developed long term relations with sub-contractors that are welcome. Such arrangements have the principle objective of improving performance and reducing costs for clients. They should not become cosy. The construction process exists to satisfy the client. Good relations based on mutual trust benefit clients."

The Report recognises that benefits may arise from contractors and subcontractors working together, but it acknowledges that the relationship should not become too complacent. This implies that some form of limited competition will still need to exist between subcontractors. It is from this situation that the term competitive partnering has arisen. Competitive partnering for the purpose of this paper is defined as:

Limited competition between selected subcontractors who have satisfied the requirements from a contractor and who are committed to reducing a contractor's client's costs and improving the service given.

Therefore, if competitive partnering is to be adopted, contractors would only need to approach two or three carefully selected subcontractors of proven ability for each trade on a project.

Partnering is taken to be a management term, although there may be legal implications. No distinction is made between partnering and alliancing; typically, partnering can be a one-off, project based relationship and alliancing a long term association over several projects.

METHODOLOGY

The pilot study on which the paper is based collected data by questionnaires and interviews. The questionnaires recognised that partnering was a new concept and asked questions of a general nature on relationships with other companies. This allowed trends rather that specific examples of partnering to be identified. The interviews gave the researcher an opportunity to talk in depth to selected contractors about partnering.

Questionnaires were returned from seven contractors and seven subcontractors out of a total of forty sent out. Interviews with five contractors included two who were adopting a partnering policy and three who were opposed to the concept. Partnering was new to the subcontractors approached and therefore only one company was used as a case study. As a result of the case study a report was prepared on how partnering could provide a competitive advantage in the market place.

Therefore, only limited conclusions can be drawn from this random selection of main and subcontractors, that give an indication of the state of play in the construction industry. The questions asked of main contractors are shown in Appendix 1 and those asked of subcontractors shown in Appendix 2.

SUBCONTRACT CHARTERS

The construction industry recognises that there must be significant changes to the working relationship between main contractor and subcontractor. Subcontract charters aim to establish an effective working relationship between the contractor and a limited number of preferred subcontractors. Through this practice, many of the outdated and adversarial practices which currently exist within the construction industry may be removed. The parties will strive to eliminate all forms of wastage and inefficiency from their work, offering the client better value and ultimately improving margins for all.

A strategy to be adopted to improve efficiency and to reduce costs involves fewer subcontractors, fewer suppliers, a lesser number of invoices and a requirement to pay immediately. A large resource is occupied in dealing with invoices received. Therefore, if the number of subcontractors can be reduced and they submit one invoice per month, the companies' administration costs may be reduced.

It would appear that contractors cannot become more cost effective unless a significant change is made in the way they deal with subcontractors. This is confirmed (Barrie, 1995a) by the number of contractors who have committed themselves to adopting partnering relationships with subcontractors and suppliers. Many others have committed themselves to reducing conflict and to working in a less adversarial way. Indeed some leading clients and contractors have launched a new code of practice aimed at ending disputes in the industry (Anderson, 1995).

It should not be forgotten that the industry relies heavily on law and the legality of contracts and there may be legal implications in entering into a partnership agreement. Hill (1995) recognises that partnering is going to be more widely adopted and outlines some of the issues which may be raised. The law assumes that partners are in a "fiduciary" relationship; meaning that unless otherwise agreed, partners are required to maintain a higher standard of conduct than is normally required in a contractual relationship. Advice is given that some "prenuptial" arrangement is made before entering into a partnering relationship. This is confirmed by Bennett and Hayes (1995) who acknowledge that partnering is concerned with living by the spirit rather than the letter of the law. However they do stress that partners may inadvertently enter into legal relationships that are not intended. The issue of the legal implications of partnering is still not clear.

DATA ANALYSIS

Questionnaires received from subcontractors highlight some of the main areas of complaint that currently exist. Included is the biased nature of the contracts; however there are plans for new legislation (Doyle, 1995) currently being discussed which will take steps towards making contracts less one sided. It has also been recognised that new legislation may be the only way to get many companies to change their practices.

The research found that:

(a) Only 40 % of subcontractors are happy with contractors terms and conditions.
(b) An average of 40% of subcontractors' work is carried out on a pay-when-paid basis.
(c) It takes contractors an average of 60 days from receipt of invoice before payment is made.
(d) Subcontractors would continue to work for only 70% of the contractors if they could be selective.

The research indicates that partnering has yet to significantly influence the work of subcontractors, but that steps are being taken to introduce this approach to the industry:

(a) All contractors select subcontractors from approved lists and that the majority of subcontractors require to be on approved lists.
(b) It is realised that if the partnering approach was widely adopted, subcontractors would find it more difficult to become approved.
(c) At present subcontractors are not finding it difficult to become approved and only 15% felt that approved lists were becoming a closed shop.
(d) Contractors can have up to 3000 subcontractors on their approved list, however they only use an average of 25% of these on a regular basis.
(e) Only 15% of contractors and subcontractors are currently involved in partnering arrangements.

An analysis was made of views on what was going to happen in the future. This gave an indication that the partnering approach may become widely used throughout the construction industry:

(a) Opinion amongst subcontractors was divided as to whether costs could be reduced without reducing margins (40% yes, 40% no and 20% not sure). Those that believed that costs could be reduced felt a saving between 5 and 10% was possible.
(b) However 70% of contractors believed that costs could be reduced without reducing margins.
(c) 40% of contractors believed that subcontractors' tender prices will increase as a result of partnering. This was mainly because more time would have to be given in preparing shop drawings than is currently given.
(d) Opinion was divided on who would get the most benefit from the arrangement, but 40% felt the client would gain greater benefit. 30% of respondents did not know who would benefit.
(e) It was not apparent how many contractors would go down the partnering route; however 60% plan to reduce the number of subcontractors, which is seen to be a first step.

The benefits recognised by contractors appear to be involved with maintaining and improving quality and working together to achieve common goals. Perhaps this shows an understanding of the principles of partnering. But the industry is still wary of partnering with concern based around the risk of paying over the market price and the formation of cartels (i.e. price fixing).

FORMAL ARRANGEMENTS

Partnering is not a new idea for the industry as construction has been partnering in a limited form for many years. Even the contractors who are opposed to the principles of partnering have their own preferred subcontractors who do the majority of their work. It was interesting to hear contractors saying that "partnering is not for us", only to hear them go on to say that they try to work with the same subcontractors on a regular basis. The impression gained from these contractors was that they waste resources in obtaining many quotations, only to award the job to their "favourite subcontractor". Many contractors are therefore close to partnering without gaining the benefits that true partnering can bring.

Implementing

How to set up formal partnering arrangements is now examined, together with the possible repercussions. When partnering is to be implemented, the contractor will identify a selected number of subcontractors per trade who operate in limited competition for work. The contractor will identify these subcontractors by assessing both performance and attitude.

The criteria a subcontractor will have to satisfy may include the following:

* Commitment to reducing costs
* Total Quality Management policy
* In-house specialist design capability
* Consistent delivery performance, service standards and product quality
* Innovative supplier of services
* Flexible attitude
* Ability to support construction activities as required

Both parties, as in any relationship, must be committed to the partnering agreement.

The subcontractors requirements may therefore include the following:

* Regular payment
* Greater share of the contractors work load
* Greater predictability of work
* Improved subcontract conditions
* Reduced tendering costs
* Limited competition

When both parties agree to enter into a relationship that relies on trust, honesty and commitment, the next step will be to formally agree a set of objectives which all parties strive to achieve. These objectives may include the following:

* Improved efficiency
* Cost reduction
* Guaranteed profits
* Lower legal costs
* Reliable product costs
* Good information flow
* Teamwork and cooperation

These objectives can then form part of a partnering charter which both parties will work towards. However the partnering charter is not a legal document and it may be prudent to state this on the charter. Copies of the charter should be circulated to all concerned and commitment to the objectives achieved. As with all management systems, the key will be to constantly monitor performance and to look for ways in which further improvements can be made.

Disadvantages

The difficulties which may occur, if contractors start to adopt partnering, are now considered. On a large project there may be up to a hundred different subcontractors on site with the value of each subcontract ranging from hundreds of pounds to hundreds of thousands of pounds. If a contactor wishes to partner with three subcontractors per trade, upward of three hundred formal arrangements will be involved. Therefore, to successfully manage the process, perhaps partnering can only be initially carried out on a limited scale by using key subcontractors.

There is a danger that, if the selected subcontractors discover who they are in limited competition with, cartels may be formed and prices become uncompetitive. If subcontractors are to be consulted more widely for specialist design, it is reasonable to assume that a cost will be involved. The main factor that is seen to be a problem is that of trust, as both parties have to work together to achieve common aims. Traditionally the relationship between contractor and subcontractor involves conflict, particularly over financial matters.

Effects

It has been acknowledged (Barrie, 1995b) that partnering may go a long way to reducing costs of procurement, administration and accounting. There could be a 20% reduction in quotations received and invoices presented. An area for improvement is in product specification when the advice of the specialist subcontractor is used. The case study has shown that about 10% could be saved on every project by using a different product with the same specification without reducing the quality of the final product. Some contractors are asking subcontractors to carry out value engineering exercises to see if costs can be reduced at tender stage.

These innovative methods may change the way in which construction contractors operate. Those who succeed with partnering may start to regard themselves more like manufacturers producing a repetitive service, as opposed to specialists building a series of one off projects. The key will be to remove all areas of duplication, especially in buying, estimating and accounting. When partnering is seen to work, giving those

involved a competitive edge, the construction industry should adopt such changes more readily.

The quality subcontractor should be in a stronger position as contractors lay down stringent requirements for subcontractors to conform to. Contractors may well become more involved in the administration of the subcontractor's business as it will be in the contractors best interest to have work produced to quality, on time and to price. The subcontractor will be in a less competitive situation and should be able to reduce tendering overheads.

The future

When interviewing contractors who are initiating partnering, it became apparent that they are not yet aware of the full implications. They knew that they wanted to improve service and reduce costs and that they had already invested time and effort. It has been widely recognised that the industry must change in order to survive and the companies with vision to recognise the advantages of new approaches could be successful. Another consideration is that if a number of specialist subcontractors form some kind of grouping, it is possible that they might bypass the main contractor and tender for work themselves.

CONCLUSION

The intention of the paper has been to investigate the concept of competitive partnering in the construction industry. Research has indicated that partnering is now becoming more widespread but possible universal adoption is still in the future. It has been confirmed that if partnering is fully adopted, then cost savings may be made. However there are significant doubts whether the true principles of partnering, that include trust, honesty, teamwork and common goals, will ever become widespread. The industry has to overcome a history of conflict, litigation and adversarial practices between contractor and subcontractor. An incentive to make partnering work will emerge if it is shown that an improved service is offered to clients and the industry becomes more competitive.

Will competitive partnering become the future link between main contractor and subcontractor? Only time will tell.

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APPENDIX 1

Questionnaire to main contractors

Do you select all of your sub-contractors you work with from an approved list?
If so, how many are there on your approved list?
How many of these do you use on a regular basis?
Do you plan to reduce the number of sub-contractors you work with?
If so, by what percentage?
Does your company believe that by fostering closer relationships with subcontractors costs can be reduced and service improved?
Do you currently have any partnering arrangements with any sub-contractors?
How do you think a sub-contractors tender prices will be affected by a partnering arrangement?
What benefits are there to be had from competitive partnering?
What concerns do you have regarding competitive partnering?

APPENDIX 2

Questionnaire to subcontractors

Do you believe the consequences of the Latham report will benefit your companies prospects in the long term?
With what percentage of your clients do you find it necessary to be on an approved list?
Are you finding it difficult to become approved by a new contractor?
Are approved lists becoming a "closed shop"?
With what percentage of contractors terms and conditions are you happy with?
What percentage of your work is carried out on a "pay when paid basis".
What is the average time taken to be paid?
Is the majority of your work obtained on a best price basis?
How much of your work is obtained by reputation and quality?
Are you currently in any competitive partnering relationships?
If so, what percentage of your work is obtained on a competitive partnering basis?
Do you believe that by fostering closer relationships with contractors you will be able to reduce costs without affecting profit margins?
If so, by what margin?
The Latham report recommends a productivity target of 30% real cost reduction by the year 2000. Do you believe that this is achievable?
If market conditions allowed you to be selective, what percentage of your clients would you be reluctant to undertake work for?
Who do you believe will benefit from competitive partnering, the client, the contractor or the sub-contractor?
It would appear that contractors are starting to make significant changes with regard to the number of sub-contractors that they work with. Do you think this will be beneficial from both a cost and service point of view?

THE DESIGN BRIEF AND INTEGRATED DESIGN AND CONSTRUCTION: RECENT TRENDS IN BUILDING PROCUREMENT IN AUSTRALIA

Rick Best [1] and Dennis Lenard [2]

Abstract

If sustainable construction, that satisfies a wide range of complex client needs, is to become a reality then there are some essential changes required in the traditional linear process of building design and construction. Innovative solutions depend on a fully integrated design and construction approach with all participants in the design and construction process providing their expert input from the earliest possible time. Fundamental to the success of these buildings is the preparation of a functional brief which sets the correct parameters from the outset of the procurement process.

To date it has been common for the engineers and contractors on a project to be presented with a quite detailed architectural design and then be asked to "make it work". This approach is inadequate if an optimum design is to be achieved. Rather there must be an innovative approach to this aspect of building procurement with a multi-disciplinary team, including not only all the design disciplines but also others such as the construction economist and contractor, assembled from the commencement of the design process. Prior to this, however, the formulation of the brief requires expert input to ensure that there all aspects of the project are properly addressed: these include the basic requirements of the building envelope in terms of heat transfer, shading, thermal mass, constructability and so on.

This paper discusses this essential change in industry culture, the way in which an holistic approach to sustainable building design and construction, satisfying complex client needs, is starting to emerge in Australia. It is suggested that the use of integrated teams and effective briefing strategies can provide the impetus for innovative idea generation.

Keywords: construction, constructability, innovation, procurement.

INTRODUCTION

Constructed facilities, throughout their useful lives, from construction to demolition, have a variety of impacts on the environment. The extraction and processing of raw materials, transport, construction, energy consumption, maintenance and eventually, demolition and disposal all leave their mark. Many of the traditional practices in the construction industry need to be rethought if the impact of buildings is to be minimised and we are to move towards sustainable forms and methods of construction.

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Innovative approaches to building procurement are beginning to play a part in minimising the environmental impact of buildings. Fundamental to these approaches is a change in the way in which design briefs are prepared and developed. Two case studies are presented in this paper and each looks at the ways in which client, design consultants and contractors are responding to a changing marketplace - one where, increasingly, questions of sustainability and innovation are raised .

Sustainable construction

In 1987 the ING Bank (formerly the NMB) of the Netherlands moved into its newly completed headquarters buildings in Amsterdam. The new buildings were unique in many ways and their success in a number of areas has provided a fine example of the ways in which cross-disciplinary design teams working towards an integrated design solution from the commencement of a project can produce a wide range of benefits for building owners and occupiers. If passive or low energy systems are utilised then environmental benefits can flow on to the community at large.

The bank's brief was simple and open-ended: it was to provide a facility which would

- integrate art, natural materials, sunlight, green plants, energy conservation, low noise levels and water
- be functional, efficient and flexible
- be human in scale
- have low running costs

The buildings were designed by an integrated team consisting of architects, construction engineer, landscape architect, energy expert (a physicist) and artists, as well as the bank's own project manager. All of the consultants on the team were involved from the project's inception, and all consultants were free to comment on any aspect of the design. The results are exemplary: energy consumption is less than one-tenth of that of the bank's previous headquarters with attendant savings in running costs of around $US 2.4 million per annum, absenteeism was reduced by around 25%, and the bank's corporate image was enhanced to the extent that it moved from fourth to second ranking amongst Dutch banks. Careful integration of the building envelope, services and extensive daylighting has led to significant reductions in greenhouse emissions associated with the operation of the building (Holdsworth,1989; Romm and Browning, 1994 & 1995).

The most important lesson which can be learnt from this project is the importance of the multi-disciplinary team approach to design, if truly better buildings are to be realised.

Integrated design and construction

Integrated design and construction is much more than mere co-ordination - it requires a close working relationship between all members of the team, and, importantly, all team members, regardless of their discipline, are on an equal footing within the team.

It has been suggested that "integrated design is not a marriage between architecture and engineering, but a reunion after a long period of separation" (Berry, 1995). The present system of many consultants from different disciplines each contributing to a specific part of the design process is a relatively recent phenomenon - the chief designer of the great European cathedrals was a master mason who handled the combined roles of project manager, architect, structural engineer, cost engineer and head contractor.

In the late 19th century a US Army engineer, Montgomery C. Meigs, designed the Pension Building (now the National Museum of Building) in Washington, DC. He was not only architect, engineer and superintendent, but he also adopted the role of ventilation specialist as he set out to provide a healthy working environment for the employees of the Pension Bureau. The purely passive ventilation system could achieve thirty air changes per hour under optimum conditions; after one year of occupation the number of sick days taken by the bureau's 1500 employees was reduced by 8,622 compared to the previous year (Lyons, 1993).

With increased complexity and sophistication in building design and construction, and particularly with the great expansion in the services component of buildings, the present fragmented design approach has evolved. This has tended to be a linear process with individual consultants, under the controlling eye of the architect, or more recently the project manager, each adding their part to the total design which is slowly refined into the final solution.

The shortcomings of this approach become most apparent when the brief calls for an "energy efficient" building. It is now quite common that clients will nominate in their brief that their new building is to be "energy efficient" and then they are satisfied when superficial measures such as variable speed motors and weatherstripping are incorporated. These can, and do, lead to reductions in energy use but the savings produced are limited in scope and have little to do with the efficient use of energy.

For more radical buildings to function successfully there has to be a fundamental change in the design process. Rather than the architect in isolation settling on a "grand design", thereby setting a range of design problems which have to be solved by other consultants, the other consultants should be incorporated early and be involved in the design decision process. The problems can be eliminated or avoided before they require solutions, when all the parties can contribute equally from the outset. This is the essence of integrated design, and it can be actively promoted by clients through the briefing and overall procurement process.

CASE STUDIES

For integrated design and construction strategies to work several components must be present. Berry (1995) suggests:

> "clear thinking and a shared vision are perhaps the two most important requirements for the individual and the team".

However, if the process is to be successful it requires that the client is both flexible and informed. One of the primary reasons for the success of projects such as the ING Bank was the large degree of client involvement throughout the design process. The initial, conceptual brief outlined above was very broad in its aims, however, the design team worked closely with the bank's representative as the details of the brief and the design were developed.

It is argued that "the key to success lies initially with agreeing the brief. This is always important, but becomes critical for naturally ventilated buildings [..]" (Building Services, 1994). This is equally true for any design which departs from usual practice. The following two case studies have been chosen because they illustrate the importance of the briefing process and in particular, the necessity of pre-contract planning. Case study two is also an important illustration of an integrated design and construction team approach.

Case study - new office building[3]

In 1994 'energyAustralia' (formerly Sydney Electricity), the major distributor of electricity in central Sydney, initiated the procurement of a new 10,000m2 office building in inner Sydney. Their aim was to move several sections of their operation to the new building which would serve as a working example of energy efficiency, and highlight a new approach to electricity supply, that of providing energy services rather than merely selling electricity. This was partly prompted by the wide-ranging reforms presently occurring in the energy sector in Australia with old monopolies being broken up and nation-wide competition for energy services being facilitated and encouraged.

The conceptual brief was relatively simple: the building was to be at the leading edge of energy efficiency in Australia, and was to demonstrate a range of 'state of the art' technologies. The client engaged a small firm of project managers, who were already managing the refurbishment of energyAustralia's main city office building, to prepare a brief and advise on a suitable procurement system.

The project managers first conducted an international literature search in order to identify the sort of designs which were being built around the world, and then engaged a strategic energy adviser (SEA) to advise them on specific performance targets for various components of the building envelope and plant. This SEA was actually a team comprising an electrical engineer, a mechanical engineer and representatives from energyAustralia. The project managers and the SEA then combined to prepare an architectural brief which was rather unusual in that it set specific performance parameters in terms of U values for various elements of the building fabric, energy consumption targets for individual items of plant and equipment, and total energy use per unit of floor area. Also included in the brief were specific requirements for energy modelling of proposed designs, and an on-going role for the SEA through the design, commissioning and handover of the building.

Those who tendered for the provision of architectural services were required to show in their bids how they intended to satisfy the parameters in the brief, and to show that they had the

[3] Interview with Greg Graham, Chase Pacific Properties, Sydney, December, 1996.

necessary expertise in their nominated project team to successfully design the sort of building required by the client.

The brief, being written as it was with significant input from the SEA, will force the design process along some new paths. In particular, the requirements for extensive energy modelling, and the involvement of the SEA during the design process will require the architect and the services engineers to work closely together in order to produce an integrated design for the building envelope. While there is no provision for any sort of bonus payment for bettering the performance targets in the brief the architects will be exposed to the possibility of a suit for breach of contract if targets are not met. Fees for services design will be linked to time spent on design work rather than calculated as a fraction of the cost of the systems installed.

Case study- innovative refurbishment[4]

This project involved the refurbishment of a five level process manufacturing facility at Botany, an inner suburb of Sydney, undertaken on a design and construct basis. The facility was operational for the duration of the project. The project had many notable features.

- The project was considered achievable. Construction occurred around the operating plant which presented a number of programming, productivity and occupational health and safety challenges.
- The client let the contract for design development at a lump sum price. After submitting an initial project estimate, the contractor accepted the full commission to provide detailed design and construction. This commission involved an intensive 18 month programme of investigation, construction planning and costing prior to any work commencing on site.
- Planning was a key part of the project's success. The building programme was coordinated with the operating plant's maintenance schedules so that full advantage could be taken of operational down-time.
- There was a partnering arrangement between the owner and the contractor, with no intermediaries involved. The partnering plan related to the actual development process and stringent occupational health and safety objectives. The parties shared their knowledge and experience and felt they had benefited from the joint development, documentation and training of staff in these areas. A full exchange of company and project aims contributed to the success of the project.
- Workplace reform was targeted as a way of improving productivity. The contractor places a strong emphasis on the workplace being a learning environment and staff and subcontractors assuming more responsibility. The contractor's goals included breaking down demarcation, multi-skilling workers, career development and counselling, increasing worker responsibility via minor works cost sheets and assisting subcontractors to implement reforms.

[4] Interviews, conducted with the client and contractor, anonymity requested, Sydney.

Project complexity

This process plant provided packaged food products for the Australian and the Asia Pacific region markets. The continuation of production within the client's planned schedule was a key objective in this project. This created an extremely high level of complexity since the facility had to be re-built around working mechanical equipment ensuring that production, safety and hygiene were all maintained in accordance with strict guide lines.

The original building was constructed in the 1940's of steel frame, timber floors (five levels) and a brick facade. Over the years that the building has been used, the process plant contained within it has been changed many times. The original timber floors of the building had been overlaid with concrete which had subsequently been modified structurally by penetrations required for new or modified process plant. All of these modifications, together with substantial corrosion to many of the original steel beams, had caused the building to become structurally unstable. Also, the building, because of its age, did not comply with fire safety regulations.

Design and Construction was the procurement method chosen with full project management services supplied by the construction contractor. The contract period for stage one was 120 weeks with a target schedule of 106 weeks and at the time the case study was undertaken the project was approximately 40% complete and on schedule.

Budget constraints and production requirements demanded that the equipment could not be shut down for any delays other than for scheduled maintenance. The production equipment within the facility was recently upgraded and specially engineered to fit within the confines of this building.

The major tasks involved in the re-building of the structure were :

- addition of temporary external bracing for the duration of the project;
- demolition and reconstruction of the floors;
- addition of a perimeter concrete beam at each level to distribute lateral loads;
- addition of a new structural service core and stair;
- improvement of the bearing capacity of footing piers;
- concrete encasement and fireproofing of steel columns;
- removal and replacement of corroded steel columns and beams and;
- demolition of the existing masonry facade and replacement with a lightweight metal sandwich panel system.

As had been stressed, the main constraint was that the refurbishment work had to be done while the production equipment and food processing plant was fully operational. This meant that work areas had to be sealed off from production areas to maintain cleanliness and hygiene. This also restricted the materials which could be used in the project. For example, no timber was allowed because of the possibility of undetectable splinters falling into processing equipment.

One example of the problems encountered was the need to suspend machinery from the floor above while the floor was demolished, formed up and poured (throughout this work the machinery had to remain operable). Once the floor was strong enough the machinery could be relocated on the floor slab.

A second example involved encasing one of the columns with concrete. This particular column had an equipment control panel attached to it with hundreds of electrical circuits connected into it from various parts of the building. This panel and its wiring had to be carefully labelled, disconnected, moved and reconnected, just to encase the column with concrete. Man-handling the materials, including heavy steel beams, was another significant difficulty encountered.

An integrated team approach

The client, a major multinational food producer, had a number of specialist production personnel interfacing with the contractor's site staff to ensure that the client's needs with respect to safety, cost and continuous plant operation were communicated and achieved. The on-site relationship between the client's representatives and the construction team was excellent and a definite feeling of 'partnering' emerged.

Overall project time, in terms of speed of construction, was of less concern to the client if food processing continued throughout the rebuilding process. However, obviously construction time was a major consideration of the contractor.

The contractor had been negotiating for up to five years with the client with a view to obtaining construction work from them. The contractor, in recent years, has developed the expertise to undertake the complete design, construction and commissioning of process plant facilities.

This project required significant interaction between the client and the contractor in many areas of the redevelopment. Both parties shared their knowledge and learned from the other. As an example, many of the client's standards for building construction relating to (internal) health and hygiene standards, were outdated and were significantly revised after discussion and consultation with the contractor.

The other major area in which this partnership has had tangible benefits for both parties was in the formulation and documentation of training in safety and quality standards for staff of both organisations.

The architects were appointed by the project manager/contractor who had used their services previously on other refurbishment projects. The architect was responsible for the design coordination and documentation of the building works.

The structural engineers had a difficult task in re-designing the structure for the building while giving consideration to the constructability issues made complex by the occupancy of the client and operating machinery. The other problems were mainly those of the unknown, such as the bearing capacity of the foundations and unexpected deterioration of existing structural elements discovered during demolition.

The contractor only appointed experienced sub-contractors with whom he had worked on previous projects. The need for safety and hygiene were critical, especially during stages of demolition which also included asbestos removal. In all there were 18 separate sub-contractors involved in structural work on the project and 6 sub-contractors involved in the finishes. The key sub-contractors were demolition, structural steel, form-work, reinforcement and concrete, the various mechanical services and finishes. All of these key sub-contractors were incorporated into the integrated team.

Design process

The extended design and planning phase of the project gave the team the opportunity to consider many alternatives for construction methods and some opportunity for the use of new technology. These choices were usually reviewed by the project manager and the client's representatives. Unsuitable alternatives were eliminated and the remaining ones evaluated on a 'constructability and cost' basis.

Cost control during the design stage was very important and was the responsibility of the project manager. Owing to the fact that the client had limited funding approval for the project and wanted a lump sum price, the project pricing had to be extremely accurate and within the client's budget. The cash flow of the client also had to be taken into consideration during the construction planning so that progress claims would be made at times agreed with the client to suit his cash flow projections.

The project organisation of the construction team for this Project was, for the most part, based on organisational principles which the company commonly used. However, the site manager pointed out that most projects were unique in some way. The major factor which influenced the decisions regarding the formation of this organisational structure was the structure of the client's team. The site manager wanted to ensure that each specialist person on the client team had a specialist person to interface with on the construction team. The rest of the construction team was determined by the needs of the project. This approach was adopted to ensure that every possible opportunity was available for communication between the contractor and the client, especially because of the heavy client involvement in the project. Communication on such a complex project was essential for the contractor both to ensure the project's success and to build the relationship that would last for the duration of the project and for future projects.

The project team was divided into sections for services and for structures, which allowed for a relatively flat structure. This structure has not changed over the life of the project thus far, although a few of the people in certain positions have changed. The project manager made certain that the people on this project were the best available and with extensive experience in refurbishment.

Uniqueness of the procurement method

As mentioned previously, this project was designed and planned simultaneously. Because of the need to rebuild so much of the structure, including floors under machinery, there was no other way to proceed with this project than to have an extensive period of on-site investigation, design, documentation, planning and pricing. The client granted a preliminary works commission worth over $A3m to the project manager. This commission included the documentation of existing services in the building together with the preliminary project design and the preparation of a Lump Sum price for the new works. Full-time construction planners for both the structure and services were costed into the commission. This allowed the contractor to give consideration to alternative methods and to make sure that the solutions were constructable. The design team prepared numerous method sheets outlining step by step instructions for almost every task on the project. These method sheets were continuously updated and added to as the project proceeded.

CONCLUSION

The case studies illustrate the importance of the establishment of muti-disciplinary teams and the important role that the client plays in promoting innovation and idea generation in the design and construction phase.

Idea generation through effective partnership and linkages in the project team

The importance of the project team was examined in detail by Lenard (CIIA, 1996a). That examination indicated that historically, project teams were seen as a barrier to rather than a generator of innovation in the construction procurement process. It was also indicated that the concept of partnering may be an effective means of overcoming this barrier. The current literature on partnering in the construction context emphasises the need to establish common goals between the parties. In fact a survey conducted by Lenard for the Construction Industry Institute Australia in 1996 indicated that establishing common goals was critical to the success of partnering arrangements (CIIA, 1996b).

The establishment of common goals can often foster new approaches and solutions to project problems. The use of mission statements and the encouragement of entrepreneurial behaviour can be useful in creating the right innovative environment. However, the current environment is limited in promoting the concept of sharing values and goals because of the current stratification and the linear single point accountability that predominates in traditional lump sum tendering.

The role of the project team could also be enhanced if project staff were drawn from a range of diverse backgrounds, covering functional specialties and creativity from marketing to project technical capability. Where possible, research and development specialists from the individual companies should also participate. Ideally the project team should have access to interactive information systems incorporating costing, design and construction solutions. While there is some evidence of individual companies adopting these systems, there is no evidence of multi-disciplinary project teams (ie. teams formed across organisational boundaries) using such systems.

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THE EFFECTIVENESS OF BUILDING PROCUREMENT SYSTEMS IN THE ATTAINMENT OF CLIENT OBJECTIVES

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Abstract

The selection of an appropriate building procurement process is crucial to the attainment of client objectives with respect to time, cost and quality. Research reveals that the way in which many clients, and their professional advisors, select the method of building procurement can be haphazard, ill-timed and lacking in logic. It has also been established that one of the principal reasons for the construction industry's poor performance is the inappropriateness of the choice of procurement system. This paper documents the results of an empirical study into the nature, use and effectiveness of building procurement methods in South Africa in the attainment of client objectives. A national questionnaire survey was administered to clients, architects, quantity surveyors, engineers, project managers and general contractors. Differences found between the respondent groups are discussed.

INTRODUCTION

Development of innovative building procurement systems is one of the most noticeable effects of change that is influencing the practices and procedures of the building industry. It corresponds to a body of knowledge which is developing rapidly, so rapidly in fact, that it is possible that we may not be aware of the current 'state of the art' unless we constantly measure the building procurement systems being used in the industry. Because of the growing globalisation of construction, it is also necessary to have this information available for each country because the development of building procurement systems is likely to evolve at a different rate and in a different form in the different national environments.

Many authors have attributed the change that is occurring in the area of building procurement to the demands of clients (Moore, 1984; Ball, 1988; Franks, 1990; Hillebrandt and Cannon, 1990). It would seem that construction clients are not happy with traditional procedures and performance and, as a consequence, are prepared to experiment with innovative procurement systems in order to attain satisfaction of their objectives (Bennett and Flanagan, 1983).

It is generally understood that each building project is unique. It is also general knowledge that there are a number of building procurement options, each one having characteristics that may suit one project and not another. Amongst the first to undertake research, intended to devise a selection system to choose the most appropriate building procurement option for any specific project, were

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Franks (1990), N.E.D.O. (1985), Nahapiet and Nahapiet (1985), Skitmore and Marsden (1988) and Bennett and Grice (1990). However, little is known about the degree to which the findings of such research is being applied in practice.

Research reveals that the way in which many clients, and their professional advisors, select the method of building procurement can be haphazard, ill-timed and lacking in logic (Masterman, 1992). It has also been established that one of the principal reasons for the construction industry's poor performance is the inappropriateness of the choice of procurement system (Skitmore and Marsden, 1988). It would seem that, whilst we now have an array of procurement options available, they may not be well understood. It could then be argued that ignorance amongst construction professionals may be a reason for the apparent lack of customer satisfaction regarding the attainment of their objectives (Bowen, 1993).

The construction industries of South Africa have experienced a great deal of change in the development and use of building procurement systems in recent times; however, little of it has been documented (Hindle and Rwelamila, 1993; P.W.D., 1996). As a result, there is a need to know about the building procurement systems in use and the degree to which client objectives are being achieved in South Africa.

METHODOLOGY

A national questionnaire survey was conducted to establish the nature, use and effectiveness of building procurement methods in South Africa in the attainment of client objectives. Participants comprised clients, architects, quantity surveyors, consulting structural engineers, project managers, and general contractors. Questionnaires were sent to practices and organisations rather than to individuals, using the membership directories of the South African Property Owners' Association, the South African Institute of Architects, the Association of South African Quantity Surveyors, the Institute of Consulting Engineers, the Institute of Project Managers, and the Master Builders' Associations. A total of 4933 questionnaires were distributed, comprising 495 clients, 1499 architects, 607 quantity surveyors, 340 engineers, 489 project managers and 1501 general contractors. Three hundred and seventy three replies were received, the individual response rates being 7% (clients), 9% (architects), 11% (quantity surveyors), 9% (engineers), 7% (project managers) and 5% (contractors). The response rates, whilst disappointing, are considered sufficient to provide an indication of opinion trends in practice. In the design of the questionnaires, an attempt was made to construct the questions for each of the six groups of participants in such a manner so as to facilitate an inter-group comparison. In the following discussion of the results, percentages refer to firms responding to specific questions.

SURVEY RESULTS

The survey results deal with issues relating to the usage of various procurement methods, the nature of and extent to which clients receive advice on the selection of procurement systems, and the perceived ability of procurement systems to achieve client objectives with respect to time, cost and quality. The survey results are discussed question by question and compare the participating groups' opinions about each issue.

Question 1: Please state the proportionate usage of each procurement system over the last five years.

The purpose of this question was to establish the extent to which the various procurement systems are used by the South African building industry. Respondents were requested to insert their percentage involvement against the various forms of procurement (see Table 1). Percentages do not summate to 100% as respondents use more than one method of procurement.

The majority of all respondent groups reported using the conventional procurement method the most frequently, with architects (70%), quantity surveyors (68%) and engineers (69%) reporting the highest usage. This result probably stems from the advisory role these professional consultants play within the building industry. The fact that the conventional system accounted for only 50% of the systems used by contractors and project managers is not surprising given the nature of their activities. Interestingly, clients reported using the traditional procurement method only 58% of the time.

Table 1. Proportional usage of procurement systems

Procurement method	Assessment of respondents regarding proportional usage of procurement systems					
	Clients	Architects	Quantity surveyors	Engineers	Project Managers	Contractors
	(%)	(%)	(%)	(%)	(%)	(%)
Conventional	58	70	68	69	51	50
Negotiated	23	14	14	15	8	24
Cost-plus	3	3	3	2	1	7
Design and build	2	3	5	4	5	8
Turnkey	5	2	1	4	8	4
Develop and construct	4	2	2	0	1	4
Package deal	2	2	1	2	0	1
Management contracting	1	1	2	0	7	1
Construction management	3	1	3	2	13	1
Design and manage	0	3	1	0	6	1

The negotiated form of building procurement enjoys the next highest usage by all respondent groups, with the notable exception of the project managers, who report a higher usage of the construction management method (13%) compared to the negotiated form (8%). The remainder of the procurement systems appear to enjoy comparatively limited usage, with none of the other methods achieving a usage in excess of 10%.

When asked to indicate the current trend in procurement system usage, a majority of clients, architects, quantity surveyors and contractors reported an increased trend towards the use of negotiated tendering procedures, with the majority of engineers and project managers claiming that the turnkey and construction management methods of procurement are increasingly the method of choice.

Question 2: Do you have a clear preference for any one of the procurement systems?

Asking the respondent groups whether or not they had a clear preference for any one procurement

system, yielded the results shown in Table 2.

Table 2. Respondent preferences for particular procurement systems

Procurement method	Assessment of respondents regarding procurement system preferences					
	Clients (n=25)	Architects (n=114)	Quantity surveyors (n=56)	Engineers (n=27)	Project Managers (n=18)	Contractors (n=53)
	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)
Conventional	20 (80%)	108 (95%)	52 (93%)	25 (93%)	10 (56%)	24 (45%)
Negotiated	18 (72%)	74 (65%)	32 (57%)	13 (48%)	9 (50%)	52 (98%)
Cost-plus	4 (16%)	10 (9%)	5 (9%)	5 (19%)	5 (28%)	20 (38%)
Design and build	7 (28%)	8 (7%)	7 (13%)	4 (15%)	7 (39%)	14 (26%)
Turnkey	8 (32%)	6 (5%)	4 (7%)	7 (26%)	6 (33%)	9 (17%)
Develop and construct	3 (12%)	9 (8%)	6 (11%)	3 (11%)	3 (17%)	11 (21%)
Package deal	5 (20%)	14 (12%)	3 (5%)	2 (7%)	3 (17%)	8 (15%)
Management contracting	1 (4%)	8 (7%)	8 (14%)	2 (7%)	9 (50%)	2 (4%)
Construction management	3 (12%)	8 (7%)	10 (18%)	5 (19%)	12 (67%)	4 (8%)
Design and manage	0 (0%)	11 (10%)	3 (5%)	1 (4%)	7 (39%)	2 (4%)

In this instance, given the fact that respondents indicated more than one preferred system and that such preferences are not mutually exclusive, the actual number of respondents from each group claiming to prefer a particular system is given. Associated percentages, relating to the number of respondents in each group, are given in parentheses.

Clearly, with the notable exception of the contractors, the procurement system of choice amongst the other respondent groups is the conventional system. This preference is particularly strong in the case of the architects, quantity surveyors and engineers. Clients and project managers appear to be more or less ambivalent in their preferences for the conventional and negotiated methods. The contractors' overwhelming preference is for the negotiated form of procurement, followed by the conventional and cost-plus methods. Interestingly, the respondent contractors appear not to favour the design and build and management-orientated forms of building procurement. One would have thought that, given the prominent role played by the contractor in such methods, these systems would have been favoured more than is the case. The remainder of the procurement systems enjoy limited support.

Question 3: Do clients require professional advice on the types of procurement systems available for use on projects ?

The purpose of this question was to establish the extent to which clients are perceived to require assistance in the selection of a procurement system for a particular building project. The client respondents were also questioned regarding the extent to which they see themselves as requiring assistance in this regard. Table 3 depicts the responses from the various groups.

Table 3. Extent to which clients require professional advice on procurement system options

Procurement team member	Assessment of respondents regarding extent to which clients require procurement selection advice		
	Always / Frequently	Occasionally	Seldom / Never
	(%)	(%)	(%)
Clients	21	24	55
Architects	73	18	9
Quantity surveyors	73	22	5
Engineers	59	24	0
Project managers	77	11	12
Contractors	69	24	7

A perception gap appears to exist between the clients and the remainder of the respondent groups regarding the extent to which clients require assistance with procurement selection. A majority of all the other groups report that clients frequently, or always, require assistance in this regard. Indeed, architects (73%), quantity surveyors (73%) and project managers (77%), the professionals most likely to be involved with the client at the inception and briefing stage of a project, are unequivocal about this issue. Clients clearly do not hold the same views, with only 21% of this group claiming to require such assistance, at least frequently.

Question 4: Is the client offered advice on procurement system selection by any of the procurement team participants ?

Given the response to the previous question, namely that clients do require assistance in procurement system selection, this question sought to establish whether or not such advice is actually offered by members of the procurement team. Respondents were given the choice of five possible alternatives in responding to this question, ranging from 'always' to 'never'. For reasons of practicality, only the responses relating to 'always' and 'frequently' are given here in combined form (see Table 4).

According to the client respondents, quantity surveyors (71%) and project managers (70%) frequently, or always, offer procurement selection advice. Interestingly, the architects are not perceived by the clients to be a regular source of such information, with 50% (data not shown) of clients claiming that architects offer such advice at most occasionally. Inspection of the raw data reveals that 22% of clients claim to receive such advice from architects seldom or never. End-users of buildings appear not to be insignificant providers of such advice to clients. Indeed, 26% of clients claim to be offered procurement selection advice from this source at least frequently.

The opinions of architects reinforce the advisory role played by quantity surveyors and project managers. However, a significant gap appears to exist between the perceptions of clients and architects regarding the extent to which advice is offered by architects. More specifically, 90% of architects claim to offer this form of advice frequently or always. Only 2% of architects admit to offering such advice seldom at best. It would seem that architects need to address the interpersonal communication aspects of the provision of advice on the selection of procurement systems to clients.

Table 4. Source of procurement system selection advice from procurement team participants

Procurement participant	Assessment of respondents (always/frequently) regarding source of procurement system selection advice					
	Clients	Architects	Quantity surveyors	Engineers	Project Managers	Contractors
	(%)	(%)	(%)	(%)	(%)	(%)
Consultant architect	50	90	77	85	23	76
Consultant quantity surveyor	71	80	91	69	32	67
Project manager	70	52	67	77	77	67
Consultant engineer	14	22	16	67	32	27
Main contractor	22	17	15	26	23	48
Construction manager	25	16	24	21	32	35
Management contractor	16	9	23	19	53	31
Sub-contractors	8	0	4	5	0	4
End-user of building	26	11	8	9	4	13

It is noteworthy that all groups, with the exception of the clients and the project managers, see the architect as playing a pivotal role in supplying the client with advice on alternative procurement systems. The quantity surveyor is seen as a major contributor by all groups except the project managers. The somewhat disparate view of the project managers may be explained by the roles they play in building projects and the type of procurement systems selected for those projects.

Question 5: If advice is offered to the client, what form does the advice take?

Given that the majority of respondents report that clients require, and indeed are offered advice on procurement selection, it is important to establish the form of such advice. More specifically, this question sought to find out whether the procurement advice consists of a broad overview of all available systems, whether it is confined to a limited selection of systems, or whether it is restricted to only one system. Again, for practical reasons, the results given in Table 5 refer only to the combined 'always' and 'frequently' responses.

Table 5. Form of procurement selection advice from procurement team participants

Procurement method	Assessment (always/frequently) of respondents regarding the form of procurement selection advice					
	Clients	Architects	Quantity surveyors	Engineers	Project Managers	Contractors
	(%)	(%)	(%)	(%)	(%)	(%)
A broad overview of all procurement systems?	33	50	39	41	42	45
Confined to a limited selection of systems?	76	78	80	89	68	74
Restricted to one system only?	48	26	37	32	41	45

A majority of all respondent groups agree that if procurement selection advice is offered to clients, it is invariably confined to a limited selection of systems. This finding corresponds with the results presented in Table 2, where it was shown that respondents have clear preferences for certain procurement methods, the systems of choice being the negotiated and conventional methods. Clearly, the procurement advice offered by team participants is influenced by individual experiences and preferences. The results pertaining to the proportionate usage of procurement systems (Table 1) support this contention.

Question 6: On what basis does the client select procurement systems ?

The purpose of this question was to establish the basis upon which clients, having been offered and received advice from their professional consultants, select the procurement systems for their projects. The results are depicted in Table 6.

Table 6. Manner by which clients select procurement systems

Basis of selection	Assessment (always/frequently) of respondents regarding manner of procurement selection by clients					
	Clients	Architects	Quantity surveyors	Engineers	Project Managers	Contractors
	(%)	(%)	(%)	(%)	(%)	(%)
Advice from in-house experts?	64	56	66	45	43	63
Previous experience of similar projects?	90	62	77	83	70	75
Company policy?	50	51	60	52	59	45
Advice from external consultants?	43	53	63	59	47	58
Contractors' marketing activities?	9	15	11	18	3	29

Clients are overwhelmingly (90%) of the opinion that such decisions are based on previous experience with similar projects. The remaining respondents agree with this assertion, but do not assign the same amount of significance to this influence. Advice from in-house experts appears to play an important, but not deciding role in most instances. Interestingly, advice from external consultants is not as influential as one might imagine, with 43% of clients and 53% of architects, respectively, claiming that this source of information frequently or always forms the basis upon which clients select their procurement systems. A significant majority of quantity surveyors (63%), on the other hand, do believe that external consultants play a deciding role in procurement selection. Interestingly, contractors' marketing activities appear to play a comparatively minor role.

Question 7: To what extent is an attempt made by the procurement team in the selection of a procurement system to match the client's needs with the characteristics of different procurement systems?

Central to the issue of procurement selection, is the problem of matching the needs and objectives of the client, invariably in terms of time, cost and quality, with the characteristics of individual systems. The analysis of the results for this particular question (see Table 7) should be read in conjunction with the results given in Table 9, relating to respondents' opinions regarding the capacity of individual procurement systems for achieving clients' objectives with respect to time, cost and

quality.

All respondent groups are of the opinion that, in the selection of procurement systems, an attempt is frequently or always made to match client needs and system characteristics. Approximately 70% of all respondents hold this view, with the notable exception of the contractors, where only 56% of this group concur.

Table 7. Extent to which procurement system characteristics are matched to client objectives

Procurement team member	Assessment of respondents regarding extent of matching		
	Always / Frequently	Occasionally	Seldom / Never
	(%)	(%)	(%)
Clients	69	19	12
Architects	71	21	8
Quantity surveyors	71	23	6
Engineers	74	11	15
Project managers	69	17	14
Contractors	56	36	8

Question 8: How extensive do you rate your knowledge of the advantages and disadvantages of the various procurement systems ?

Given that 43% of client respondents report invariably basing their procurement selection decision on the advice from their external consultants, respondents' knowledge of the various procurement systems and their associated advantages and disadvantages, is important. The results to this question are given in Table 8. Only the 'very good' and 'good' responses are depicted.

Table 8. Respondent knowledge regarding advantages and disadvantages of procurement systems

Procurement method	Assessment of respondents (very good/good) regarding extent of knowledge					
	Clients	Architects	Quantity surveyors	Engineers	Project Managers	Contractors
	(%)	(%)	(%)	(%)	(%)	(%)
Conventional	94	98	98	100	91	96
Negotiated	94	85	91	82	79	85
Cost-plus	66	56	69	48	56	77
Design and build	47	33	40	40	70	56
Turnkey	53	26	32	41	62	38
Develop and construct	37	22	32	17	45	51
Package deal	43	27	39	20	33	43
Management contracting	37	18	29	14	69	28
Construction management	38	23	26	29	73	45
Design and manage	28	29	24	9	67	26

A clear majority of clients rate their knowledge of the conventional (94%) and negotiated (94%) procurement systems as good or very good. Similar views are held by all respondent groups in respect of these procurement methods. Comprehensive knowledge of the cost-plus system, whilst not as widespread, is held by a majority of all groups except the engineers.

Of the various groups, the project managers display the most comprehensive knowledge of the various procurement systems, with a majority claiming good or very good knowledge of *all* systems with the exception of the package deal, and develop and construct methods. Given the role of project managers in building procurement, this finding is not surprising. What is surprising is that a majority of architects and quantity surveyors report that their knowledge of systems other than the conventional, negotiated and cost-plus forms, is fair at best. How then are they in an informed position to provide professional advice on procurement selection? This probably explains the limited nature of advice received by clients from consultants (Table 5) and the credence given to such advice (Table 6).

Question 9: Please rank the following procurement systems regarding their capacity for achieving the client's objectives with respect to time, cost and quality (where 1 = high satisfaction; 10 = poor satisfaction)

Of primary importance in the selection of procurement systems, is the extent to which the respondent groups rate the systems in terms of their capacity to attain client objectives with respect to time, cost and quality. Respondents opinions in this regard are given in Table 9. With respect to achieving clients' objectives with respect to *time*, the conventional system is not rated highly. More specifically, only the engineers give it a higher average ranking than 4, with project managers and contractors being less impressed with ratings of 10 and 8, respectively. With the exception of the project managers, the negotiated system appears to be comparatively highly rated (<3) by all groups.

Table 9. Respondents' ranking of procurement systems in terms of attaining client objectives with respect to time (T), cost (C) and quality (Q)

Procurement method	Assessment of respondents regarding ranking of procurement systems																	
	Clients			Architects			Quantity surveyors			Engineers			Project Managers			Contractors		
	T	C	Q	T	C	Q	T	C	Q	T	C	Q	T	C	Q	T	C	Q
Conventional	4	3	2	4	1	1	5	1	1	3	1	1	10	7	4	8	6	5
Negotiated	2	2	1	1	2	2	1	2	2	2	2	3	7	5	3	1	1	1
Cost-plus	6	9	8	10	10	3	8	10	6	10	7	6	9	10	5	6	10	6
Design and build	5	7	7	5	9	7	4	7	7	4	5	8	6	8	7	5	5	4
Turnkey	1	4	3	3	8	10	3	5	10	1	4	7	3	1	9	3	3	2
Develop and construct	7	8	10	8	4	8	3	6	9	7	6	10	8	9	8	4	2	3
Package deal	3	1	4	2	3	9	2	8	8	8	2	9	5	3	10	2	4	7
Management contracting	10	5	6	6	7	6	6	4	4	5	3	5	4	2	6	9	8	9
Construction management	8	6	9	7	6	4	7	3	3	9	3	4	1	6	1	7	7	8
Design and manage	9	7	5	9	5	5	9	9	5	6	4	2	2	4	2	10	9	10

The turnkey method is also comparatively highly rated, although not as highly as the negotiated system. The remaining procurement methods do not find favour with many of the respondent groups.

Insofar as the *cost* objective is concerned, with the exception of the project managers and contractors, the conventional and negotiated procurement systems find the most favour with average rankings of 3 or less. The contractors concur with the merits of the negotiated system, leaving the project managers alone in the belief that they not highly rated in this regard. The project managers appear not to be impressed by either the conventional or negotiated systems. Interestingly, the package deal method is comparatively highly rated by all groups except the quantity surveyors.

The *quality* objective of clients appears best achieved via the use of the conventional and negotiated systems, according to a majority of the respondent groups. Interestingly, the project managers and contractors do not appear to favour the conventional method in respect of quality achievement, the contractors preferring the negotiated form whilst the project managers opt for the construction management approach.

CONCLUSIONS

At least ten different building procurement systems are in use in South Africa at present. The conventional system still predominates, although it is clear that it has lost ground.

It would seem that few of the respondents to this survey have a good understanding of the various building procurement systems and that they would not be able to make recommendations about the advantages of one system over another for a given project. Project managers would seem to be most knowledgable in this regard, and it may be postulated that the growth of this profession has been based upon their knowledge of such systems.

Most advisors and clients use those systems with which they are familiar, and those who seem least inclined to change are architects, engineers and quantity surveyors, the very design team professionals who's advice is most frequently sought by clients concerning the choice of building procurement system.

It is clear from the foregoing that, for most building projects undertaken in South Africa, it is 'good luck' rather than informed advice that resulted in the most appropriate (?) procurement system being chosen for a given project. Arising from this, it could be argued that client objectives are not being attained to the extent which might otherwise be possible. However, because clients are largely ignorant about other procurement options, it is possible that they are blissfully unaware of this fact.

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LINKS BETWEEN INNOVATIONS IN PERFORMANCE MEASUREMENT AND THE PROVISION OF FACILITIES WITH INNOVATIVE TECHNOLOGIES

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Abstract

Ascertaining user preferences and translating these into performance requirements useful in procurement can be both complicated and unreliable. Principles of customer-orientated service management offer an opportunity to deal with a situation where the services of a built facility are imperfectly marketable. Interpreting suggestions and complaints from facility users and translating into contract requirements is one aspect. Moreover, considerations of economic efficiency suggest that criteria for performance should take into account the costs for both owners and contractors in predicting and monitoring performance. Therefore, the incentives for innovative technologies also depend on the scope for innovations in the technology used for measuring performance.

INTRODUCTION

That the development of innovative technologies in construction as well as the use of the best available technologies can be encouraged by clients who increase their use of performance criteria as a procurement strategy is often conceded (Civil Engineering Research Foundation, 1996; Hewlett, 1996). In order to formulate performance requirements in terms of functions, rather than prescriptive methods, and to check whether these requirements are met by contractors, the range of possible methods for measuring performance has to be gone through. Any method of measurement can be characterized by its relation to fundamental preferences, expressed as functional requirements of the client, and by its cost aspects.

A special case is where the client requirements have to be derived at least partly from the preferences of a large number of not well identified users of a facility, either because the initial users are unknown or because there is a significant uncertainty as to the identity of future users. Sometimes the users are identified, but for some reason it is difficult to charge them for the services provided by the facility. User anonymity and lack of pricing of services are often encountered in the public sector, but not exclusively there. The purpose of this paper is to investigate how to link user preferences to the provision of facilities by means of a selection of performance measurements. The context is that of information exchange between parties to performance based contracts, and the specific perspective chosen is that of how innovative technologies are promoted.

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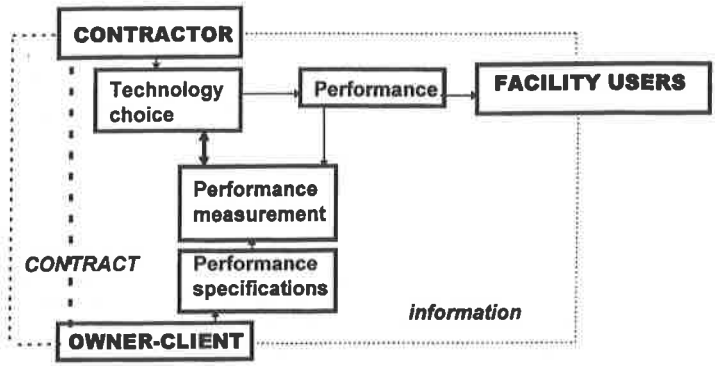

Figure 1. Technologies and flows of information.

Experiences from fully outsourced facility management today include a range from office buildings to roads[1], each sector with its particular sets of service level demands unlike those traditionally dealt with in contracts for new construction. Contracts that cover not just the construction but also at least part of the subsequent management of the constructed facility create the opportunity for continuous learning about preferences and of continuous improvement of fit between preferences and the services provided by the contractor.

Innovative technologies and durability risk

Lack of skills in devising an efficient contractual environment for dealing with durability risk retards the development and acceptance of innovative construction technologies. The concept of innovative technologies refers to methods and equipment used for providing a facilities related service or to embedded technology, something that is built into the facility itself. While it should be in the obvious interest of at least the larger and more frequently procuring construction clients to encourage the development of innovative technologies that provide better performance or at least the same performance but at a lower cost than traditional technologies do, the risk associated with the long term characteristics of new technical solutions for components, systems and structures must be identified and shared in an efficient manner between the parties. The risk to be managed is that there will be unexpected and significant costs somewhere in the life cycle of the facility and that these costs are caused by hidden faults or unsuitable choices of materials and components or poor execution.

[1] Work reported here has been partly financed by the Swedish Transport & Communications Research Board (KFB) under contract 1996-0245 (Road Quality Definition and Monitoring in Maintenance Procurement).

Durability risk can be handled in more than one way. One possibility is to combine design-and-build with an operations and maintenance undertaking for a period of typically between three and seven years. By combining these phases of the process, incentives are created for the contractor to select technologies that lead to a more balanced pattern of resource use over the life cycle of the facility. The alternative of design-and-build combined simply with a long-term guarantee of facility performance is less attractive for contractors, if there are significant opportunities for the client, the users or the environment to cause unpredictable performance losses or damage to the facility during the operations and maintenance phase. Ensuing conflicts about who caused what threaten to be costly to resolve.

A further extension of contractor involvement with a facility is when a concession is granted for a given period, often between ten and thirty years. The growing frequency of Build-Operate-Transfer (BOT) arrangements contributes to the need for looking at how technical risks ought to be shared at successive stages of the project life cycle (Walker and Smith, 1995). BOT concessions often cover facilities where full individual pricing of service qualities is hampered by barriers of technology, which historically has contributed to the role of the public sector as an intermediary between infrastructure users and providers. However, by transferring a longer term risk to the contractor-concessionaire, the need for sophisticated measurement technology decreases for the ultimate owner-client, although the contractor incentive for taking advantage of new technologies does not diminish.

Outline of the analysis

After presenting the underlying economic theory for assessing the efficiency of alternative bundles of methods for measuring performance, the problems associated with dubious validity of many measurement methods leads to a discussion of more direct involvement of facility users in the determination of facility service levels.

THEORETICAL BACKGROUND

The theory of transaction costs provides a framework for identifying efficient contractual arrangements. When applied to the analysis of construction projects (Winch, 1989) it has the advantage of a direct relation to economic efficiency. A further advantage is that this body of theory is independent of the concepts of particular legal systems and lends itself to international comparisons of contractual matters (Winch, 1995). Transaction cost analysis can also be used for predicting effects of improved information technology (Bröchner, 1990).

Cost minimization

Simplifying our task by assuming that performance is totally controlled by the contractor, our task is to minimize the (discounted) sum of production costs and transaction costs:

$$\textit{total cost} = \textit{contract sum} + \textit{contract preparation cost} + \textit{performance measurement cost} + \\ + \textit{conflict resolution cost}$$

This expression implies that relatively costly specifications and measurements have to be weighed against the probable reduction in tender levels, a reduction caused by increased opportunity to utilize cost-saving innovative technologies. Although it means foregoing a potential for new technologies, specifications of appearances and other matters concerning aesthetics, safety or the environment character will tend to be given in a detailed prescriptive format, which is often cheaper both to produce and to measure conformity with.

Dealing with external influences

However, in real life, the contractor will not be able to exercise full control over facility performance, since there are external influences at play. As a consequence, two terms have to be added to the expression: *contractor risk premium* and *external measurement cost*, where "external" stands for the impact of owners, users and other environmental loads. Environmental loads may carry either positive or negative signs, since this term covers factors such as the truly exogenous "outdoor temperature" and the endogenous "soil pollution", where the latter might follow from contractor choice of chemicals used in operating the facility. We may now rewrite total cost as

total cost = contract sum (incl. risk premium) + contract preparation cost +
+ performance measurement cost + external measurement cost +
+ conflict resolution cost

As usual, by means of raising the contract sum by a premium, tenderers can be expected to signal that the intended pattern of risk sharing between client and contractor is perceived as being skewed and inefficient. Where performance specifications under a fixed-price contract cannot be combined with an efficient scheme for risk allocation, it is better to exclude particularly troublesome activities and make them dependent on client/owner *ad hoc* orders, being priced in a separate list initially submitted with other tender documents. Nevertheless, allocating risks and providing incentives to reduce the likelihood of e.g. winter road accidents, where the weather, user behaviour and contractor policies interact, remains a complex matter.

MEASURING PERFORMANCE

It is intuitively obvious that the recent growth of measurement technologies, mostly due to the development of embedded information technology enabling more rapid and precise registration of the physical aspects of facilities, benefits the introduction of new construction technologies. There are novel types of sensors, and integrated monitoring systems emerge.

Three reasons for measuring

According to what is being measured, it is convenient to distinguish between the measurement of facility status parameters, of environmental loads and of facility service levels. Each of these three types of measurement has its own potential for development of technology.

Measuring facility status

A broad range of more or less sophisticated methods are available for the measurement of the physical status of a facility. At one end of the scale, we have rapid checks of the surface appearance of the facility, such as when Wong and Ying (1994) present a system for checking whether maintenance activities have been performed. Slightly more advanced, the comparison of facility appearance with reference photographs or drawings contains an element of subjectivity. Test methods that pry behind or below the surface of the facility structure may be both costly and time-consuming in relation to the value of the facility, especially if it is not intensely used, while providing quantitative data with minimal subjective influences (Lewry and Crewdson, 1994).

To building occupants and other facility users, the measurement of physical status is often of less direct interest than the measurement of services that the facility can provide. For the owner-client, status measurements make it possible to predict costs of future provision of services from the facility, over its entire life cycle (Masters and Brandt, 1989). This is especially valuable for the design and monitoring of contracts where the owner-client is given the option of postponing or accelerating maintenance work over the years, while keeping operational service quality constant. Moreover, facility status is usually subject to more thorough determination before a contract is signed, before the inception of contract work, when retendering approaches and at the termination of a contractual relationship.

Measuring environmental loads

In order to support risk sharing between the owner-client and the contractor, external influences have to be measured. Environmental loads affecting the facility include outdoor climate and intensity of use (number of visitors, vehicles etc. per time unit). On the other hand, operation and maintenance of the facility may give rise to noise, pollution and accidents which have to be monitored to provide incentives for the contractor. The degree of subjectivity in the measurement of environmental loads is comparatively low, although there may be doubts as to the validity of measurements.

Measuring service levels

Rightly or not, engineers and builders are under the suspicion of concentrating on the physical, durable aspects of any facility and of habitually overlooking transient service qualities. Rosen and Karwan (1994) distinguish between six dimensions that together measure service quality: tangibles, reliability, responsiveness, assurance, knowing the customer, access. These dimensions bring forward the importance of timing and mutual information when operating facilities.

Characterization of measurement methods

Methods for measuring facility status, environmental status or facility service levels can be characterized according to Table 1. The characterization serves as a structure for handling quantitative data on transaction costs associated with each method. Costs for the owner-client

and for the contractor, sometimes also for the tenderers, have to be taken into account. Duplication of both measurements and of equipment can be needed to sustain internal incentives for improvement and learning in the contractor organization.

Table 1. Characterization of measurement methods.

A. Resource use • Life cycle cost of equipment • Competent staff	**B. Process characteristics** • Duration of measurement • Duration of analysis and interpretation • Sampling strategy
C. External effects of measurement • Interference with user activities • Environmental effects	**D. Quality of measurement** • Reliability • Validity

Category D in Table 1, Quality of measurement, covers reliability (the consistency of measurements when repeated under the same circumstances) and validity (does it measure what it purports to do? does it measure it accurately?). New and more advanced technologies for measurement have to be tested for their relation to user preferences.

USER PREFERENCES

Determining the validity of any method for measuring performance in a situation with incomplete or no pricing of services is no easy task when there is a great variety of user preferences. A major divide runs between the analysis of revealed preferences of users, studying their actual behaviour in the facility, and the analysis of their stated preferences. Users may state preferences when asked to, periodically or at a single point of time, as in the user satisfaction survey reported by Leifer et al. (1996). Another possibility is when users report their preferences at a time of their own choosing, typically identified as complaints.

Interpreting complaints

Complaints arise when performance is seen as falling short of user (or third-party) expectations. Understanding how expectations arise and how they can be influenced is helpful when analysing complaints and translating analysis insights into better performance specifications together with strategies for information to users and improved interaction with these. User and third-party expectations are probably formed by comparison with

- government regulations (legally defined minimum rights)
- policy statements issued by the client/owner
- policy statements issued by the contractor
- recent experience from similar facilities
- earlier experience from the same facility.

The first three points are in a class apart. The last two sources of expectations are more of a challenge, since they can be influenced by increasing the involvement of users and by judicious provision of information to users. It is noteworthy how sudden and great

discontinuities in service levels system failures may either reduce user expectations for the immediate future or on the contrary raise phenomena above their threshold of awareness.

The frequency of complaints are affected by several factors, in addition to the failure to meet user expectations:

- whether complaints are easy to lodge
- whether there is a culture where complaints are felt welcome
- whether users expect complaints to lead to change.

Developing the feedback structure suggested by Bröchner (1996), complaints have been classified in Table 2. The relative frequency of various types of complaints is also an indicator.

Table 2. Characterization of complaints.

A. Source • User category • Time of complaint	**B. Medium** • Person-to-person contact • Telephone • Fax • E-mail • Letter • Mass media (Letter to the Editor, ...)
C. Object • Tangibles • Reliability (Timing of activity, ...) • Responsiveness	**D. Root cause** • Unexpected endogenous effect (technical breakdown, ...) • Unexpected exogenous effect (snowstorm, earthquake, ...) • Lack of planning • Lack of communication

The last point under the fourth category (D. Root cause) covers lack of communication between the pairs of owner-client/user, owner-client/contractor, contractor/user, user/user, third-party/owner-client, third-party/contractor and third-party/user.

Although attendance to complaints is a useful check in the validity of methods for measurement of facility performance, including the choice of sampling strategies, it is hardly suited as a replacement for services development policy. Quite apart from the value of complaints for checking the validity of measures of quality, the advantages of good management of complaints are obvious to e.g. a large private health care organization (Dingemans, 1996). There is no reason why those who care for built facilities should not learn from other branches of the service sector.

DEVELOPING THE INFORMATION FLOWS

It is not only to enhance their validity that new methods of measurement should be matched by the development of stronger flows of information between users and providers of

facilities. In the absence of information technology support for user pricing, anonymous users should be given the opportunity to learn about the operation of the facility and how resources are allocated. Users may both receive and deliver information concerning existing facilities and their operation. Taking complaints as a starting point, user experiences can generate ideas for a proactive dialogue. There is a number of methods available for drawing customers into planning and implementation (Barkley and Saylor, 1994), even when there is a situation with initial anonymity.

Minimal feedback loops

An important principle is that of reducing the distance covered by feedback loops. One extreme is that of individual control of certain features of the facility. Lack of control as a source of dissatisfaction should be noted: user-operable windows can be important for giving every building occupant at least some control over the private microclimate, just as is increasingly common for lighting. Leaman and Borden (1993) claim that lack of control can be significantly related to ill health symptoms in the office environment. They expect the offices of the future to deliver more types of responsive control to different types of users.

The empowered front-line

As a general principle, complaints should be dealt with as close as possible to the point of service, be very easy to lodge, and receive a prompt response including explanation of how the original situation arose and of how the phenomenon that caused the complaint will be handled. In the owner-client/contractor/user relations, the handling of complaints should ideally be based on direct contact between front-line staff of the service provider and the user. This means that front-line staff must be empowered, in the sense of having access to all relevant information to deal with complaints, and also be able to carry the economic responsibility for action taken.

Relations in the triangle of user/contractor/owner-client can be managed through an administrative system and e.g. monthly meetings where user complaints, other information from users and action taken by the contractor are discussed. It is vital for contractor employees to receive information directly and quickly from users; conversely, the client needs information for future specifications (in performance terms) of standard levels to be used for procurement purposes.

CONCLUSIONS

New technology that promises lower costs or higher quality in new facilities may be tainted by the suspicion that it will give rise to disadvantages later in the life cycle. This is a strong argument for trying arrangements where design and build are linked under a single contract to several years of facility management. However, this extended linking of process phases leads to a strong need for designing the information flows between users and the parties involved.

It is likely that future advances in information technology will increase the proportion of services that can be charged individually, thus reducing the need for indirect derivation of user preferences. This will not happen overnight. Therefore, a crucial principle is that of closely following the emergence of new and better ways of measuring performance. It has been shown that the validity of any exact measurement method must be carefully investigated and compared to more direct signs of user satisfaction. Inspiration should be sought from how other types of facilities are managed - roads can learn from offices, and *vice versa* - and from across the service sector of the economy. By doing so we can help in establishing a contractual climate that encourages technical innovation.

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THE USE OF PERFORMANCE SPECIFICATION IN THE PROCUREMENT OF BUILDING COMPONENTS.

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Abstract:

Though the UK public sector construction is now much diminished, the attempts by UK public sector architects to improve performance in use of completed buildings has stimulated many useful and interesting developments. One of these, the UK Department of Environment, Property Services Agency, Method of Building was an open system of building which allowed flexibility in design and choice of components but by restricting the ranges of components available for use by designers aimed to both save design time, improve standards of performance and reduce costs in use.

The development of performance specifications, appropriate test methods and responses of component manufacturers are described. The legal agreement comprised conditions of agreement, the performance specifications, the product specifications and the price schedules. A co-ordinated set of handbooks consisted of a Library of Working Details, Component Selection Guides, Component Technical Guides, Product Data and associated cost data.

Following changes in government policy, the decision to sell off the Property Services Agency and to compel government departments to use independent consultants for their architectural and associated professional services, much of this useful development has been squandered.

Keywords: ***Public Sector; Performance Specification; Components; Dimensional Co-ordination; Procurement.***

INTRODUCTION

Many have written about the theory of performance specifications in architectural design over many years (see for instance Mainstone et al., 1969). CIB established a specialist commission, W60 - The Performance Concept in Building, in 1970 which has held many meetings and published many reports (see for instance Becker, 1993). None however have considered the powerful stimulus that the performance approach can provide to restructuring the component supply industry and how a major client, by using its buying power and by subtle changes in contractual arrangements, can bring about major improvements in building component performance.

Throughout history, building designers have used subjective experience of past design decisions to imply a level of performance for future designs. With a limited range of materials, tools and techniques, design solutions changed slowly. There was little difference in construction methods used for different building types. We now have an increased specialization and diversification of building types, advances in structural forms and increases in the number of basic materials and the components made from combining them as composites. With this large number of possible choices, it is not surprising that mistakes

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occur in design and materials specification, manufacture and site workmanship. Consequently the desired level of performance is frequently not achieved. Failures of all types have been widely reported over many years in publicly available and widely circulated feedback digests which formed part of the Department of Environment's magazine "Construction." The Property Services Agency made technical information freely available to its employees by means of a "Focal Point", a named contact person designated to receive and disseminate information arising from the agencies work on particular topics.

It was because the Property Services Agency (PSA) of the Department of the Environment *maintained* the British Government's property and land assets at home and abroad that it obtained feedback on building failures. These failures identified areas where designers required technical guidance and where use of tested and evaluated components could make a major contribution to the improvement of performance; for example timber cladding on one estate of Army Officers' housing had to be replaced though less than 10 years old; (Anon, 1978); failure of windows was often found to be due to reliance being placed on manufacturers' claims without positive evidence of performance; in two large multi-storey office blocks complete and costly window replacements were necessary. The evidence was that the apparent freedom of architectural designers to select components from any source when designing was in practice producing buildings that were less than satisfactory. There were more failures due to poor selection, detailed application and workmanship than failures from components themselves. (Addison, 1977). Thus there was seen to be a need for more care in the selection and use of components.

The PSA was probably the most successful pioneer and user of performance specifications where they formed an integral part of the agency's Method of Building (MOB). The system supplemented long established works instructions and the PSA General Specifications, by evolving to be a co-ordinated set of handbooks comprising Library of Working Details, Components Selection Guides, Component Technical Details, and Product Specifications.

PERFORMANCE AND PRODUCT SPECIFICATIONS CONTRASTED

"Performance Specification" as a name for a deliberately adopted method of specifying is only 30 to 35 years old. Previously, a "specification" was understood to mean a Product Specification: there was no other kind. Once the term Performance Specification came into use, the older kind needed a new name to distinguish it. Several alternative names have appeared: "Traditional Specification", "Prescriptive Specification", "Descriptive Specification".

A Performance Specification is a description of the required performance or function of a component, wherever possible in quantifiable terms. Methods of test to prove performance have to be specified and often devised, and levels of achievement viz acceptance levels defined. It does not say what materials must be used or how they are to be put together. A Product Specification describes the materials to be used, workmanship and how they are assembled in terms of current trade practice. The specifier is assumed to have considered the functions and know from experience that what has been specified will perform well enough for the conditions of use. Essentially a performance specification says what the component must **do**, a traditional specification what it is to **be**.

This contrasting of performance and product specifications should not be taken to mean that they are alternatives, diametrically opposed or mutually exclusive. In fact, they are complementary, for a performance specification must generate one or a series of product specifications before anything can actually be made or selected. There may well be a number of stages. First an overall performance specification for the building. Then performance specifications for elements and components. Each of these may split into product

specifications and further performance specifications until finally the whole design is expressed in terms of specific products.

The advantage of starting with a performance specification is that the performance requirements are explicitly defined for each element or component. Test methods and acceptance levels are predetermined for each defined condition. Consequently the effectiveness of new materials or components can be assessed. Innovation can be stimulated by the explicit consideration and identification of requirements. Producers (manufacturers and contractors) have a free choice to make best use of materials, plant, skills and ingenuity to meet requirements economically. Existing components may be assessed for use in changed conditions. The process of forming performance specifications stimulates re-evaluation of solutions rather than unthinking repetition of past solutions merely because they exist. Innovation is not discouraged by the need to play safe by using only constructions and materials known (or hoped!) to be adequate from long experience.

The preparation of performance specifications draws attention to service conditions, consequently unusual conditions should be recognised. Thus the act of forming performance specifications encourages improvement in meeting functional needs with long term economy. Even when a performance specification is fully complete - in specific terms, not just a vague set of hopes - the producer may be faced with a considerable task in developing a product that meets it.

Conversely, starting with a product specification is to imply a performance level, whether the specifier is conscious of this or not. The resulting level may be inadequate for service life conditions or it may be capable of withstanding more severe conditions than necessary but also be more expensive and complex than necessary. Over-specification wastes materials and labour. A further disadvantage of starting with a product specification is that apparently minor changes in construction and materials may have unforeseen side effects, adversely influencing the performance. The opposite mistake is to refuse to allow apparently minor changes for fear of unforeseen consequences.

PROPERTY SERVICES AGENCY METHOD OF BUILDING

In 1968 the UK Ministry of Public Building and Works, annual building programme was approximately two billion pounds per annum (£2,000M) at today's prices (£100 M in 1968 money) of which half related to the actual cost of building, and the remaining concerned external works, and civil engineering (Rabeneck, 1973) Although over 150 named building types appeared in the programme, 75% of the programme comprised: Armed Forces: sleeping quarters, social (messes and clubs), offices, educational building and support workshops; post office facilities such as telephone engineering centres and vehicle workshops, single, two storey and multi-storey automatic telephone exchanges and postal sorting offices; offices to house government departments within the UK and overseas property, embassies and diplomatic quarters.

There was a desire to create an "open" system of building based on a component approach which could be applied to satisfy the building needs of the wide variety of PSA clients in the UK. It was the requirement that MOB should cater for a wide diversity of user requirements which led to its basic characteristics of "openness" and specification by performance. Andrew Rabeneck (1973) wrote "The PSA's building programme is a microcosm of the industry as a whole. While the total national capital injection is fairly constant, with a rising trend, there is a considerable fluctuation in the incidence of particular building types from year to year, which any method has to take into account." Thus 'Method' sought by developing technical guidance and improved building components to overcome the dependence on single building types associated with 'closed' component systems such as

those developed by the Schools consortia, CLASP, SEAC, SCOLA, on the basis of guaranteed annual programmes of buildings of a similar type.

A dimensional framework, a prerequisite for component compatibility, was introduced in 1971. (Addison, 1971a). It rationalised the ranges of dimensions used for components, structures and services. It was based on a controlling framework of 300 mm and a selection of first preference increments. The impetus for this came from two sources, one the general adoption of metric units by the UK Construction Industry, the other the restricted range of dimensions associated with modular co-ordination (British Standards Institution, 1966).

To examine the implications of the dimensional discipline and to demonstrate the close links between research and development, a series of building frames representing the five main types of construction, brickwork, insitu reinforced concrete, space frame roof with steel columns, precast concrete frame and composite construction were constructed at the Building Research Station, Garston. The objectives of Phase 1 were to provide a full scale model as a training aid, illustrating the application of a selected range of controlling dimensions and to show the basic space requirements for certain key components and assemblies together with the junction conditions involving jointing, fixing and tolerances. The second phase demonstrated the implications of jointing, fixings, and tolerances on the work size of components of known cost and performance. Some jointing solutions were presented to demonstrate compatability between components and the inter-changeability of components within different types of structure (Addison, 1971b).

The aim was to aid improvements in design and construction without increasing capital costs while reducing maintenance costs. Thus the PSA Method of Building was developed so that by 1976 (Anon, 1976) it was;

> "a way of thinking and working which aims to achieve economy of operation through the rationalisation and simplification of design and building practice to:
>
> 1. SAVE TIME for design staff and in construction. To shorten the average period spent in design and construction of new works.
> 2. IMPROVE STANDARDS in design and quality of building for initial capital outlay on PSA buildings.
> 3. REDUCE COSTS IN USE by facilitating design decisions which take life, maintenance and energy costs into account.
> 4. IMPROVE FINANCIAL CONTROL of new projects while improving building performance.
> 5. IMPROVE DESIGN EFFICIENCY by obtaining a better return, both in quality and quantity from the professional effort available."

The use of MOB components became mandatory for all designers working for PSA "except where there are compelling reasons for not doing so". This knowledge encouraged manufacturers to participate even without the firm guarantee of a building programme.

Generating Performance Specifications

The Method of Building Component Development team wrote performance specifications and established test methods and acceptance criteria for hardware, windows, partitions and doorsets, because analysis of maintenance reports indicated these components frequently caused problems. Because of the wide range of user requirements, grades of performance were recognised for different applications. This policy avoided the redundant performance (and consequent high cost) implicit in products that can meet all conditions. For example, four exposure grades of window performance were established (Method of Building, 1977).

To determine these performance levels, examples of well known components were purchased by the MOB development group, subjected to test under both normal and abnormal conditions eg. the force of a man being thrown against a partition was analysed and a test evolved to establish maximum acceptable deflections (Method of Building, 1975).

For a period, the Government widened the industry sponsorship role for the development of performance specifications by forming an inter-departmental committee to represent the requirements of health and social security buildings. This committee sought to influence the development of performance standards by the British Standards Institution. Later the PSA programme was extended to include, sanitary fittings, suspended ceilings and platform floors.

The specification document was in two parts. The first part described the performance conditions in which the products would be used (viz those aspects of design discipline relevant to the use of the product); attributes of shape, dimension and weight; non-quantifiable attributes of appearance; physical, chemical and biological properties sought (eg. for door sets a sound Reduction Index minimum of 19 dB with an improved grade of 23 dB measured as described in BS 2750 : 1956); durability, properties of working parts; and working characteristics (eg. ease of handling). The second section described the tests to which the products would be subjected and provided a design specification target for the manufacturer.

Where BS tests existed, they were used, but several new tests had to be developed. For example, the resistance of partitions to changes in humidity was important; a hygro-thermal cabinet was devised to allow testing for **a)** resistance to changes in humidity and **b)** ability to tolerate differential environments. The test specimen consisted of a complete section of the partitioning system measuring 2700 mm x 2700 mm and included two vertical joints. Partitions were pre-conditioned for 14 days at 25°C and 55 - 65 percent RH. Length, height, squareness and "cup and bow" were measured. The maximum deviation in squareness permitted was 0.2% of the shortest diagonal; in cup and bow, 2 mm over 900 mm or 3 mm along a straight edge or diagonal. The partition was then subjected to 25°C and 30 percent RH for 7 days and measurement of deformation taken until movement below 0.005 mm per hour recorded over a 24 hour period. The maximum deviation in straight edge or diagonal length permitted was 5 mm. This was followed by conditioning at 25°C and 90 percent RH for 7 days. Again the maximum deviation permitted was 5 mm. Similar limits applied when the test specimens were subjected to differential conditions of 25°C at 40% RH on one side and at 5°C and 85% RH on the other. (Method of Building 1975a).

Component Procurement

An open tender approach to the building component manufacturing industry was adopted to obtain products from as many firms as possible, to encourage development of new products and to give the best chance of meeting the PSA requirements. In April 1970, advertisements appeared in the national and technical press to alert industry to the fact that tenders incorporating performance specifications would be invited. There were some 500 replies and each manufacture was sent a brief precis of the tender documents and a questionnaire relating to manufacturing capacity, financial standing and examples of workmanship. Questionnaire responses were appraised by PSA and full documentation for tenders sent out to 150 firms who were given three months to respond with a product concept, outline cost information, and more detailed information to establish the firm's long term viability. Often manufacturers submitted details of existing product ranges. Confidential reports on each submitted design and questionnaire were prepared, in which firms were advised of the suitability of their designs and given an indication if suggested costs seemed too high for eventual

acceptance. No firms were turned down at this stage, but many took the hint and did not proceed to the second stage.

In the second stage, detailed designs and costs were required. These were analysed and the more viable proposals determined. These firms were invited to submit prices and evidence to support their performance claims. The firms making the most promising offers were asked to submit components for test by PSA and at stipulated testing houses. Test results were surprisingly poor, for example, more than half of the windows initially selected for evaluation (Hill, 1978) failed to meet the necessary performance requirements despite manufacturers' claims. The most expensive windows did not have the highest performance.

The successful components which passed all the performance requirements, were then assembled on a component rig by the manufacturers' workmen. The rig was used to investigate the compatibility of the components, the practicability of the assembly techniques, quality of workmanship, and the ability to deflect without damage and absorb other tolerance factors. All the successful components were finally judged by a representative panel of design staff. This final evaluation included the aesthetics of the assembly. Successful firms were asked to make minor modifications if necessary to achieve compatibility with products chosen in other categories, for instance between partitions and door sets. The intention was to conclude agreements with the manufacturers of the most successful four or five components which provide the best value for money in relation to required ranges of performance, so as to satisfy designers' needs over a wide range of building types. An added reason for having more than one manufacturer, for example of aluminum windows, was to ensure there were alternative components available should a manufacturer cease to take part. Furthermore PSA was protected from the sort of difficulties that can arise with a single supplier and be assured of competition on service.

The need for a product specification remained. A description of the materials, qualities, sizes of sections, joints used, factory manufacture sequence and site assembly procedure is an essential part of the Method agreement. The product specification described the product that has satisfied the performance specification. Component Selection Guides enabled the correct component for a particular purpose to be chosen. The appropriate product specification was the only specification which needed to be seen by main contractors to ensure that goods delivered and installed were those specified. For generic products such as precast concrete cladding panels and profiled sheet claddings which the PSA records showed generally performed satisfactorily MOB provided Technical Guidance [see for instance Method of Building (1975b)].

Over some 20 years, the MOB system underwent several cycles of development. The programme of selection of internal door sets was undertaken four times, that for windows six times, that for partitions and integral doorsets five times. Thus architectural designers had a choice of windows fabricated in wood, steel, aluminum and PVC from 16 manufacturers and choice of internal doorsets from four manufactures. The partitions programme included plasterboard systems, steel systems and two composite systems, all of which offered various levels of acoustic and fire endurance performance so they could satisfy the requirements of all situations.

It was more difficult to get improvements to sanitary ware and there was only one notable development, the NISA wc pan. The water circulation pattern enhanced its self cleaning properties. Improvements to the quality of hardware for institutional use were required and manufacturers made substantial improvements, particularly in performance of overhead door closers, for which no British Standard tests existed. Weaknesses in compatibility between door furniture and locks were overcome. These two developments resulted in considerable savings on cleaning and maintenance costs.

Component and Contractual Agreements

Agreements were for three-year periods with options for extensions. In essence they were statements of intentions by the two parties - the manufacturer and the PSA. The agreement documents comprised Conditions of Agreement (that would exist between a Main Contractor and a 'nominated' supplier/subcontractor), the Performance Specification, the Product Specification, and the Price Schedule. There was no programme guarantee and the only commitment was that PSA designers would select wherever possible from the selected list of manufacturers' products. They achieved contractual significance with regard to price and terms of ordering only when an order was placed.

The agreement between the manufacturer and the PSA was not a contractual agreement and it remained the main contractor's responsibility, when appointed, to enter into a subcontract with the manufacturer/supplier. The manufacturers were, however, notified of the proposed use of their products at the detail design stage prior to a particular building contract being put to tender. The main contractor for particular projects was normally appointed after traditional competitive tender. Consequently the main contractor became responsible for component performance as well as the workmanship of the subcontractors' operatives as in the normal JCT contracting situation. Clearly as a large and powerful client, the PSA Method of Building Group could bring considerable pressure to bear if the subcontractor/ supplier failed to perform but was not a party to the contract and would not interfere in the normal legal side of a specific contract. The agreements also included conditions which would apply when the PSA placed direct orders with suppliers/ subcontractors. This occurred in refurbishment and similar projects. All information necessary to use products in accordance with the agreement was given in the product data handbooks and reference copies of the agreements were available in all PSA regions and directorate offices.

An important aspect of the Method approach was that components could be easily designed into drawings and specified in bills of quantities. A nominated Prime Cost was included in the bill because all the competitive aspects of pricing had been dealt with in the earlier tender and evaluation process. This provided a major economy of procedure, for once selected the product could be named directly in the project documentation by the PSA design team; any approved component could be selected at the designers' discretion without reference to further authority or competition. A major benefit was that designers could incorporate known details of the components into their detailed production drawings making the building fully designed before going to tender. This is preferable to the common practice of leaving detailed design until after tendering is completed and including large scale detailed design drawings by means of variation orders. The library of working details of dimensionally co-ordinated components ensured that designers adopted sound and tested solutions.

Cost data "blue" books, primarily for use by Quantity Surveyors, contained product descriptions, price schedules for all types and grades available, price variations agreed for delivery to different locations and additions for small value projects and standard wording for P.C. sums and for contractors' profit to be included in Bills of Quantities.

A successful development

The most easily quantified early success of Method was reduced prices from keen quotations reflecting both the potential size of the PSA market and the reduced product ranges with associated reduction in fabrication, assembly and stocking costs to manufacturers. The benefits resulting from reduced maintenance costs, higher standards in design quality, time saved by design teams in selecting components, improved financial control due to reduction in claims because projects are more fully documented at the contract stage and overall satisfaction by the client are difficult to quantify. The feedback gathered is negative in that

failures and not successes are reported; lack of failure must indicate success (Addison, 1977).

There has also been an impact on the private sector. Products developed for PSA are being marketed with supporting test data for use in the private sector. In most cases these perform to higher standards than those implied by previously used product specifications. British Standards for building components are generally product specifications set to allow for the quality attainable by the least able producer, that is to say, a lowest common denominator grade. The Method approach (Addison, 1981) has shown the need for graded product specifications and the British Standards Institution (BSI) (Anon, 1981) has adopted this approach. This has enabled some British Standard products to more fully meet the heavy duty needs of institutional users. Technical input to various Committees of the BSI by staff of the PSA provided a counterbalance to the views of those manufacturers represented who had no wish to innovate.

Bryan Jefferson PPRIBA, Managing Director, PSA Specialist Services, (Jefferson, 1990), emphasised the successes of the initiative.

> *"Method of Building'* has been a way of life in PSA for the past 20 years. Let us remind ourselves of its contribution.
>
> - repetitive defect reports of leaking windows supplied by contractors no longer in business are distance memories;
> - platform floors are now adequate to bear their valuable computer loads;
> - impact damage to doors and partitions has been greatly reduced and there are fewer complaints that soundproofing is inadequate;
> - time and money spent on maintaining these and other MOB items has been greatly reduced."

MOB had made this significant achievement by the long process of developing test methods, defining graded performance standards and assessing manufacturers' claims that their products meet them. But Jefferson also draws attention to pitfalls.

> "However, construction quality is only maintained by continued vigilance. Our clients may not be directly aware of the dangers of departing from MOB standards or have PSA's experience of the direct relationship between capital and maintenance costs."

More importantly, by encouraging designers to consider the performance approach and to accept a dimensional discipline, an open system of component building evolved which encouraged satisfaction of user requirements through skillful design while avoiding the visual monotony produced by many closed systems of industrialised building.

Changed Political Priorities

In a democracy, the elected government will always be judged by its success in implementing its manifesto. In 1979 the Thatcher Government declared its aim to be to reduce the influence of Government on businesses and to free individuals to make their own arrangements for their personal social security. The associated tax reductions were funded by privatising nationalised industries and by reducing the size of government administration. Thus large departments and their associated agencies were prime candidates for scrutiny. The new building work of the PSA rapidly reduced as client departments such as the Post

Office was divided into post and telecommunications. The privatisation of British Telecom reduced the captive client market. The end of the cold war in Europe has been matched by a reduction in armed forces and their supporting facilities. The establishment of freestanding Agencies to implement departmental policy decisions has distanced Ministers from day to day operational control of many former government departments. The agencies have become responsible for maintaining their own premises, primarily using private sector rather than public sector employees. The maintenance function of the PSA and the new building designing activities have all been 'privatised'. Various PSA regional offices and their staff were 'sold' to competing groups of consultants and contractors on assurance of future contracts. The group requiring the least subsidy for taking on the assets and liabilities of the regional PSA offices won! Tarmac was paid £49.6M to "purchase" PSA Projects which included the Method of Building group in 1993 as compensation for future losses and commercial risk, presumably to cover redundancy payments and pension costs to staff who would become redundant when the guaranteed programme of work was completed. Recently the Environment Secretary has told Parliament (Anon, 1997) that an independent expert has recommended Tarmac refund to the government £19.9M plus £2.6M interest. With errors of this magnitude occurring in the negative valuation of these formerly valuable and useful public sector skills and assets, there must inevitably be concern as to the wisdom of the original decision of the government to dispense with its capacity to design, construct and maintain public property assets. An organisation employing 27,000 people, many of them professionally qualified Architects, Engineers and Surveyors supported by experienced Clerks of Works and Engineering Inspectors, has ceased to exist. All associated research and development work discontinued and most of the benefits of this major development squandered for the PSA's former client departments are inexperienced in commissioning building works directly.

CONCLUSIONS

The use of Performance Specifications has been limited by the fact that developing one, complete with test methods and acceptance criteria, for a single class of component or element needs much knowledge, research and judgment; years of work by many people. Consequently, only a few have been developed to a usable form and even these have been by no means universally adopted. Only large organizations, such as the Property Services Agency could meet the costs of time and effort necessary to fully develop performance specifications. Component manufacturers developed products to meet these standards because of the size of the market. This approach provided a major aid to improving the quality (performance in use) of PSA designed buildings.

The benefits to the British building components manufacturing industry were considerable. Not only did the restricted range of sizes enable manufacturers to rationalize their production but investment in product development, improvement and testing became a worthwhile activity. These improved products have been available to all purchasers and have enabled manufacturers to maintain their domestic markets and provided a base for exports. Nonetheless the PSA MOB operated in an open competitive market and many components were supplied by firms based in mainland Europe.

It was the UK government purchasing power as a major client of the UK construction industry that enabled its design agency to influence innovation in component design and manufacture by its procurement policies. The use of performance specifications provided a basis for comparisons of products and prices from competing manufacturers. The changes in Britain dictated by the political priorities of a government determined to reduce the role of the state and the size of the civil service has created a situation in which procurement induced innovation is no longer possible. No single remaining client is large enough to stimulate innovation by price competitive component manufacturers.

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PLANNING FOR DISPUTE RESOLUTION IN CONSTRUCTION CONTRACTS

Sai-On CHEUNG*

ABSTRACT

The purpose of a contract is to formalize transactions. Construction contracts are no exception. A Contract is an essential tool to restate the intentions of the parties with regard to the transaction in question. These intentions in connection with the allocation of obligations and risks are of prime importance and require careful planning. Provision for contingencies is another key element of contract planning. However, any claim for perfect presentiation is futile. Presentiation refers to efforts to make or render present in place or time; to cause to be perceived or realized at present. A certain degree of flexibility, particularly in relation to the performance of the contract, is therefore necessary. This is particularly true for construction contracts. Dispute resolution clauses are included in construction contracts to deal with situations, inter alia, where there are disagreements over the interpretation or the use of such flexibility. This paper examines the characteristics of various types of contracts commonly encountered during the construction process. The governance structures and the potential use of innovative dispute resolution procedures in such contracts will also be discussed.

Keywords: Contract Systems, Governance Structure, Litigation, Arbitration, Alternative Dispute Resolution.

INTRODUCTION

The law of contract can be described as a branch of law which determines the circumstances in which a promise shall be legally binding on the persons making it (Guest, 1986). The American Restatement of the Law of Contracts gives the following legalistic definition: "A contract is a promise or set of promises for the breach of which the law gives a remedy, or the performance of which the law in some way recognizes as a duty." The importance of contract under the promise principle is to secure that the expectations created by a promise of future performance will be fulfilled, or that compensation will be paid for its breach.

In construction projects, the developer purchases the site, more often than not with money borrowed from a financial institution. The developer promises to repay the loan with interest at some future date. The architect and engineer are then engaged to design the work, and the quantity surveyor to prepare bills of quantities. In modern sophisticated projects, a solicitor may also be engaged to do the legal work connected with the development. The construction work will be put out to tender and the successful tenderer will be awarded the contract as main contractor. The main contractor will often sub-contract parts of the work to other contractors called subcontractors. The subcontracting chain may further be extended to the

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direct workers' level, depending on the particular trade and the prevailing industry practice. The performance of these subcontractors depends on the performance of others with whom they may have no direct contractual relationship. Project success therefore depends on concerted efforts of the varies parties involved. Such cooperative endeavors will only be effected if the parties sustain an ongoing working relationship.

FUNCTIONS OF CONSTRUCTION CONTRACTS

In the introduction, a contract has primarily been defined as a promise and serves the function of ensuring access to redresses accorded by the courts if either party failing to keep the promise. Other important functions of a contract include facilitating forward planning of a transaction and making provision for future contingencies.

In planning for a transaction, the first and foremost matter to be dealt with is the value of the exchange. In the case of a contract between the developer and the financier, the values of exchange between the parties are the loan and the interest. In a construction contract between main contractor and client, the values of exchange are the construction work and the price to be paid.

Construction contracts also establish the respective responsibilities of the parties and the standard of performance to be expected of them. Specifications and quality of materials to be used, the contract price and the date for completion of the work are notable examples.

Risks are inherent in every construction contract and would affect project performance. The planning of a transaction through contract enables the risks involved in the transaction to be allocated in advance between the parties. Examples of risk allocation in construction contracts include price fluctuation provisions for inflation/deflation risk, insurance provisions for risks associated with property damage and personal injury.

Planning for contingencies involves the inclusion of provisions to deal with situations if things go wrong. Suppose that the contractor fails to rectify defects when required by the architect or the employer fails to pay for the work which has been certified completed then remedy of determination is available to the innocent party.

Hence, a contract is the instrument by which the separate and conflicting interests of the participants can be reconciled and brought to a common goal. However, this ideal may not be achieved and there exists a practical need of planning for dispute resolution (Macneil, 1975). Transaction characteristics may dictate the type of dispute resolution procedure.

CONTRACT SYSTEMS

Macneil (1974, 1975, 1978) distinguishes transactions into discrete and relational. A three-way classification of contracts, namely classical, neoclassical and relational, is also offered.

Classical contract law enhances discreteness and intensifying "presentiation." Presentiation refers to efforts to make or render present in place or time; to cause to be perceived or realized at present (Macneil, 1978). Classical contract law endeavors to implement discreteness and presentiation in several ways. First the identity of the parties to a transaction is treated as irrelevant. Secondly, formal features take precedence when contested by informal terms. Thirdly, the remedies for nonperformance are narrowly prescribed; hence in case of when nonperformance materializes, the consequences are relatively predictable. Fourthly, third-party participation is discouraged. Therefore the emphasis is on legal rules, formal documentation and self-liquidating transactions (Williamson, 1979). As there is no concern with the relation between the parties when dispute arises, what remains is only a dispute to be resolved. Litigation neatly serves the purpose in terms of dispute resolution.

Complete presentiation, particularly in the ever-changing construction environment, is almost impossible. This impossibility may be due to the unforseeability of the future or the inadequacy of the adjustment provisions. The prospective breakdown of classical contracting leads to neoclassical contracting. Neoclassical contracting is suitable for long-term contracts executed under conditions of uncertainty. These long-term contracts are characterized by the existence of gaps in their planning and the presence of a range of processes and techniques used by contract planners to create flexibility (Macneil, 1975). Third party assistance in resolving a dispute and in evaluating performance often has advantages over litigation in serving these functions of flexibility and gap filling (Williamson, 1979). This idea mainly stems from the procedural differences. In an arbitration, the arbitrator may seek clarification during the proceeding, thereby helping the parties to proceed more intelligently with the case (Fuller, 1963). More significantly, continuity is presumed under the arbitration machinery, and this presumption is much weaker when litigation is employed. Relationship is effectively fractured if a dispute reaches litigation (Friedman, 1965)

Progressively increasing the "duration and complexity" of contracts has resulted in the displacement of neoclassical adjustment processes by other processes of a more thoroughly transaction-specific, ongoing administrative kind (Macneil, 1974). Relational contracting responds to the pressure of sustaining ongoing relations. In relational contracting, by contrast with the neoclassical system, where the reference point for effecting adaptations remains the original agreement, the reference point under a truly relational approach is the "entire relation as it has developed.....[through] time." (Macneil, 1974).

TRANSACTION CLASSIFICATION

Williamson (1979) takes a transaction approach to contract classification. The work of Williamson can be described as the identification of a set of environment factors which, together with a related set of human factors, explain the circumstances under which complex claims contracts will be costly to write, execute and enforce. Faced with such difficulties, and considering the risks that simple (or incomplete) contingent claims contracts pose, the firm may decide to by pass the market and resort to hierarchical modes of organization (Romani, 1986).

Transactions can be characterized by three attributes; frequency with which transactions recur; the degree to which durable transaction-specific investments are incurred, and uncertainty (Williamson, 1979).

Under the frequency dimension, transactions can be classified as one-off, occasional and recurrent. For the attribute of transaction specific, transactions can be non-specific, mixed and idiosyncratic. In a non-specific transaction, the parties' identity bears no relevancy. There is no concern with continuity. Formal features of the contract take precedence over those informal ones. Consequences of non-performance are relatively predictable and not open-ended.

Uncercertainty is another important attribute. In non-specific and one-off transactions, response to uncertain environment can be through establishing new trading relations. The notion of uncertainty is therefore uninteresting. However, at the other end of the spectrum, idiosyncratic transactions under conditions of uncertainty are those where the human and physical assets required for production are extremely specialized. In such transactions, not all future contingencies for which adaptations are required can be anticipated at the outset, and appropriate adaptations will not be evident for many contingencies until the circumstances materialize. Mixed transactions are those between nonspecific and specific.

GOVERNANCE STRUCTURE

In addition to the three attribute characteristics, contract classification can further be enriched by the use of governance structure, a concept which parallels with the contract systems suggested by Macneil (1974). Governance Structure refers to the institutional matrix with which transactions are negotiated and executed. Market Governance is typically analogous to Macneil's classical contracting and is the governance structure for nonspecific transactions, both occasional and recurrent.

Trilateral governance structure applies to occasional transactions, mixed or idiosyncratic. By trilateral, it refers that the two parties to the contract and a third party to assist resolution of dispute and evaluation of performance. It carries the characteristics that neoclassical contracting sought after.

Transaction-specific governance relates closely to relational contracting. For recurrent and idiosyncratic transactions, the specialized human and physical assets become more specialized to a single use, the choice of organizing mode turns on which mode has superior adaptive properties; vertical integration will appear in these circumstances.

A matching of governance structures (together with contracting systems) with commercial transaction characteristic is presented in the following Figure A. The relationship between transactions characteristics and dispute resolution will be examined in the next section.

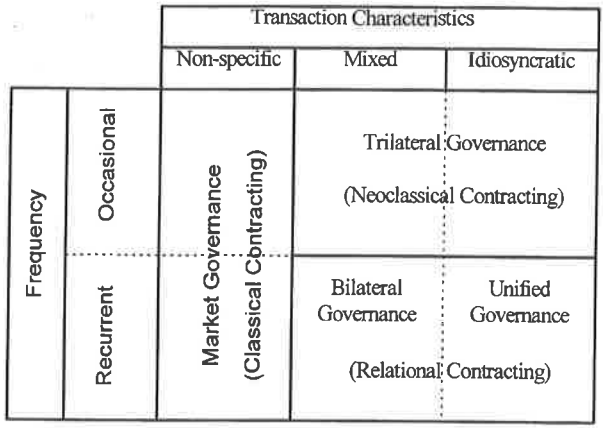

Fig. A Matching Governance Structures with Transaction Characteristics (After Williamson, 1979)

TRANSACTION CHARACTERISTICS AND DISPUTE RESOLUTION

Figure B presents the interrelationships between the contract systems, transaction characteristics and dispute resolution processes. Under the Classical contract law, litigation is the dispute resolution method. Transactions under this contracting system are characterized by 'sharp in by agreement and sharp out by performance'(Macneil, 1974). Litigation is employed to ensure the parties keep their promise.

Under neoclassical contracting, the reality of incomplete presentiation is acknowledged and planning for flexibility and gap filling becomes important. Arbitration has evidently been employed in construction to fulfill this gap filling function. The desire to continue with the relation while disputes are being referred to arbitration characterizes transactions under the neoclassical contracting system.

As the transaction cost between the parties increases and the investment characteristic moves towards idiosyncratic, vertical integration is favored over trading. The growth of relational contracting responds to this sort of situations. Preservation of relationship is of prime concern. The changes in the last twenty years in the construction industry in connection with the innovations in procurement methodologies such as partnering, are notable illustrations.

Total integration involves the establishment of design office and contracting arms within a developer organization. This may not be the common form of integration observed. Moreover, developers tend to use the same design consultants and contractors repeatedly. The need to minimize transaction costs have prompted some coalitions (the client, contractor and subcontractors) to remain constant across a series of transactions (Alsagoff & McDermott, 1994).

Employing the dimensions used in Figure A to describe transactions and the relation between contract law and dispute resolution process, it is possible to consider the type of dispute resolution process to be used in the light of transaction characteristics. Such an integration is provided in Figure B.

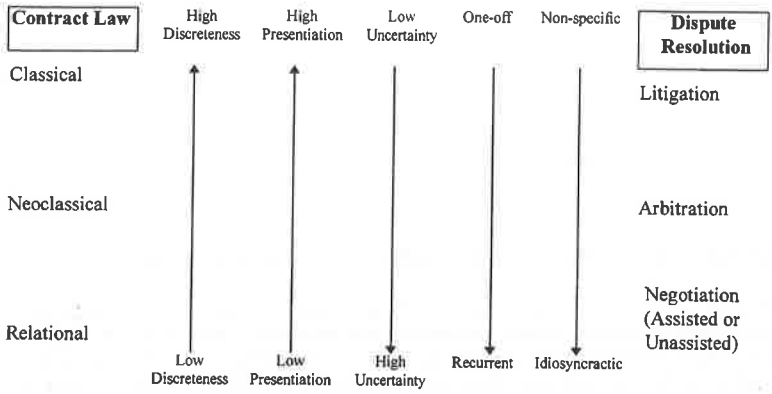

Fig. B Transaction Characteristics and Dispute Resolution

CONSTRUCTION CONTRACT CHARACTERISTICS

For the discussion of planning for dispute resolution for construction contracts in this paper, the types of construction contracts commonly encountered during the construction stage will be discussed.

The relationship between contractor and developer has undergone a tremendous change over the years, shifting from the simple provision of craftsmen's service to nowadays full range of services including design and construction. As project complexity increases, in both scale and technicality, the barrier to entry for these segments of the market increases. The number of contractors capable to deliver such a comprehensive service is not large, so that the frequency of transaction between prospective developers and these contractors tends to move from

occasional to recurrent. As the relation between the parties began to develop, the transaction specificity changes towards an idiosyncratic type. The governance structure moves from bilateral to unified. The arrows in Table A indicate the moves described.

Contracts between main-contractors and domestic subcontractors are similar to those between the main contractor and developer except the element of uncertainty. Uncertainties mainly arise from the risks associated with the contract. Nowadays employers are shifting more and more risks towards the main contractor in contracting. Theoretically, main contractors similarly shift the risks towards the domestic subcontractors. However, because of the difference in scale of operations, the effectiveness of such shifting of risks towards domestic subcontractors is questionable.

In both cases, the shift is from neoclassical contracting towards relational contracting, and the corresponding dispute resolution procedure should emphasize continuing relationships. Alternative dispute resolution, which in essence, a form of assisted negotiation, is advocated for use.

The situation between main contractor and nominated subcontractor poses a different scenario. Duncan Wallace (1995) describes the situation and notes that there is no risk to a main contractor in entering into a nominated subcontract, as nominated subcontractors are chosen by the employer, and the main contractor has little control over the choice. The frequency of transaction between the main contractor and the nominated subcontractor is expected to be at the most occasional, if not one-off. The transaction is non-specific with a market governance structure. As project complexity increases, effecting a narrowing of the choices available, a move towards a mixed or trilateral governance situation is expected. These characteristics typify classical contracting, moving towards neoclassical as project complexity increases. Hence arbitration is the preferred choice.

Contracts between subcontractors and workers carrying out the work are usually short in duration. The workers receive payment on completion of the work packages. These packages are usually small. Some are even paid daily as the job progresses. Each payment signifies the completion of one transaction. The identities of the subcontractor and the workers bear no relevance and the transaction is purely governed by the market. These transactions carry the characteristics of the classical contracting system. There is little in them to be presentiated and dispute is not anticipated; any argument would be on the promise itself. Though litigation is not usually perceived, nevertheless, it will theoretically be the dispute resolution tool for the parties.

The above analysis is obviously subjected to variations, be it regional, cultural and institutional. However, transaction characteristics provide the reference points for the choice of dispute resolution process.

The characteristics of construction contracts can be summarized in the following Table A:

Table A Construction Contracts: Transaction Characteristics

Contract Type		Main Contractor - Client	Main Contractor - NSC	Main Contractor - Dom. Subcontractor	Dom. Subcontractor - Labourer
Uncertainty	Low		↓	↓	↓
	Medium	↓			
	High				
Frequency	One-off		↓		↓
	Occasional	↓		↓	
	Recurrent				
Transaction Specific	Non-specific		↓		↓
	Mixed	↓		↓	
	Idiosyncratic				
Governance Structure	Market		↓		↓
	Trilateral				
	Bilateral	↓		↓	
	Unified				

PLANNING FOR DISPUTE RESOLUTION

The use of Figure B and Table A in the planning for dispute resolution in construction contracts is illustrated in Figure C.

Contract planning, like any other planning function, requires a systematic approach. A systematic approach advocates a logical and holistic view in dealing with problems. In such an approach, objectives and alternatives are carefully considered. Figure C illustrates a systematic contract planning process.

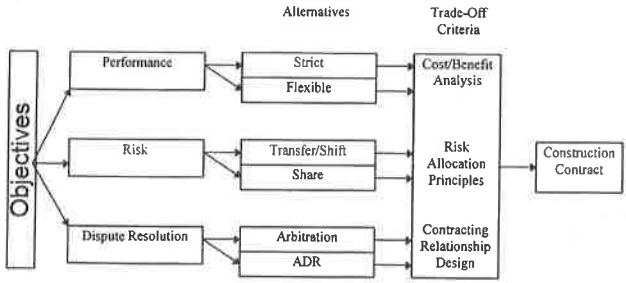

Fig. C A Systematic Approach to Contract Planning

In construction contract planning, objectives can be expressed in three essential aspects: the performance of the contracting parties, the treatment of risks, and the planning for dispute resolution. Performance such as time, cost and quality can be strict or with certain flexibility allowable. Risks associated with the required performance are allocated through contract documentation. Dispute resolution provisions are in place to provide a mechanism to resolve differences that may arise. A thorough planning involves the examination of the alternatives available in each of the planning aspects; each alternative carries its own merits and demerits and requires proper evaluation. The choice of the available alternatives can be evaluated in the light of economic (cost/benefit analysis), equity (risk allocation principles) and relation (contract relation design) considerations. Planning for dispute resolution should take into account transaction characteristics, particularly where the objective of preserving relationshipd is to be attained.

CONCLUDING REMARKS

Planning for dispute resolution is a vital part in contract planning. Considerable effort has been put into the drafting aspect to avoid disputes. This is very much under the influence of classical contracting. The acknowledgment of gaps necessitates a rethinking in the approach of dispute resolution planning. Reliance on litigation ignores economic reality. Alternative dispute resolution, as a form of assisted negotiation, has gained tremendous momentum in the last two decades and appears to be matching well with the growth of relational contracting. The framework discussed in this paper employs transaction characteristics as the reference points for planning the type of dispute resolution process to be used in varies types of construction contracts.

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THE FAST TRACK APPROACH TO REAL ESTATE FEASIBILITY ANALYSIS

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KEY WORDS

Discounted cash flow models, feasibility analysis, property development and investment, spreadsheets.

ABSTRACT

The paper investigates a feasibility analysis model which aims at promoting quick and accurate decision making at the procurement stage. The model makes use of discounted cash flow techniques and includes all income and expenditure affecting the cash flow of the building, the reversion at the end of the holding period, the calculation of the full range of property decision making ratios, the capitalisation of income and calculation of market value for comparison with development costs and equity inputs. This process involves teaching and training property and construction analysts the theory and application of feasibility analysis and spreadsheets.

The speed and flexibility of currently available spreadsheet programmes and of modern computers, allows for quick and accurate decision making, while allowing for the comparison at the procurementn stage of a variety of alternative properties that could be developed. In the process, differences in the timing, amount and certainty of receipts over the holding period for different properties are compared. In addition, use of a fast, high quality printer, enables the client and the analyst to print out a variety of alternatives for the subject property and the alternative properties. These alternatives could allow inter alia, for changing of interest rates, rentals and building costs to gauge their effects on project feasibility.

INTRODUCTION

In the competitive world of property development and investment, developers need to be one step ahead of the opposition in order to profit from available opportunities. Furthermore, developers are required to be more professional and more knowledgeable than ever before, since the amount of data to be collected and the number of calculations to be performed for an accurate feasibility analysis are often vast for a commercial building, or a shopping centre.

Fortune magazine (18 May 1992, pp. 46 - 59) also sounded a warning against neglecting to survey the macro and micro environments. Injudicious development of the property markets in the early nineteen nineties returned vacancy rates averaging 18,8 percent in the United

States of America, whereas in 1981, the average vacancy rate was 4,8 percent. Furthermore, in isolated cases the situation was so bad that brand new 50 storey office complexes had individual vacancy rates of between 50 and 100 percent. The problems experienced at Canary Wharf in London are also mentioned. Moreover, the property development process does not occur in a vacuum, as both the macro environment and the micro environment affect the destiny of property developments. Horne (1978, p. 13) lists these macro and micro environmental factors as:

UNCONTROLLABLE FACTORS

- World economic situation.
- National socio - political factors.
- National economic factors.
- Government legislation.
- Legal factors.
- Financial position & size of company at a given point in time.
- Short and long term business confidence.
- Town planning and local building legislation.

CONTROLLABLE FACTORS

- Property type and quality.
- Property Location.
- Price, Rent Costs.
- Timing and Promotions.

Accordingly, property and construction analysts need to be encouraged to think in a rational manner and follow the total approach of considering all the factors affecting the development of the proposed subject property when preparing feasibility analyses. They need both a strong theoretical as well as a thorough practical grounding in the application of real estate and computer spreadsheet theory and practice. The background information required for the model as well as the framework for the model forms the rest of this paper.

EVALUATION OF THE APPROACH

A rational approach to investment analysis

Approaches of investors to investment analysis range from being cautious and analytical, to the seat of the pants / gut feeling type management decisions. Furthermore, the investor, according to Mckeever (1968, p. 5) "may be gifted with strong hunches and good horse sense, but he is better equipped when he has definite facts at hand". Moreover, Barrett and Blair (1987, p. 6) point out that even though, "the market study is perhaps the most important single element in the planning process.", yet developers often gloss over this important area in the investment analysis process. Consequently, what is required is a rational approach to investment analysis, incorporating a series of steps for the gathering of information, analysing the information and taking a decision on the basis of this analysis. The result is that the characteristics of an investment property are considered objectively and related directly to a particular investor's needs.

In addition, of utmost importance to all investors in this process according to Greer and Farrel (1988, p. 17) are amount, timing and certainty of revenues, as the investor is faced with an array of alternatives for which he has to determine relative investment values. Maritz (1983, p. 288) also provides a framework for the investment process which includes; an analysis of the needs, requirements, objectives and resources of the investor, an investigation

of the availability and price of borrowed capital (financing), a physical inspection of a selected property, or selected properties, the qualification of the productivity of a selected properties, or a selected property, the calculation of the investment value to the specific investor of one, or more selected properties and the evaluation of the market and of external factors that influence the value of a selected property, for both present and future decision-making.

Key stages in the development process

According to Barrett and Blair (1987, p. 8), the development process comprises the following key stages

Stage 1. Initial planning stage of the project embraces four phases comprising

Phase 1	Formulation of the developer's objectives,
Phase 2	Conducting a market analysis,
Phase 3	Preparation of a financial feasibility study and
Phase 4	Taking a decision on whether to continue with the project, shelve it until a later date, or abort it completely

Stage 2. Acquiring the land - an option can be taken on the land at an earlier stage
Stage 3. Developing the land
Stage 4. Constructing the building / s
Stage 5. Marketing and leasing space and / or units
Stage 6. Setting up a property management and maintenance system.

It is important to note that some of these stages could run in tandem with other stages. For example marketing of a development often commences before construction of the building process. Therefore, what is of importance to note is that these stages, according to Graaskamp (1970, p. 11), could differ in sequence according to whether the ***use is known*** and the site is to be determined, whether the ***site is known*** and the use is to be determined, or whether ***an investor is looking for involvement in the two above options.*** Other factors include; the type of development i.e. township development, or shopping centre development where tenant mix is of prime importance (Stevens, 1991, p. 7) and the magnitude of and complexity of anticipated project, and especially where the initial planning stage could vary time wise; according to Graaskamp (1970, p. 5).

Defining feasibility

Though there are many definitions of feasibility analysis, Messner, Boyce, Triblehorn and Ward (1977, p. 14) suggest that "**A Feasibility Study** is a study to determine the probability that a specific real estate proposal will meet the objectives of the developer and / or investor." This definition will suffice, as it is short and to the point. Graaskamp (AIREA, 1977, p. 215) also recommends the following components should be included as a framework for total feasibility analysis:

1. Objectives of the enterprise for whom the feasibility should be performed
2. Market trends to identify opportunity areas consistent with objectives
3. Market segmentation for merchandising targets

4. Legal political constraints
5. Aesthetic-ethical constraints
6. Physical-technical constraints and alternatives
7. Financial synthesis of proposed enterprise form.

Graaskamp (AIREA, 1977, p. 215) also adds that " The essence of a feasibility determination lies in correctly defining the objectives which the solution must serve, and the context or standards wherein an acceptable solution must be found." Only then is the analyst in a position to take a decision on the degree of consensus between external factors affecting the decision to be made and the internal ability to achieve individual objectives in the real estate enterprise.

The remaining stages in the development process

The remaining stages consisting of acquiring the land, developing the land, constructing the building/s, marketing and leasing space and / or units and setting up a property management and maintenance system, are clearly of importance and not to be neglected.

GATHERING THE INFORMATION

Resources of the investor

With the acquisition of investment properties, large quantities of equity / own capital is often required and it is therefore important for the investment analyst to ascertain the resources of a potential investor. Bearing the above in mind, Maritz (1983, p.290) lists the typical questions that should be answered as; how much equity capital is available for investment, what is the maximum amount that can be invested in a single property, is there sufficient cash to obtain possession and transfer of the specific property, will there, for example, be sufficient money available to pay transfer duties, conveyancers fees and mortgage bond registration costs, what other financial assets are there that can possibly be employed to carry the property, either temporarily, or permanently, what appropriate non-financial resources does the client / developer possess, e.g. know-how to administer the property and to what extent is the investor willing and able to take in partners for the intended investment?

Investor needs and objectives

The investor begins by conducting an analysis of his own needs on the basis of which he then formulates his own criteria for selecting and evaluating investment opportunities. However, though needs differ with investors, they can according to Maritz (1983, p. 290), be formulated in terms of the following considerations, namely; expected yield, or return on capital, liquidity of the investment risk attached to the investment, income tax considerations and management requirements of the investment.

Management Requirements

The first step according to Barrett and Blair (1987, p. 8) is to define the developer's (or investor's) goals and objectives which are obtained through discussion prior to establishing uses for sites or sites for uses. Furthermore, the objectives will differ; as the private investor will be driven primarily by the economic principle while government bodies and welfare organisations will consider the social costs versus the social benefits as well. For "To plan,

design, and build outside the constraints of market-determined supply and demand forces is to court disappointment and financial disaster, for both the developer and the consultant" (Barrett and Blair, 1987, p. 9).

At this stage, the investor needs to assess and define his financial, managerial and technical capabilities for comparison with the scope and objectives set for the project. A further consideration would be the assessment of any community and political resistance to the project, particilarly regarding it's size and impact. In addition, management systems for controlling maintenance and security are most important, as many of the costs incurred on the inside of the building such as maintenance, electricity and water costs are passed on to the clients, who then become more careful about services they pay for themselves.

Financing possibilities

Once the investor's available equity, resources and investment needs have been identified, it is necessary to determine whether there is adequate additional finance or borrowed capital available, especially in a high interest rate market, since an investment property cannot be considered by an investor unless the required finance is available and the financial conditions fall within his acceptability limits. Therefore, in terms of borrowed moneys or loan capital the analyst needs to fully understand and become aquainted with the instruments of finance, such as, mortgages, leases, the sources of finance, the costs associated with the acquisition of finance and the conditions and procedures relating to such loans.

Physical inspection of a selected property

Before taking the final decision to purchase the subject property, the investor usually conducts a thorough physical inspection to ensure the property meets his objectives and requirements. Furthermore, besides the state of the property market and general prevailing economic conditions, the most important factors influencing the net income of a property (Maritz, 1983, p. 300) are the utility, or productivity generating attributes which consist of; the physical nature of the land and improvements, the location of the property including its exposure and convenience networks, the institutional attributes of the property, and the stae of the national and local economy. Moreover, the evaluation of these utility-generating attributes (market value contributing attributes) are the object of a physical inspection of the property to enable the investor to reach a conclusion regarding the nature, amount, quality and other relevant aspects of the yield which the property can provide in competition with alternative properties.

Non-financial Requirements of the investor

Investors often have their own special requirements for properties which are required by their company policy, or due to past experience in this field. However, these requirements, though they may not be easy to measure financially as applied to the possible advantages they generate, could include; special space configurations to promote efficiency and productivity, special work environments to promote worker well being, environmentally friendly approaches to the building, saving trees on the site, architectural styles in terms of company image, tenant selection and tenant mix in terms of centre image. They all need to be considered by the analyst, or by the developer.

ANALYSING THE INFORMATION

Framework for analysing investment information

On completion of the collection of all necessary and relevant information to conduct an investment analysis, the next step is to place a monetary value on the current and possible future services or benefits that the property can produce. However, such an analysis should not just be of a quantitative nature, but also of a qualitative nature.

Qualitative analysis

Qualitative analysis of investment information involves the evaluation of the micro market and the external macro market that may influence the value of the property; as previously pointed out, the value of a property is a function of the utility-generating factors of the property which incorporates land and improvements, location and institutional attributes, the market, and external economic, social and political factors. All of the above factors must be analysed by the investor prior to finally deciding whether to purchase the property or not.

Quantitative analysis

Maritz (1983, p. 302) states, that the net monetary income which can be yielded by an investment property consists of the income stream, or net operating income obtained from running the property as a going concern i.e., the monthly income accrued from the letting of space in an apartment block, office complex, or shopping centre, and / or the reversion or income obtained from the refinancing or sale of the property when its market value increases. Furthermore, Maritz also points out that the yield on the investors' equity, or own capital can be further increased by taking advantage of income tax benefits / tax shelters and financial strategies. Income tax shelter are available to developers of certain types of real estate such as hotels, industrial properties and newly constructed blocks of flats up for lease) and financial benefits result from the use of borrowed capital, or leverage.

The two most important methods used by investors in the market place to quantify the income stream are the normalised income for the first year, or the actual operating income stream over a projected period, while the reversion on the other hand is the net income that can be obtained from the resale of a property at the end of a projection period. In addition, depending on the needs of the investor, calculations can be performed at 3 levels of sophistication (Maritz, 1983, p. 302), namely quantification of the productivity (income stream and reversion) of the property alone (i.e. prior to the employment of borrowed capital and in the absence of income tax considerations), quantification of the before tax productivity of the investor's equity (i.e. after the employment of borrowed capital but before the payment of income tax), and quantification of the after-tax productivity of the investor's equity (i.e. after the employment of borrowed capital and the payment of tax).

The components of the discounted cash flow model

The components of the discounted cash flow model consist of the Operating Income Statement which represents the cash flow of the prospective property and should be projected over the holding period of the building with the important items to calculate in the operating income statement including at least; Annual gross rental income, Effective gross income,

Calculation of Net Operating Income, Normalised Before-Tax Cash Income and Normalised After-tax Income. The reason for projection according to Greer and Farrel (1988, p. 111), is that "The economic desirability of an investment proposition is strictly a function of the amount, timing and certainty of after-tax cash flows."

The Resale Return to the Investor Table is the next important component as according to Maritz (1983, p. 310), there are two principal types of value that must be distinguished in investment analysis, namely, the utility or use value of the property for a specific owner / user, and market value i.e. the value for which the property can be exchanged in the market place for money, or the price that a willing buyer will pay to a willing seller in the market. The resale return to the investor calculations are therefore important, in that they supply data for the calculation of various real estate investment ratios / measures as well as allowing for comparison between development cost and market value. In addition, the present values of the cash from reversion can be calculated over the holding period and can be compared with the initial equity inputs.

The following items could therefore be calculated over the holding period of the property; Capitalisation Rates, Market Values, Effective Gross Proceeds from the Sale (Reversion), Before Tax Net Worth, After Tax Net worth, Justified Present Value of Equity Capital and Justified Present Value of the Project.

MAKING THE DECISION

The investment decision

The investment decision taken by the investor is based on analysis of both quantitative and qualitative information and on the buyer and seller agreeing on the price at which a property will change hands, as well as on the conditions of sale. Furthermore, the price agreed on in any transaction is influenced by knowledge about the property and by the negotiating abilities of the parties concerned and therefore, according to Maritz (1983, p.318), once the investor has analysed his needs and resources, investigated the availability and price of finance, analysed the utility of the property, quantified the productivity of the property, determined his investment source and evaluated the market and external factors that can influence the value of the property, only then does he decide on whether or not to purchase the property.

Qualitative versus quantitative decision making

Whereas quantitative decision-making in investment analysis is largely based on the use of financial decision-making ratios, qualitative decision-making hinges on aspects such as the opportunity costs of capital, the utility value of the property to the investor, his specific needs and resources, the evaluation of the market and economic, social and political factors, the availability and price of external finance, tax considerations and risk perceived, and, while quantitative decision-making ratios may assist in indicating the feasibility of a project, qualitative information may preclude the investor from initiating the investment project.

Quantitative decision making

There are numerous quantitative decision-making ratios which can assist the investor in arriving at objective decisions concerning an investment project and therefore for the

purposes of this paper, the ratios / measures that are part of the model under discussion are; Debt : Equity ratio, Loan : Value ratio, Debt Coverage Ratio, Gross Income Multiplier, Net Income Multiplier, Operating ratio, Break-even ratio, Overall Capitalisation Rate, Return on Equity Investment Before Tax, Return on Equity Investment After Tax, Return on Total Investment, Broker's Rate of Return, Payback Period, Profitability Index, Present Value, Net Present Value (NPV) and Internal Rates of Return (IRR). These ratios can be found in more detail in many real estate text books, though they are often labelled with different names / descriptions. Greer and Farrel (1988, pp. 133, 232 - 238 and 275 - 287) describe these ratios / measures in sufficient detail.

THE FAST-TRACK APPROACH

The above process involves teaching and training property, construction professionals and students in real estate theory as well as the theory of spreadsheets. In addition, real estate investment theory is best applied by engaging students in simulated and real life projects where the students are required to; choose a real development project in progress, give an overview of the development process applied to that project, give an overview of the feasibility methodology to apply, conduct a market analysis for the project and then, produce and execute feasibility analysis for the project which, includes a spreadsheet that covers the expected holding period of the building. Furthermore, providing students with spreadsheet print-outs of non-feasible projects and expecting them to seek solutions is a another method of applying the theory they learnt and thereby assisting them to understand the problems involved in the quest to produce a better solution.

The above project invariably ends up being a mini dissertation of 80 to 100 pages with a spreadsheet of between 180 000 and 250 000 bytes. In most cases the work is of a high standard. The spreadsheet too, is best learned by teaching students the theory in a computer laboratory and then expecting students to write their own spreadsheets for this discounted cash flow based model. In this manner students are assisted to understand each formula they use as well as the structure of the spreadsheet they have written.

The student / analyst is now also in a position to compare the subject property with a variety of alternative properties that could be developed at procurement stage. In the process, differences in the timing, amount and certainty of receipts over the holding period for different properties are compared and the use of a fast, high quality printer, enables the client and the analyst to print out a variety of alternatives for the subject property and the alternative properties. These alternatives could now allow the analyst and the client to adjust building and land costs, equity and loan inputs to maximise leverage, play with interest rates, floor areas and rentals as well as any other factor which may affect the feasibility of the property.

Another key factor in educating and training students in feasibility analysis techniques, is that of ensuring that the student understands how real estate ratios are compiled as well as the meaning of the answers the real estate ratios produce. Furthermore, a thorough understanding of the time value of money and of concepts such as internal rates of return and net present values, as well as the results they produce is essential. Understanding the meaning

of the formulas and ratios is essential for the quick and accurate interpretation of spreadsheet results. So too, is the understanding of the formulas used on a spreadsheet and the manner in which the discounted cash flow model has been constructed on the spreadsheet.

Lastly, knowing how to advise the client on how to improve, or maximise the feasibility of the project without unrealistically manipulating the inputs is of paramount importance to assist the developer to make speedy decisions at procurement stage. However, the key lies in the method used to train and educate the student and the end result is an analyst who can produce multiple alternative feasibility studies accurately and speedily.

CONCLUSION

This paper looks at the pre-requisite inputs required for a feasibility analysis model which aims at promoting quick and accurate decision making at the procurement stage. Furthermore, the model is one which can easily be taught to prospective analysts and is easily applied to any income generating property in the fields of commercial, industrial, retail, or hospitality sectors of real estate, by making minor adjustments to the income and operating sections of the spreadsheet.

In addition, real estate feasibility analysis can be complex and time consuming because of the large amount of information required and the many calculations required to be made and because the value of a real estate project extends for the holding period of the owner. This holding period often extends for many years past the first years capital input and therefore, the ensuing years bring in income and incur inter alia, running costs and maintenance expenditure, while the resale at the end of the ownership period also requires reckoning. Consequently, since the calculations extend over a number of years they invariably relate to more time and cost on the part of the analyst and a spreadsheet model becomes one of the viable methods of promoting speed and innovation in the procurement decision making process.

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THE 'TENDERING CONTRACT': FAIRNESS, EQUALITY and INNOVATION

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Abstract

This paper considers judgments in New Zealand and Canada where the court reviewed a public authority's duty of fairness to all tenderers and how this duty is breached by accepting an 'alternative tender' which does not conform to the relevant procurement code. In both cases the alternative proposals accepted go beyond the scope of the original invitation to tender. The paper then reviews procurement systems on these points and fails to find any one right answer to the problem. The paper concludes with guidance on how a contractor's innovatory proposals might be handled without breaching the owner's obligations to other tenderers.

Keywords: Bids, Tenders, Innovation, Alternative tenders, Fairness, Equality, Law.

1. Introduction

For many years an invitation to tender was considered to be no more than an invitation to treat, creating obligations for neither party. The owner could reject or accept tenders as it pleased,[2] or could negotiate with one or more tenderers to produce a satisfactory deal. Generally the owner was unrestrained in how tenders were assessed and the award of contracts made. But recent developments show the courts are much more prepared to regulate the tendering process.

2. The 'tendering contract'

The Supreme Court of Canada first established the principle of the 'tendering contract' in the *Ron Engineering* case. Giving the judgment of the court, Estey J said:

> "There is no question when one reviews the terms and conditions under which the tender was made that a contract arose upon the submission of a tender between the contractor and the owner. ... This contract is brought into being automatically upon the submission of a tender"[3]

It was necessary to find obligations in contract between the parties at this stage, prior to the formation of any construction contract, in order to maintain the integrity of the bidding system.[4]

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[2] *Spenser v. Harding* (1870) LR 5 CP 561.

[3] *The Queen in Right of Ontario et al v. Ron Engineering & Construction Eastern Ltd* (1981) 119 DLR (3d) 287, 272.

[4] *Ibid., per* Estey J at 273.

3. The Pratt Contractors case, New Zealand

Pratt Contractors Ltd v. Palmerston North City Council[5] highlights the problems for owners associated with 'alternative tenders' and the 'tendering contract'. The plaintiff contractor sued the local Council for damages because it did not obtain the contract. The wide range of issues between the parties arising out of this case have been commented on previously.[6] Here the issue is how to deal with 'alternative tenders' so as to permit contractor's innovation within a regulatory framework[7] which demands fair and equal treatment for all bidders, whilst not unduly restricting the scope for any tenderer's innovative solutions to the owners' requirements.

Four conforming tenders were received. Pratt Contractors submitted the lowest conforming tender and on the basis of the contract award criteria, set out above, expected to be awarded the contract. But another tenderer, Higgins, submitted an *alternative tender* in addition to its conforming tender. Tendering procedures had contemplated alternative tenders, which might be permitted as a means of encouraging or permitting innovation. Proposals for alternative construction methods or choice of materials could be considered but such proposals must not alter the scope of the final product. Higgins' alternative tender outlined a different design solution which would achieve the same product: "the saving in the construction costs would be in the order of $250,000."[8] Certain other claims were made for the alternative scheme and Higgins concluded: "We would be happy to meet and discuss this proposal or forward any further information you may require."[9]

The saving in price offered by the alternative tender was attractive to the Council. After some negotiation over the exact status of the alternative tender, the Council accepted same and advised the other tenderers of the contract award decision. When matters were fully resolved a formal contract was executed between the Council and Higgins, the submitter of the alternative tender. Pratt commenced proceedings against the Council.

The New Zealand High Court held that there was a contractual relationship between the Council and Pratt Contractors formed when Pratt submitted a conforming tender in accordance with the Council's stipulations. This contract is described here as the 'tendering contract' to distinguish it from any construction or engineering contract that may result from the tendering process. The 'tendering contract' obliged the Council not only to treat all conforming tenders equally and fairly, but to abide by its own stipulations. But the Council was not in breach of the 'tendering contract' in failing to award the contract to Pratt because it had submitted the lowest conforming tender. The Council rightly relied on words which footed the tender form to avoid this obligation: "the Principal is not bound to accept the lowest or any tender he may receive".[10]

The court then had to consider whether Higgins' alternative tender was a conforming tender capable of acceptance within the Council's tender conditions. Pratt argued that the alternative tender was not a tender at all because it lacked certainty of price, and that it did not meet the specific requirements laid down in the tender conditions. The language used in the alternative tender was too vague on which to found a contract. A saving of $250,000 was

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5 [1995] 1 NZLR 469, in the New Zealand High Court, Palmerston North.

6 See CIB-W65 Conference Proceedings, Glasgow 1996, vol.2, pp.391-402.

7 Both in statute and common law.

8 Reference to the alternative tender letter, [1995] 1 NZLR 469, 473/15-38.

9 *Ibid.* at 473/37-38.

10 This obligation disclaimer is frequently referred to in Canada as 'the privilege clause'.

mentioned, but not as a price, merely as a 'saving in construction cost'. The figure was not given definitively, but put 'in the order of'.

The court agreed with Pratt's argument. If Higgins' conforming tender had been couched in the same vague terms as their alternative tender, it would not have been considered to be conforming: "in any event [the alternative tender letter] refers to a saving in construction costs and not to a price at all."[11] The alternative tender was therefore not a conforming tender. It was insufficiently precise to be capable of acceptance within the Council's tender conditions.[12] The Council itself realised that the alternative tender could not be accepted in the form submitted, and sought clarification. The alternative tender did not therefore comply with the Council's tendering stipulations.[13] In purporting to accept the alternative tender the Council was in breach of the 'tendering contract'.[14]

The 'tendering contract' imposed a duty of fairness on the Council when dealing with tenders. That duty was breached by purporting to accept the alternative tender and thus destroying the business potential secured by the lowest tenderer. That was unfair and came close to negotiating with one of the tenderers on terms which do not apply to other tenderers.[15]

The cost savings offered by the alternative tender did not appear to the court to be genuine. There was a real danger here of unfairness and tender abuse whereby an otherwise unsuccessful tenderer could reduce its tender by a sum sufficient to secure the contract by offering a 'saving' derived from a purported 'alternative' method of construction but which offeree no real economy. Such an unscrupulous tenderer, could not only achieve success over other tenderers in this way, but if that tenderer was in fact the lowest tenderer, could avoid being held to the alternative if that proposal was insufficiently precise to give rise to contractual obligations. Gallen J said:

> Those are all good reasons for insisting upon a precision in definition for alternative tenders, which gives not only the tendering authority adequate means of assessing what is proposed, but also does not disadvantage other tenderers who have submitted tenders as requested."[16]

The Council was in breach of its 'tendering contract' with Pratt Contractors, who were entitled to damages.

4. The Health Care case, Newfoundland[17]

The Health Care case illustrates the problems caused by inviting tenders for design and construct projects without first setting design evaluation criteria. In the context of this paper, every tender now becomes 'alternative' in as much as a contract award to one party is likely to be a breach of contract with another, which was exactly the result achieved here!

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[11] *Ibid.* at 483/4.
[12] *Ibid.* at 483/5-7.
[13] *Ibid.* at 483/19-20.
[14] *Ibid.* at 483/ 30-33.
[15] See Gallen J at 483/34-41.
[16] *Ibid.* at 484/10-19.
[17] *Health Care Developers Inc. and others v. The Queen in right of Newfoundland (the Crown)* (1996) 136 DLR (4th) 609.

Tenders were invited by the Government of Newfoundland and Labrador for the design, construction and lease-back of health care facilities. Tender documents included statements of functional requirements, preliminary plans and outline specifications for the various required facilities, but no detailed architectural or engineering drawings or specifications. The invitation asked for irrevocable proposals to design, build and lease the required facilities to the Government for a period of 30 years, with an option to purchase for a nominal payment at the end of this period.

Included among the tender documents was the ubiquitous 'privilege clause'. The Government reserved "the right to accept or reject any or all of the proposals received" and that decision was to be final and at the sole discretion of the Government.[18] They would "not necessarily accept the lowest or any of the Tender Proposals."[19]

Seven tenders were received, including tenders from Health Care, Dobbin and Trans City. Dobbin was lowest bidder (ie. required lowest annual rent) on two sites. Health Care was lowest on one site. Officials decided that the schemes put forward by Dobbin and Trans City would need extensive redesign. Health Care became 'preferred bidder'[20] for all three sites. Its schemes provided a "design, structure and layout [which] met the minimum code and engineering standards, and complied with the functional program."[21]

This was not a "standard" tender evaluation, but a tender evaluation made on the basis of "best overall proposal". The difficult question was: which proposal offered the highest standard of construction whilst satisfying the demands of the functional programs? To answer this question each proposal was examined against criteria developed by the Government but which had not been published in the invitation to tender or the tender documents. The 'preferred' but undisclosed design solution was a "non-combustible type structure using brick cladding and steel."[22] Only two tenderers offered such a design proposal, Trans City and one other. A committee of four Government Ministers controlled the evaluation and award process and recommended that Trans City's bids be accepted rather than the bids from Health Care. Cabinet authorised the award of the contract to Trans City as an 'exception' under s.8 of the Public Tender Act. Under that section, when it did not appear "expedient" to award the contract to the preferred bidder, Cabinet might authorise rejection of the preferred bid and the award of the contract to another bidder. Under this provision, a decision was made not to award the contracts to Health Care, but to award the contracts to Trans City.

The Tender Act did not expressly require Government to award a contract to the preferred bidder. But it seemed clear to the trial judge that, taking the legislation as a whole and whilst maintaining the integrity of the public tendering system, it was the intention of the Act that public tenders should be awarded to the preferred bidder, unless the s. 8 'exception' was applied.

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[18] Article 2.2 of the Tendering Instructions (1996) 136 DLR (4th) 609, 615.

[19] Article 8.1, *ibid.*

[20] The term 'preferred bidder' is used in the Public Tender Act RSN 1990.

[21] (1996) 136 DLR (4th) 609 *per* Cameron JA at 616d. (A 'functional program' is a detailed written description of a facility and services to be provided. It includes: specific space, staff and equipment requirements and functional and operating relationships.) (at 616c).

[22] *Ibid.*, at 616f. This was no doubt due to the fact that extensive design for steel and masonry structures had previously been commissioned at a cost to the Government of about $400,000 (at 613c) prior to the decision to invite tenders on a "design/ build/ lease" basis.

Health Care and Dobbin commenced actions against the Government claiming that in awarding the contract to Trans City, they had breached obligations founded both in contract and in legislation. The actions were not consolidated but heard together. The trial judge held in favour of Health Care and Dobbin and awarded damages based on lost profits to Health Care, but only nominal damages of $1 to Dobbin. The Government appealed the finding of liability against it, Dobbin appealed against not being found to be preferred bidder and not being awarded either lost profits or wasted tendering costs. In the words of the Court of Appeal, the "story is somewhat unusual".[23]

Several cases show that there is an obligation placed on the owner to act fairly towards all tenderers. Certain good practice principles have evolved. This fairness obligation can be seen as a duty imposed on the owner to conduct the bidding process in good faith, or it can be treated as an implied term of the 'tendering contract'. English courts are reluctant to talk in terms of 'good faith' but Canadian, Australian and USA courts are increasingly doing so.[24]

Restricted space prevents consideration of the many interesting issues raised in this case. The issue for consideration here is whether the Government breached this duty of fairness in awarding contracts to Trans City rather than to Health Care and/or Dobbin. Was there sufficient evidence to show that Trans City's bid should have been rejected because it was conditional, failed to provide the purchase options and failed to meet the functional programme on one site? Does the evidence show that the contract awarded was materially different from what was requested in the tender documents?

The court answered 'yes'. It held that Trans City's bid should have been rejected. There was sufficient evidence to support such a finding. Trans City's proposal for one of the sites was assessed as "totally missing the intent".[25] There was no substantial compliance with the owner's requirements. It was not a small discrepancy nor a mere technical error. No purchase option was provided. This award amounted to "something other than contract B": "a Cabinet paper had identified eight major variations between the contract with Trans city and the tender call".[26]

Was Dobbin truly the preferred bidder on two sites? The court answered, 'no', declining to find in favour of Dobbin. Although the Dobbin bids were the lowest price for two sites, the assessors concluded that their proposals would require extensive reworking to make them "functionally acceptable". Their concepts were "extremely poor". The court concluded that these were indeed *bona fide* assessments and that there was no basis to reject those findings. "In short, the Dobbin bid did not qualify. It did not meet the requirements of the call."[27]

Did *any* of the bids meet the requirements of the tender call? The nature of the tender invitation required tenderers to exercise judgment in their response to that invitation. It was not expected that bids would be rejected due to a minor departure from the functional programme. But errors of interpretation or bids that required substantial redesign should be rejected.

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[23] *Ibid.*, at 611f.

[24] It was said that in England there is no general doctrine of good faith: *Interfoto Picture Library Ltd v. Stileto Visual Programmes Ltd* [1989] QB 433 at 439 (CA). But a duty of fairness was imposed on the owner in the *Blackpool* case [1990] 1 WLR 1195, 3 All ER 25 (CA).

[25] (1996) 136 DLR (4th) 609, 629b.

[26] *Ibid.* at 629d.

[27] *Ibid.* at 629f.

Is Health Care entitled to compensation? If so, on what basis? The court said 'yes'. As the trial judge had held that the Government was obliged to award all three contracts to Health Care, they were

> "entitled to loss of profits on those projects. Claims for the cost of preparing and submitting tenders were rejected, except insofar as those costs may be recovered in any assessment of loss of profits."[28]

The court awarded Dobbin only nominal damages of $1.00. If the Government had properly performed the 'tendering contract', it would have awarded contracts to Health Care, not Dobbin. Dobbin's appeal failed.

5. UK - The Public Works Contracts Regulations 1991

These regulations implement European Union Council Directives 71/305 and 89/440 (effectively 93/37) within the UK. Regulation 20 deals with the "criteria for the award of a public works contract". There is no reference within these regulations to the term 'alternative tender'. When a public authority awards a contract on the basis of the "most economically advantageous" offer (but not when "lowest price" basis applies) it may take into account tenders (alternative tenders) which offer some *variation* on the requirements stipulated within the tender documents.[29] There are conditions precedent which must be satisfied if this system is to apply. The award criteria must be stated "in the contract notice or in the contract documents".[30] The examples given of appropriate criteria are of an economic character, for example "price, period for completion, running costs, profitability and technical merit".[31]

To qualify under these regulations the alternative tender must, firstly, meet the minimum requirements of the public authority as set out in the tender documents, and, secondly, the authority must have stated in the contract notice that tenders offering variations would be considered. Thirdly, the contract documents must also state any requirements of the public body as to the presentation of an alternative tender.[32]

6. The American Bar Association Model Procurement Code for State and Local Governments (1979)[33]

The Code is put forward as a model for adoption by any State of the USA. The Code provides that bids must be opened in public[34] and "shall be unconditionally accepted without alteration or correction" except as the Code might permit. Evaluation must be carried out using criteria as stated in the Invitation. The indicative criteria can be grouped as matters of "acceptability" and "economy".[35] "The contract shall be awarded [...] to the lowest responsible[36] and

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[28] *Ibid.* at 630b.
[29] Regulation 20(4).
[30] Regulation 20(3).
[31] Regulation 20(2).
[32] See Regulation 20(4).
[33] Recently published in the UK as an appendix to Odams, A.M. (ed.) (1995) *Comparative Studies in Construction Law: The Sweet Lectures*, Construction Law Press, King's College London.
[34] S.3-202(4).
[35] S.3-202(5).
[36] ie. a person who has qualified in accordance with s.3-101(6).

responsive bidder[37] whose bid meets the requirements and criteria set forth in the Invitation for Bids."[38]

There is another process termed "Competitive Sealed Proposals" at S.3-203. The main distinction here is that "Proposals shall be opened so as to avoid disclosure of contents to competing offerors during the process of negotiation." Public scrutiny is confined to a "Register of Proposals".[39] The "Request for Proposals" must "state the relative importance of price and other evaluation factors."[40]

The crux of the Code for the purpose of this paper is the provision at S.3-203(6) that "discussions may be conducted with responsible offerors who submit proposals determined to be reasonably susceptible of being selected for award for the purpose of clarification to assure full understanding of, and responsiveness to, the solicitation requirements." There is a safeguard: "Offerors shall be accorded fair and equal treatment with respect to any opportunity for discussion and revision of proposals, and such revisions may be permitted after submissions and prior to award for the purpose of obtaining best and final offers. In conducting discussions, there shall be no disclosure of any information derived from proposals submitted by competing offerors."

7. The Word Bank Guidelines on Procurement under IBRD Loans and IDA Credits

The Word Bank (WB), publishes procurement rules[41] intended "to inform those carrying out a project that is financed in part by [the Bank[42] ...] of the arrangements to be made for procuring the goods and works (including related services) required for the project."

Traditional procurement guidelines anticipate the possibility of 'alternative tenders': "The bidding documents should specify any factors which will be taken into account in addition to price in evaluating bids [...] If bids based on alternative designs, materials, completion schedules, payment terms etc are permitted, conditions for their acceptability and the method of their evaluation should be expressly stated."[43] This is sound advice.

"Bids should be opened in public. [... The] total amount of each bid, and of any alternative bids if they have been requested or permitted should be read aloud and recorded when opened [...]".[44] "The [owner] should ask any bidder for clarification needed to evaluate his bid" but no changes to "the substance or price" of the bid is permitted after bid opening.[45] Once bids are opened, any further information disclosed by tenderers is kept private.[46] "If a bid is not

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[37] ie. "a person who has submitted a bid which conforms in all material respects to the Invitation ..." (s.3-101(7).

[38] S.3-202(7).

[39] S.3-203(4).

[40] S.3-203(5).

[41] *Guidelines for Procurement under IBRD Loans and Credits* published by IBRD/ World Bank in 1985, 1986, 1988 and (4th ed.) 1992 on which this text is based. It is understood that a (5th) revised edition was published in 1995.

[42] The *Guidelines* refer to finance being provided by the International Bank for Reconstruction and Development (IBRD) or the International Development Association (IDA) collectively referred to as "the Bank". Both organisations have the same procurement requirements. Reference to loans includes credits.

[43] *Ibid.*, par. 2.16

[44] *Ibid.*, par. 2.45.

[45] *Ibid.*, par. 2.46.

[46] *Ibid.*, par. 2.47.

substantially responsive[47] [...] it should not be considered further. The bidder should not be permitted to correct or withdraw material deviations or reservations once bids have been opened."[48] The owner is required to submit a detailed report to the WB "on the evaluation and comparison of bids setting forth the specific reasons on which the recommendation is based for the award of the contract."[49]

9. The United Nations Model Law on Procurement of Goods and Construction

The United Nations General Assembly created the United Nations Commission on International Trade Law (UNCITRAL)[50] which was mandated "to further the progressive harmonisation and unification of the law of international trade".[51] The Commission adopted the *Model Law on Procurement of Goods and Construction* in Vienna during 1993.

Article 25 deals with "Contents of solicitation documents." It provides at 25(g): "if alternatives to the characteristics of the goods, construction, contractual terms and conditions or other requirements set forth in the solicitation documents are permitted, a statement to that effect, and a description of the manner in which alternative tenders are to be evaluated and compared" must be stated. Article 31 provides for the opening of tenders in the presence of all tenderers and for the recording of results, but not for any public attendance.

Article 32 states that "No change in a matter of substance in the tender, including changes in price and changes aimed at making an unresponsive tender responsive, shall be sought, offered or permitted." But arithmetical errors can be corrected.[52] A tender may be regarded as "responsive only if it conforms to all requirements set forth in the tender solicitation";[53] or alternatively, "responsive if it contains minor deviations that do not materially alter or depart from the characteristics, terms, conditions and other requirements set forth in the solicitation documents".[54] An unresponsive tender cannot be accepted.[55] Only assessment criteria set out in the solicitation document may be used for the tender evaluation.[56] The successful tender is either the lowest price, or the lowest evaluated tender. [57] Criteria are set for deciding the lowest evaluated tender, for example operating costs, delivery time, functional characteristics, payment terms, effect on balance of payments and other non-price criteria to do with the local economy. The scope of economic matters is wide, but the criteria to be used must have been specified in the solicitation documents.[58] All tenders may be rejected without liability to tenderers.[59] Negotiations between owner and tenderer are prohibited.[60] There is no express provision here for dealing with alternative tenders.

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47 ie. it contains material deviations from or reservations to the terms, conditions and specifications in the bidding documents.
48 WB Guidelines, par. 2.48.
49 *Ibid.*, par. 2.54.
50 By resolution 2205 (XXI) of 17 December 1966.
51 24th Report (1993) p.39.
52 Model Law Article 32(1)(b).
53 Article 32(2)(a).
54 Article 32(2)(b).
55 Article 32(3)(c).
56 Article 32(4)(a).
57 Article 32(4)(b).
58 Article 32(4) (a)-(c).
59 Article 33.

10. Conclusion

The judgment in the *Health Care* case is emphatic that fairness must prevail over the bidding process, so that everyone is bidding on the same contract and there are no hidden preferences.[61] There are a number of 'good practice' points which emerge out of the good faith or fairness duty. Bids must be rejected which do not comply with the tender call. If this is not done, other bidders are likely to be prejudiced by relying on the tender call stipulations. It would be bad faith if the owner awarded a contract, the requirements of which bear little resemblance to the tender specification or functional program. In awarding damages to Health Care the trial judge identified eight major variations between the contract wrongly award to Trans City and the original tender call.[62]

There was argument in *Pratt* as to whether the tendering process permitted alternative tenders at all. Clearly this is a matter which is, or ought to be, controlled by the relevant tender rules. It can be seen from the systems analysed that insufficient thought has been given to this problem. Only one system examined here[63] seems to anticipate in some detail how unique and innovatory proposals might be handled so as not to breach the fairness and equal treatment obligation and the tenderer's intellectual property right. And even this arrangement is treated as an exception to the normal system of procurement, when it could preferably be positioned more centrally in the mainstream of procurement practice. It seems that the ABA Code enables tenderers to put forward unique and innovatory solutions to the authority's "Request for Proposals". Those solutions are processed in privacy but in accordance with the "fair and equal treatment" provision. Transparency of the procurement process does however appear to be abandoned.

Whether by tender code or tender statute, it must make clear what set of criteria will be applied by the owner in evaluating alternative tenders. "A tenderer is [...] entitled to know the basis upon which a tender will be assessed and the way in which the tendering authority will approach the tenders submitted to it."[64] Without the presence within the 'tendering contract' of sufficient detail on this point, it is likely that the owner is prevented from any consideration of any alternative tender. Had it been necessary in giving judgment, the High Court of New Zealand would have decided in *Pratt* that the owner had no power at all to consider an alternative tender.[65]

Having defined the basis within the 'tendering contract' for dealing with alternative tenders, it will be necessary for the owner to make a decision as to whether any particular proposal constitutes a valid alternative bid within these terms. In *Pratt* the tender manual stated that any alternative proposal had to be "within the scope of" the original invitation to tender. This term was defined as follows: "*Scope* is the project's principal purpose(s) and service(s) to users as specified in the [tender documentation]."[66] Apparently this definition was created in the light of early practical experience gained before any formal definition was given.[67] Others thought that the term must be "considered in relation to the nature of the

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[60] Article 34.
[61] The *Health Care* case (1996) 136 DLR (4th) 609, 627 g.
[62] *Ibid.* at 617h.
[63] ABA Code S.3-203, Competitive Sealed Proposals.
[64] The *Pratt Contractors* case [1995] 1 NZLR 469, 485/20.
[65] *Ibid.* at 485/35.
[66] *Ibid.* at 485/54.
[67] *Ibid.* at 486/5.

project, as distinct from its purpose and in that case, its conformity became a matter of degree."[68] In the guidance manual before the NZ High Court, alternative tenders merely propose "alternative methods or materials which may alter the quality or durability but not the scope of the end result".[69] This is a more restrictive interpretation of 'scope'.

In *Pratt* the court suggested that there was no advantage in placing the concept of alternative tenders into "too tight a strait-jacket of definition".[70] This will not assist innovation. But "in order to be fair to those tenderers who submit conforming tenders, the concept ought not to be so broad that it involves a quite different proposal. That would be unfair to other tenderers and could also lead to abuse in the selection of tenders."[71]

In the *Health Care* case it was clear that projects originally destined for a *build/lease* tender invitation suddenly became *design/build/lease* projects.[72] This change was caused by political pressure to advance the projects' progress in order to stimulate construction work in a time of recession. The invitation to tender was published before commissioned design work was completed. The difficulty of evaluating bids when there was no design specification or settled design evaluation criteria had been realised by the officials[73] but this did not deter the politicians in their pursuit of early tenders. It seems clear that the tender invitation and documents were here deficient in not stating design evaluation criteria, that is that a "non combustible type structure using brick cladding and steel" was required.[74]

Where the call for tenders does involve tenderer's design proposals, it is inevitable that some judgment has to be made by the tender assessors. The bids should not be rejected for minor departures from stated requirements. But those bids which misinterpret the owner's requirements and which would require substantial re-design should be rejected. "Substantial compliance with the conditions of the tender call is the test."[75]

There is no doubt that 'alternative tenders' are potentially valuable to both parties and to society at large. By the means of 'alternative tenders' contractors can make novel proposals to owners. Society is expected to benefit from stimulating such innovation. Tenderers may be in a better position than the owner's advisers to put forward more efficient and cost effective methods of construction with obvious potential dividends. But despite the growing trend amongst contractors to submit alternative tenders, there is not yet sufficient established custom and practice that would permit the implication of the necessary enabling terms to the 'tendering contract'.

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[68] *Ibid.* at 486/10.
[69] *Ibid.* at 486/12.
[70] *Ibid.* at 486/21.
[71] *Ibid.* at 486/21-24.
[72] The *Health Care* case (1996) 136 DLR (4th) 609, 613g.
[73] *Ibid.* at 613h.
[74] *Ibid.* at 616f.
[75] *Ibid.* at 629h. Cameron JA referred to *British Columbia v. SCI Engineers & Constructors Inc* (1993) 22 BCAC 89.

PROCURING SUBCONTRACT WORKS: HEAD CONTRACTOR'S RIGHT TO RELY ON IRREVOCABLE SUBCONTRACT QUOTATION

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Abstract

This paper examines the condition caused by the revocation of a subcontract offer after the head contractor has relied on that offer in the formulation of the main contract tender. Authorities from England, New Zealand, US A and Canada are reviewed in search of a commercial solution which will uphold the integrity of the bidding process.

Keywords: Bids, Tenders, Subcontract, Revocation of offers, Promissory estoppel, Law.

Introduction

Procurement is rarely discussed in the context of the head contractor subcontractor relationship. Yet for every head contract, there may be scores of subcontracts, and each subcontract must be procured with the same integrity as the head contract. The problem is commonplace. The head contractor submits its tender based on a subcontract quotation and secures the head contract. The subcontractor in the meantime secures other work, or discovers an error in its tender, and does not wish to stand by its offer to the head contractor. An alternative subcontractor must be appointed at greater cost which is irrecoverable under the head contract. Does the head contractor have a remedy against the defaulting subcontractor?

In English law promissory estoppel[2] does not by itself found a cause of action

Although English law generally requires consideration to bind a promissor to its promise, an English court might employ the doctrine of estoppel, in this case *promissory* estoppel, as an apparent substitute for consideration. The essential elements of an estoppel were given by Lord Birkenhead in 1921 in the following statement:

> "Where A has by his words or conduct justified B in believing that a certain state of facts exists, and B has acted upon such belief to his prejudice, A is not permitted to affirm against B that a different state of facts existed at the same time."[3]

Note that here the representation complained of had to be one of *fact*. The estoppel arises through B relying on and acting upon facts given by A and B now suffering loss or detriment caused by that reliance and action. Although it is frequently said that estoppel can be used as a shield but not as a sword, this is an over-simplification. Estoppel, whilst not actionable *per se*, might provide the essential ingredient without which a cause of action would fail.

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[2] Estoppel is a rule of law whereby a person is prevented from denying the truth of a statement made or denying facts alleged to exist. Promissory estoppel is an equitable doctrine and its effect is explained in the text.

[3] *Maclaine v. Gatty* [1921] 1 AC 376 *per* Lord Birkenhead at 386.

In *Central London Property Trust v. High Trees House Ltd*[4] Denning J (as he then was) reassessed the modern view of estoppel. He noted that the historic position (as noted above) was that to qualify as an estoppel, the representation must be one of *fact*. Any representation as to the *future* had to be embodied in a contract or deed. But the law had not stood still. Denning J said:

> "As to estoppel, this representation with reference to reducing the rent was not a representation of existing fact, which is the essence of common law estoppel; it was a representation in effect as to the future [...]. At common law, that would not give rise to an estoppel, because, [...] a representation as to the future must be embodied as a contract or be nothing.[5] So at common law it seems to me there would be no answer to the whole claim.
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> What, then, is the position in view of developments in the law in recent years? The law has not been standing still [...] There has been a series of decisions over the last fifty years [...] In each case the court held the promise to be binding on the party making it, even though under the old common law it might be said to be difficult to find any consideration for it. The courts have not gone so far as to give a cause of action in damages for breach of such promises, but they have refused to allow the party making them act inconsistently with them. It is in that sense, and in that sense only, that such a promise gives rise to an estoppel. The cases are a natural result of the fusion of law and equity; for the cases [...],[6] show that a party will not be allowed in equity to go back on such a promise. The time has now come for the validity of such a promise to be recognised."[7]

Denning J was satisfied that such a promise was binding in law. In *Combe v. Combe*[8] Denning LJ (as he then had become) set some limits to the principle of the *High Trees* case, "lest it should be endangered". It does not create a new cause of action where none previously existed. Its effect is to prevent a party from relying on its strict legal rights when it would be unjust to permit such reliance, when regard is had to the parties' previous mutual dealings. "It may be part of a cause of action, but not a cause of action in itself." He said:

> "The principle, as I understand it, is that where one party has, by his words or conduct, made to the other a promise or assurance which was intended to affect the legal relations between them and to be acted on accordingly, then, once the other party has taken him at his word and acted on it, the one who gave the promise or assurance cannot afterwards be allowed to revert to the previous legal relations as if no such promise or assurance had been made by him, but he must accept their legal relations subject to the qualification which he himself has so introduced, even though it is not supported in point of law by any consideration, but only by his word.
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> Seeing that the principle never stands alone as giving a cause of action in itself, it can never do away with the necessity of consideration when that is an essential part of the

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4 [1947] KB 130; [1956] 1 All ER 256.

5 As was said in *Jorden v Money* (1854) 5 HL Cas 185.

6 *Hughes v Metropolitan Ry Co* (1877) 2 App Cas 439, *Birmingham & District Land Co v London & North Western Ry Co* (1888) 40 Ch D 268, and *Salisbury v Gilmore* [1942] 1 All ER 457.

7 [1956] 1 All ER 256, 258-259.

8 [1951] 2 KB 215; 1 All ER 767 (CA).

> cause of action. The doctrine of consideration is too firmly fixed to be overthrown by a side-wind. Its ill effects have been largely mitigated of late, but it still remains a cardinal necessity of the formation of a contract, although not of its modification or discharge."[9]

In English law the *High Trees* doctrine, or the doctrine of *promissory estoppel*, has been applied in several cases where one party has agreed to forego a right under a contract, but not as a substitute for consideration in the formation of a contract. A subcontractor might revoke its promise to keep its bid open for acceptance providing the head contractor avoids liability to the owner, but not if the head contractor becomes bound to the owner.

But in Australia the High Court has gone further in holding that a representation, not of fact but of future intent, constituted a promissory estoppel giving rise to a cause of action.[10] And in several States within USA promissory estoppel has for many years been an alternative to consideration in creating a ground to enforce a promise.

The (US) *James Baird* case: head contractor is not entitled to rely on a supplier's tender, under the doctrine of promissory estoppel, when tendering to the owner.

Assume that a head contractor has successfully tendered for construction work. His tender price included a price quoted by a merchant for the supply of linoleum. The merchant under-estimated the total quantity of linoleum to be used and mistakenly submitted a lump sum quotation. The merchant subsequently discovered its mistake but before that mistake could be communicated to the contractor, the latter's tender had been accepted by the owner. The merchant refused to supply at the quoted price and was sued by the head contractor.

Is the head contractor entitled to rely on the supplier's tender to contract with the owner? 'No' said the Court of Appeals in *James Baird Co v. Gimbel Bros Inc.*[11] It was held, firstly, that there was no bilateral contract by which the contractor accepted the offer of the merchant and promised to pay for the linoleum in the event of its tender being accepted. In this respect the Judge Learned Hand said:

> "The contractors had a ready escape from their difficulty by insisting upon a contract before they used the figures; and in commercial transactions it does not, in the end, promote justice to seek strained interpretations in aid of those who do not protect themselves"[12]

Then the judge went on to consider the alternative argument that the merchant should be held bound by the doctrine of promissory estoppel but declined to hold the defendant bound in the absence of a binding contract of supply between contractor and merchant. (But an example of conflicting authority is *Drennan v. Star Paving*,[13] discussed below.)

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[9] [1951] 1 All ER 767, 770.

[10] *Walton Stores (Interstate) Ltd v. Maher* (1988) 164 CLR 387. High Court of Australia.

[11] F 2d 344 (1933), Circuit Court of Appeals.

[12] *Ibid, per* Judge Learned Hand at 346.

[13] 333 P (2d) 757 (1958) cited in *Hudson's Building and Engineering Contracts* (11th) para. 1.027.

The New Zealand court follows *James Baird*: head contractor is not entitled to rely on a subcontractor's tender, under the doctrine of promissory estoppel, when tendering to the owner.

In the New Zealand case of *Cook Islands Shipping Co Ltd v. Colson Builders Ltd*[14] the court also considered the question whether a subcontractor could be bound by the doctrine of promissory estoppel: that as a matter of justice, the subcontractor, having submitted a quotation to provide services in a given amount, on which the contractor relied in submitting its tender to the principal, should be estopped from denying the existence of a contract. Mahon J referred to the position in the USA, using the *James Baird* case (above) as an authority to deny the contractor a remedy under the doctrine of promissory estoppel.

The New Zealand court observed the inconsistency of United States authority in such circumstances but adopted the view that by the contractor obtaining his own contract by tender, the subcontractor is not bound in the absence of a prior bilateral contract between them. For those reasons the New Zealand court rejected the contractor's claim against the subcontractor based upon promissory estoppel.[15]

The (US) *Star Paving* case: head contractor is entitled to rely on a supplier's tender, under the doctrine of promissory estoppel, when tendering to the owner.

Tenders are due to be submitted to the owner tonight. It is now morning, and the head contractor takes a telephoned quotation from a subcontractor for incorporation in its tender. This procedure is common local practice. Between fifty and seventy-five bids from subcontractors will be telephoned to the head contractor that day. An administrative system had been devised to record and classify these bids. The head contractor is required to submit the names of subcontractors used in its bid. A bid bond is also required to 10% of the tendered sum, as a guarantee to enter contract if awarded the work. The head contractor wins the contract. The next day the subcontractor informs the head contractor of a mistake in its price and withdraws. The head contractor expects the subcontractor to honour its bid, but subcontractor refuses to perform. Another subcontractor is then employed at greater cost. The head contractor sues the original subcontractor for his loss, on the grounds that it relied on the subcontractor's bid in submitting its own tender. The subcontractor defends on the ground that there was no enforceable contract between the parties: it has made a revocable offer and revoked it before the head contractor communicated its acceptance to the subcontractor.

Does the head contractor's reliance make the subcontractor's tender irrevocable? 'Yes' said the Supreme Court of California (Traynor J) in *Drennan v. Star Paving.*[16] The court held that although the subcontract tender had made no promise of irrevocability and no express or implied promise that the head contractor would employ the subcontractor should the head contract tender be successful, the subcontract tender did amount to an enforceable promise, if the head contractor relied on that tender to his disadvantage.

The *Restatement of Contracts*, applicable in California, provided at s.90 that a promise which can reasonably be expected by the promisor to be relied upon to induce action or forbearance of a definite and substantial character on the part of the promisee, and that action

[14] *Cook Islands Shipping Co Ltd v. Colson Builders Ltd* [1975] 1 NZLR 422, at 438.
[15] [1975] 1 NZLR 422, *per* Mahon J at 438/39.
[16] 333 P (2d) 757 (1958) cited at *Hudson* (11) para. 1-027. Supreme Court of California.

or forbearance is induced, is binding on the promisor if to hold otherwise would be unjust.[17] A list of authorities shows application of this rule in California.[18] The subcontractor promised to perform on terms expressed or implied and knew that the head contractor would rely thereon if the bid should prove to be the lowest. The subcontractor's offer induced "action of a definite and substantial character" on the head contractor's part.[19]

The subcontract offer was silent as to revocation. Had it made express provision for revocation, the court would have taken a different view. But here it must be decided whether terms as to revocability of the offer should be implied in law or in fact. Consider the analogous matter of a unilateral contract. An offer for a unilateral contract cannot now be withdrawn if part performance is given or tendered by an offeree.[20] The rationale is that a subsidiary promise is implied to the main offer, to the effect that if part performance or tender is given by the offeree, the offeror will not revoke its offer. Part performance or tender can thus be treated as consideration for the implied subsidiary promise. And, of course, under s.90 (above), one party's justified reliance and action upon an offer may be a sufficient basis to make the promise binding. Traynor J said:

> "Whether implied in fact or law, the subsidiary promise serves to preclude the injustice that would result if the offer could be revoked after the offeree had acted in detrimental reliance thereon. Reasonable reliance resulting in a foreseeable prejudicial change in position affords a compelling basis also for implying a subsidiary promise not to revoke an offer for a bilateral contract."[21]

Any lack of consideration here is not a problem, because reasonable reliance, exceptionally, acts as a substitute.[22] That is the effect of the estoppel doctrine, which is not to say that the need for consideration in a contract is abolished.[23] The subcontractor submitted its bid to obtain the subcontract. It intended, and wanted, the main contractor to rely on it, if it should be the lowest bid received, to formulate the main contract bid. It was in the interest of the subcontractor to make its bid as low as possible: the lower the subcontract bid, the lower the main contract bid, the greater the likelihood of being awarded the work.

The head contractor does not appear to have 'accepted' the subcontractor's bid in any way normally recognised in contract. The head contractor did promptly inform the subcontractor of its success, and it was at this time that the subcontractor purported to revoke its offer. But it was only fair, said the court, that a head contractor should have a "an opportunity to accept the [subcontractor's] bid after the general contract has been awarded to him."[24] The head contractor's obligation, on being awarded the main contract, is not to delay acceptance of the

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[17] According to *Hudson* (11) this is followed in the *Second Restatement of Contracts* (US, 1981) para. 89(2) and in subsequent cases. Reference is made to Sweet (1985) *Legal Aspects of Construction Contracts* (3d ed) West Publishing Co. USA: pp. 727-729.

[18] 333 P (2d) 757 (1958) *per* Traynor J at 759[2].

[19] *Ibid.* at 759[3].

[20] See s.45 of the *Restatement of Contracts*.

[21] 333 P (2d) 757 (1958) *per* Traynor J at 760[5].

[22] See s.90 of the *Restatement*.

[23] 333 P (2d) 757 (1958) *per* Traynor J at 760[6], referring to *North Western Eng Co v. Ellerman* 69 SD 397, 408; 10 NW 2d 879, 884, Supreme Court of South Dakota

[24] 333 P (2d) 757 (1958) *per* Traynor J at 760[7].

subcontract bid whilst it shops for cheaper bids. "Nor can he reopen bargaining with the subcontractor and at the same time claim a continuing right to accept the original offer."[25]

Does the presence of a mistake in the subcontract tender change the position? The subcontractor argued that it was entitled to revoke its offer on the ground of its mistake. Several cases were cited to the court in support. Traynor J said:

> "In those cases, however, the bidder's mistake was known or should have been known to the offeree, and the offeree could be placed in *status quo*. Of course, if [the head contractor] had reason to believe that [the subcontractor's] bid was in error, he could not justifiably rely on it, and section 90 would afford no basis for enforcing it.[26] [The contractor], however, had no reason to know that [the subcontractor] had made a mistake in submitting its bid, since there was usually a variance of 160 per cent between the highest and lowest bids for paving in [the area of the job.] He committed himself to performing the head contract in reliance on [the subcontractor's] figures. Under these circumstances [the subcontractor's] mistake, far from relieving it of its obligation, constitutes an additional reason for enforcing it, for it misled [the contractor] as to the cost of doing the paving. Even had it been clearly understood that [the subcontractor's] offer was revocable until accepted, it would not necessarily follow that [the subcontractor] had no duty to exercise reasonable care in preparing its bid. It presented its bid with knowledge of the substantial possibility that it would be used by [the contractor]: it could foresee the harm that would ensue from an erroneous underestimate of the cost. Moreover, it was motivated by its own business interest. Whether or not these considerations alone would justify recovery for negligence had the case been tried on that theory,[27] they are persuasive that [the subcontractor's] mistake should not defeat recovery under the rule of s.90 of the *Restatement of Contracts*. As between the subcontractor who made the bid and the general contractor who reasonably relied on it, the loss resulting from the mistake should fall on the party who caused it."[28]

The court affirmed the judgment given by the trail judge. The general contractor was entitled to rely on the subcontractor's bid, despite the alleged mistake therein.

In Canada the head contractor is entitled to rely on a subcontractor's tender when tendering to the owner under the principle of the two contract analysis.

The contractor submits a tender including a sum for mechanical work provided by a subcontractor. That tender is the lowest tender received by the owner, who, under the tender conditions, has thirty days available in which to give an acceptance or rejection. Four days after submission of tenders the subcontractor advises the head contractor of an error in its price, and purports to withdraw its tender. The head contractor argues that the subcontractor is unable to withdraw, since the subcontract tender is also bound into the thirty days acceptance period prescribed by the head contract.

Is the subcontract tender capable of being withdrawn or must the tender remain open for thirty days for the head contractor's acceptance? In *Northern Construction Co Ltd v. Gloge*

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[25] *Ibid.* at 760[8]: see *RJ Daum Const Co. v. Child*, Utah, 247 P.2d 817, 823.
[26] *Robert Gordon, Inc., v. Ingersoll-Rand, Inc.* 117 F 2d 654, 660. 7th Circuit.
[27] See *Biakanja v. Irving* 49 Cal 2d 647, 650; 320 P 2d 16.
[28] 333 P (2d) 757 (1958) *per* Traynor J at 761[9,10].

Heating and Plumbing Ltd[29] the Canadian court held that the subcontractor could not withdraw its tender. There was a tacit or implied agreement between head contractor and subcontractors that the subcontract tender would remain open for acceptance for the same period as the head contract tender remained open. The subcontractor is liable for the damages suffered by the head contractor caused by its refusal to perform the subcontract.

Miller J observed that many of the authorities cited by counsel in this case dealt with the owner-contractor relationship rather than contractor-subcontractor relationship. In the former circumstances (no doubt due to owner's tender checking and evaluation process) the mistake is discovered soon after opening of tenders and certainly before a tender is accepted. There is a difference between cases where the tenderer is author of the mistake and would itself suffer if held to contract, and here, where the head contractor has relied on the subcontractor's tender and would suffer if held to contract, but the subcontractor who is responsible for the error avoids liability.

There were two lines of authority available to the court. Following *Belle River Community Arena Inc v. WJC Kaufmann Co Ltd*[30] it would be inequitable if the owner, in the full knowledge that the tenderer has made a significant mistake, was allowed to extract performance from the tenderer. The rationale there was based on principles of equity rather than, as in *Ron Engineering*,[31] the contract fundamentals of offer, acceptance and revocation. In the latter case, the court held that a 'tendering contract' (a unilateral contract) was created by the submission of a timely and conforming tender, that this contract was collateral to any contract for construction work, and under its terms the tenderer was expressly bound not to revoke its offer, a promise secured by a tender deposit. As both owner and tenderer were not under any mistake when the 'tendering contract' came into existence (ie when the conforming tender was submitted) it was irrelevant to consider the law of mistake. Estey J in the Supreme Court of Canada disagreed with the approach and decision of the Ontario Court of Appeal in *Belle River*.

Piggott Structures Ltd v. Keillor Construction Co Ltd[32] was a case involving a claim by a head contractor against a subcontractor. The subcontractor had tendered for ground work, the tender had been accepted, then the subcontractor refused to perform alleging that the nature of the contract work had been misrepresented by an employee of the head contractor. The contractor sued for the subcontractor's specific performance. Evidence was apparently given at trial that it was custom and practice within the construction industry that a subcontractor's tender could be withdrawn at any time until the head contractor had submitted its tender, but not after that time. In the view of the court, this was reasonable, provided both parties were in agreement as to what the offer was.[33] As the majority of the Court of Appeal found no agreement between the parties as to the nature of the work, the head contractor's claim was dismissed. But this case is significant here because the court "seemed to affirm the general principle that a bid by a subcontractor, when used by the contractor, constitutes a binding

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[29] (1984) 6 DLR (4th) 450; 1 Const LJ 144. Alberta Court of QB, Canada, Miller J, 3.2.1984.

[30] (1978) 87 DLR (3d) 761, Ontario Court of Appeal.

[31] *The Queen in Right of Ontario et al v. Ron Engineering and Construction Eastern Ltd* (1981) 119 DLR (3d) 267, Supreme Court of Canada.

[32] (1965) 50 DLR (2d) 97, Ontario Court of Appeal.

[33] See McLennan JA in *Piggott* at 112, cited (1984) Const LJ 144, 149.

contract by the custom and usage of the construction industry which can be enforced by the contractor."[34]

In *MJ Peddlesden Ltd v. Liddell Construction Ltd* [35] the court found for the subcontractor against the head contractor. The subcontractor's tender was used by the head contractor in its submission to the owner. The owner accepted the head contractor's tender within the period stipulated, but the head contractor did not communicate this fact to the subcontractor until after the period had lapsed. The head contractor then used another subcontractor for the work and the original subcontractor sued for damages. The head contractor defended on the grounds that there was no contract to breach but the court found that a unilateral contract between head contractor and subcontractor had been created by the tendering process which required only the owner's acceptance within the stipulated period to further bind all three parties. It was the owner's acceptance which finally bound the head contractor to use the original subcontractor, not the subsequent communication of acceptance. The head contractor was liable for its breach to the injured subcontractor.

Miller J returned to the *Ron Engineering* case. He referred to commentaries on the case,[36] then said:

> "When contract A (the 'tendering contract'), as discussed in *Ron Engineering*, is analysed as an option contract, the following obtains. The invitation to tender by the owner, or by a general contractor to a subcontractor, is a request for an option that sets out the terms of the option except the price and includes the length of time it will remain open. That invitation to tender also states the consideration, namely, a promise to consider the submitted tender for the award of a contract. The submission of the bid by the subcontractor sets the price and binds the subcontractor to the terms proposed by the contractor. It should be noted, however, that while an optionee may propose terms, option contracts have been described as unilateral contracts because they impose obligations only on the optionor or grantor. ... The Optionee is not bound and never will be if he fails to exercise the option ... Exercise of the option must be communicated to the grantor in a manner consistent with the terms of the option ... The exercise of the option will require the optionee to award the contract to the grantor or, in default, to pay damages equivalent to the grantor's expectation loss.
>
> In *Peddlesden* the court essentially found that the option had been exercised when the contractor 'adopted and made part of its tender' the subcontractor's bid. In *Piggott* the court essentially held that the earliest the option could have been exercised was at the deadline for the contractor's tender, since until that time, the subcontractor could withdraw his bid.
>
> Indeed, *Piggott* suggests that, in accordance with the custom and usage of the construction industry, the option commences at the deadline for the contractor's bid. It must not be forgotten that all subcontractors who submit tenders are giving options to the contractor. Except where the invitation to tender specifies that the contract will be awarded to the lowest bidder, the contractor has promised only to consider the tenders. *Peddlesden* suggests that where a contractor uses a subcontractor in his successful bid, he has exercised his option subject only to the owner's acceptance of the construction tender.

[34] Miller J (1984) 1 Const LJ 144, at 149.
[35] (1981) 128 DLR (3d) 360, British Columbia Supreme Court, Ruttan J.
[36] *Commentaries*, (1982) 60 Can Bar Rev 345, at 353-354, Prof. Robert Nozick at 352.

> That exercise, however, unless the invitation to tender so specifies, does not end the options given by the other subcontractors. They remain open for the specified period so that the contractor may substitute a subcontractor if the designated subcontractor fails to honour his option.
>
> While both *Peddlesden* and *Piggott* are unclear as to when the adoption of the subcontractor's bid was communicated to the subcontractor, it must be noted that option cases require such communication before the option may be said to be binding."[37]

If the option contract analogy is pursued, here, Northern Construction would be seen to exercise its option at the time when its tender was submitted to the owner incorporating Gloge's name and price. The subcontractor would be seen to have waived its right to receive communication that its bid had been adopted in accordance with construction industry practice, or, alternatively, the subcontractor did have notice of the option's exercise prior to its attempt to withdraw the option. But it is not the relationship between the date of *exercising* the option and the date of discovering the mistake that is relevant: it is the relationship between the date of *granting* the option and the date of discovering the mistake which is relevant. Miller J quoted from Professor Nozick:

> "The principle of unilateral mistake has indeed been utilised to deprive parties of their expectation interest but only where (a) there is knowledge, whether actual or constructive of the mistake of the other party, and (b) where this knowledge was placed with the 'guilty' party *prior* to contract formation - this is the so-called 'snapping up' of a mistaken offer. It has never been applied where the mistake became known *after* contract formation."[38]

Following this proposition, even if Northern Construction exercised its option *after* learning of Gloge's error, Gloge is still bound by the contract and liable for breach.

Gloge's only way of avoiding liability then would be to establish that Northern Construction knew of the error prior to the *commencement* of the option. Gloge argued that Northern *did* know, simply because Gloge's price was 'significantly low', that is more than ten per cent below the next highest bid. Does this amount to constructive knowledge of the mistake? The expert evidence in this case suggested that questions would not be asked until the bid differential was more than ten per cent. As any bid could be 'low' for several different reasons, and only one being error, the court not find constructive knowledge of error simply because on bid was lower than another by 10% - 12%. Therefore Northern Construction had neither actual or constructive knowledge that Gloge's price contained a significant error when they used that bid in their tender to the owner, and thus created the 'tendering contract' which obliged Gloge to perform, or created the irrevocable option. If Gloge were allowed to withdraw with impunity, that would make Northern unpaid insurer of Gloge's mistakes: Miller J knew "of no principle of contract or equity which imposes that kind of duty unless it is expressly provided."[39] The subcontractor is liable for the damages suffered by the main contractor caused by its refusal to perform the subcontract.

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[37] Miller J (1984) 1 Const LJ 144, 150-151.
[38] *Ibid.* at 151.
[39] *Ibid.* at 152.

Conclusion

Owners tend to distance themselves from subcontract procurement. But the common law appears to recognise that owners, interests are better served by a bidding system which extends its integrity to subcontract procurement. Distrust at this level will affect final outcomes.[40]

In English law it seems that it remains necessary for the head contractor to give consideration to the subcontractor in order to secure the irrevocability of the subcontract bid. The doctrine of promissory estoppel has been applied so as to bind a promissor to its promise but not, as in the Californian court, as a full substitute for consideration so as to create a cause of action if the subcontractor's offer is revoked before acceptance by the head contractor. But, it is submitted, following the Canadian authorities and by analogy with the position between owner and head contractor, the subcontractor's consideration for the irrevocability of its offer is the head contractor's obligation to consider the subcontractor's tender properly submitted. If the head contractor uses that subcontract bid in the formulation of the head contract bid, that amounts to 'acceptance' of the subcontractor's offer, subject only to acceptance of the head contract offer. Alternatively, the invitation to tender can be explained as a request for an option granted by the subcontractor on the terms stipulated by the tender invitation. On both bases, the successful head contractor must inform the subcontractor of the tender outcome in good time. The head contractor then becomes bound to award the contract to the subcontractor. By this scheme the integrity of the bidding process is upheld.

The Californian case of *Drennan v. Star Paving*[41] might also have been argued on the contractual basis of an irrevocable subcontract tender. The subcontractor could have been seen to offer irrevocability in exchange for the main contractor's consideration of the tender submitted and its eventual use and incorporation within the main contract bid. Or it could have been argued that by using the subcontract offer as the basis of the main contract bid, the main contractor had conditionally accepted that offer, conditioned only on being awarded the main contract. Any such arguments would have to be underpinned by evidence. According to the judgment of Traynor J, there was no such supporting evidence.

It is, of course, not surprising that the necessary evidence could not be found to support the contract arguments, if those arguments were not run before the court. And it mattered not that consideration for the promise was not found: the court applied the doctrine of promissory estoppel as set out in s. 90 of the *Restatement of Contracts*, which provided a circumvention of the consideration rule. According to *Hudson* this Californian decision has exercised great influence in the USA construction industry.[42] *Hudson* doubts whether an action based on promissory estoppel would succeed in England, but that an action in negligence based on *Hedley Byrne & Co Ltd v. Heller & Partners Ltd*[43] might succeed. Perhaps the action could also be founded on the two contract analysis of *Ron Engineering*[44] along the lines developed above.

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[40] Latham's *Interim Report* (Dec. 1993) commented on the lack of trust within the industry at p.9.

[41] 333 P(2d) 757 (1958).

[42] *Hudson* (11) at par.1-026.

[43] [1964] AC 465 (HL).

[44] (1981) 119 DLR (3d) 287; 4 Const LJ 241. Supreme Court of Canada, 27.1.81.

THE EFFECTIVENESS OF INTERNATIONAL CONSTRUCTION CONTRACT PERFORMANCE IN RELATION TO CLIENT INVOLVEMENT- A COMPARATIVE STUDY OF FRENCH AND UK SYSTEMS ×

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Abstract

This paper covers the separate evaluation of findings from questionnaire surveys in order to assess, initially, how each of the national construction industries performs in relation to client expectations and the effect of client involvement and client experience on performance. This includes statistical distribution analysis which examines relationships between client priorities or requirements, client experience, client satisfaction with performance, preferred level of participation and procurement systems favoured; the construction of a correlation matrix using Spearman's Rank Correlation system in order to examine the correlation between client performance ratings including participation and overall client satisfaction with performance.

A null hypothesis which contends that there is no significant difference in the non-parametric results of the above relationships, between the two countries, will be tested using the chi-square formula for category-variable data and the Mann-Whitney U test for ordinal data. The purpose of the comparative study is to discover if there are any similar trends which transcend national boundaries and may be of universal significance in terms of the implementation of client-centred procurement strategy in order to harmonisation, on a global scale.

Keywords : client, experience, involvement, performance, procurement systems

INTRODUCTION

Previous work relating to French procurement systems and French construction clients (Davenport,1994; Davenport and Smith, 1995a; Sharif and Davenport, 1995) establish the background and rationale for the comparative study of client participation in relation to client satisfaction with construction investment and project requirements. The findings of earlier research has resulted in the compilation of a questionnaire (Davenport and Smith, 1995b), of UK Public and Private clients, which seeks to address these unknowns and which can be applied to a range of international procurement systems and methodology.

The objective of this paper is to extend this preliminary study to a comparative survey of French and UK construction clients and to ascertain if there is a relationship between the

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priority and performance ratings awarded by the client for participation in the construction process and increased satisfaction with the investment. Clients who prefer maximum participation are most likely to be those who are expert and those who are most satisfied with construction industry performance generally. The null hypothesis to be tested is that there is no significant difference in the distribution of variation, between the two countries.

In the assessment of levels of participation it is valuable to classify clients according to their experience or expertise as there is likely to be a direct correlation to the amount of involvement which a client requires. An underlying premise of this study is that public and private clients tend to cluster into three main sub-group categories as follows :

- Expert (constructs on a regular basis using in-house multi-disciplinary teams)
- Quasi-Expert (constructs on a regular basis using external consultants)
- Non-Expert (rarely constructs)

METHODOLOGY

Survey of client satisfaction with construction investment

A study of the comparative effectiveness of French and UK construction procurement systems in the achievement of maximum performance standards includes a survey of industrial and commercial companies as clients. Questionnaires have been sent to 500 public and private organisations in each country, 1000 in total, randomly selected from the Lotus Company Directories for the UK and for Europe; the results were analysed using the SPSS computer systems package. The survey examined the following :

- client categories - experienced or inexperienced
- client needs/objectives/priorities
- performance rating of the construction industry in satisfying client needs
- types of construction project ordered by client
- most commonly used procurement method
- cost ranges of building work
- level of participation required

The survey is an analytical one, based on a questionnaire and structured to focus upon the main issues of construction client participation in terms that, for experts or non-experts alike, can be readily comprehended. Likert and ratio scales and banded and closed questions are employed in accordance with the analytic survey methodology set out by Gill and Johnson (1991). 7 out of 12 of these questions are examined in this paper.

Analysis of the Survey

The response to the questionnaire is shown in Table 1 :

Table 1 Survey response

Client Group	Number sent out	Number completed	% completed (approx)
UK Public	250	87	34.8
UK Private	250	49	19.6
French Public	250	85	34.0
French Private	250	26	10.4
Totals	**1000**	**247**	**Average 25%**

Question 1 - Which of the following classifications most closely matches your perception of yourself as a construction client?

The result was as follows in Table 2 :

Table 2 Level of expertise

Classification	UK Public	UK Private	French Public	French Private	Totals
Expert(In-house multi-disciplinary team)	61 (70%)	11(22%)	17(20%)	9 (35%)	98
Quasi Expert (External consultants)	17(20%)	24 (49%)	57 (67%)	4 (15%)	102
Non Expert	9 (10%)	14 (29%)	11 (13%)	14 (50%)	48
Totals	**87**	**49**	**85**	**26**	**247**

The table indicates that 70% of UK as opposed to approximately 20% of French Public clients regard themselves as Expert whereas 67% of French in contrast with 20% of UK Public clients regard themselves as Quasi Expert. 49% of UK Private clients and only 15% of French Private clients regard themselves as Quasi Expert whereas 50% of French clients assess themselves as Non Expert compared with 29% for UK clients. However, a larger proportion of French Private clients, 35%, regard themselves as Expert compared with only 22% for UK Private clients. The sample for the French private sector is much smaller than for the UK which may account for the disparate results for both countries.

Question 2 - Indicate the scale of importance of the following priorities when establishing objectives at the initial or brief stage of the construction procurement process.

The survey responses, translated into mean category scores (see note below) and number ranked (in parentheses with '1' as the leading priority), are indicated on Table 3 :

Note : Category 1 = Not Important, Category 2 = Moderately Important, Category 3 = Important, Category 4 = Very Important, Category 5 = Most important

Table 3. Mean Category Score and Rank of Client Priorities

CLIENT GROUPS Priority	UK Public Mean Score (rank)	UK Private Mean Score (rank)	FR Public Mean Score (rank)	FR Private Mean Score (rank)
Time	3.747 (5)	3.816 (4)	3.329 (6)	3.360 (5)
Design Quality	4.012 (4)	4.041 (3)	4.071 (2)	4.000 (3)
Buildability	3.483 (7)	3.510 (6)	3.730 (5)	3.455 (4)
Construction Quality	4.093 (2)	4.061 (2)	4.289 (1)	4.039 (2)
Cost	4.299 (1)	4.367 (1)	3.929 (3)	4.040 (1)
Environment/Energy saving	3.537 (6)	3.184 (9)	3.259 (7)	2.922 (7)
Life Cycle/Maintenance	3.437 (8)	3.408 (7)	3.812 (4)	2.958 (6)
Claims/dispute free	3.299 (9)	3.184 (10)	2.885 (10)	2.667 (9))
Insurances/Guarantees	3.126 (10)	3.225 (8)	3.107 (8)	2.720 (8)
Other legal safeguards	3.035 (11)	3.143 (11)	2.123 (11)	2.083 (10)
Participation	4.035 (3)	3.813 (5)	3.091 (9)	2.667 (9)

Time, cost and quality (of design and of construction) are the basic priorities which for the contemporary client, whether public or private, British or French, persist as the most important criteria being consistently in the top five of mean ranks. Client participation for the UK Public client ranks number 3, in front of design quality and time and the UK Private client rates participation at number 5, behind cost, construction quality, design quality and time. This trend is not repeated in the case of French clients who regard client participation as less important than other priorities and rate participation as low as ninth priority. It is important to note that, despite its low ranking, client participation is regarded on average by French Public clients as in the category range of "Important" to "Very Important" (at 3.09) in line with UK clients whereas French Private clients rate participation as less than "Important" at 2.667. (See Table 3). The findings of this survey, in line with the pilot study by Davenport and Smith (1995) endorse Masterman's findings (1994) that UK clients require informed involvement with the construction project and regard it , as well as cost, time and quality, as one of their foremost priorities.

Question 3 - What type of construction work do you normally order?

The response to this question cannot be published here due to lack of space but the results are summarised as follows. Most construction clients from both the public and private sectors, seem to order a variety of work across a range of different building types including housing, commercial and industrial units, retail developments, educational institutions, hospitals, police and fire headquarters, domestic, commercial and industrial refurbishment, heritage and conservation, leisure facilities and infrastructure.The responses provide relevant data on the types of building procured in relationship to the range of construction clients and the value of work and serves to illustrate the strong level of homogeneity within the sample population in terms of the categories of construction work ordered.

Question 5 - Which of the following procurement methods do you use?

This question produces a client orientated assessment of the typical types of contract procurement systems currently utilised by clients and, because it is not addressed to a wide range of construction professionals, cannot be regarded as a comprehensive survey of current procurement methods. The results were as shown in Tables 4 and 5 :

Table 4 UK Clients

UK Procurement methods	Public No	Public % by value	Public weighted %	Private No	Private % by value	Private weighted %
Traditional lump sum	78	71.79	85.63	29	62.76	52.90
Design & Build	11	34.55	5.81	18	54.44	28.49
Management Contracting	2	60.00	1.83	7	48.57	9.88
Construction Management	6	63.33	5.81	5	44.00	6.40
Other (Term, Schedule of rates etc)	1	60.00	0.92	1	80.00	2.33
Totals			**100%**			**100%**

Design and Build is much more popular, at 28.49% with private clients than with public clients (5.81%) It appears that traditional lump sum tendering is still widely popular especially with public clients who procure over 85% of projects by value, using this system and 52.9% of private clients, who, in this sample, seem to prefer Traditional to Design and Build and other systems.

Table 5 French Clients

French Procurement methods	Public No	Public % by value	Public weighted %	Private No	Private % by value	Private weighted %
Lots separés	65	57.54	50.41	15	57.33	43.89
Groupes Conjoints	34	42.94	19.68	3	40.00	6.12
Groupes Solidaires	28	31.43	11.86	0	0	0
Entreprises Générales	32	38.75	16.70	15	49.33	37.75
Conception Construction	2	50.00	1.35	3	40.00	6.12
Entreprises Ensemblières	0	0	0	3	40.00	6.12
Totals			**100%**			**100%**

The French results follow closely those of UK in relation to the popularity of the traditional indigenous method of contracting ie by *lots* or *groupements.* The use of the *Entreprise Générale* is also popular, especially in the private sector although the design input and responsibility of the French main contractor may be much more significant in France than in the UK. The low percentages recorded for the use of *Conception Construction* (*Conception Réalisation* or Design and Build) echo the hostility expressed by interviewees, consultants and contractors, (Davenport 1993) to this popular British system. This may be partly owing

to a high level of design input of *lot* contractors within the traditional French procurement systems as well as fears expressed by Architects of diminishing roles, if the package deal was to be introduced on a wide scale in France.

Question 6 - What is the approximate cost range of completed projects?

Results are not included in this paper but were examined to ascertain if there were any significant differences between the two countries in terms of value of construction work normally ordered by the sample of clients. Taking into account the exchange rate, the distribution of contracts by value undertaken by public and private clients is broadly similar for both countries and, as in the case of types of building being undertaken, serves to emphasise the underlying strength of homogeneity of the two sample populations.

Question 7 - How do you rate the performance of the construction industry in achieving or satisfying the following performance standards?

Original scores were out of ten with a score of ten indicating maximum satisfaction with performance. These have been translated into percentage scores and ranked in accordance with Table 6. This indicates that client satisfaction is rated at levels above 65% for all main groups of clients with the highest rating awarded by French Private clients at 74% and the lowest ranking (5) from the UK Private client. Client understanding, defective-free construction as well as client protection from claims and defects scores at the lowest levels in all groups (between 49 and 60%). Construction quality is rated high by all groups (average 69.45%) with design quality also attracting higher percentages (average 68.48%). Delivery on time falls behind quality with mid-range rankings at number 6 for all except French Private clients who put this variable at the head of their performance ratings at 74.5%, slightly behind value *(qualité-prix)* which has the highest average level overall at 75%. For the UK Public client, final cost rates a percentage of less than 60% whereas other groups record higher ratings for this variable.

Quality of construction and design lead the field in terms of performance for all groups apart from French Private clients who put value (*qualité-prix*), delivery on time and satisfaction at the top of performance standards achieved. Otherwise, examination of the figures on this table shows a fairly even distribution and lack of variation between the groups which can be confirmed by further statistical analysis. No scores exceed the 75% level and the lowest average score of 49.47% is the predictable outcome of client understanding for French Private clients. The range demonstrates a need for improvement of performance standards across the range of criteria listed.

Table 6 Percentage Performance Rating and Rank

Client Group Performance rating	UK Public	UK Private	French Public	French Private	Overall mean %
Client satisfaction	67.47 (3)	66.38 (5)	68.25 (4)	74.00 (3)	69.03 (3)
Complexity of contract	62.24 (7)	61.84 (9)	63.73 (8)	59.44 (8)	61.81 (9)
Level of client participation	63.61 (5)	63.64 (8)	63.87 (7)	60.00 (9)	62.78 (7)
Level of client understanding	55.66 (12)	57.50 (11)	59.33 (11)	49.47 (13)	55.49 (13)
Delivery on time	62.85 (6)	65.00 (6)	65.32 (6)	74.50 (2)	66.92 (5)
Final cost	58.82 (9)	67.39 (4)	68.00 (5)	72.00 (4)	66.55 (6)
Good value	65.00 (4)	68.51 (3)	69.62 (2)	75.00 (1)	69.53 (1)
Defect-free construction	56.65 (11)	56.89 (13)	56.20 (13)	56.50 (11)	56.56 (12))
Quality of design	68.25 (2)	68.67 (2)	69.49 (3)	67.50 (6)	68.48 (4)
Quality of construction	69.59 (1)	68.91 (1)	70.25 (1)	69.05 (5)	69.45 (2)
Quality of project management	61.34 (8)	64.09 (7)	62.78 (9)	60.50 (7)	62.18 (8)
Environ/energy saving/Icc	58.31 (10)	60.46 (10)	59.87 (10)	60.48 (8)	59.78 (10)
Client protection from defects	55.37 (13)	57.05 (12)	57.60 (12)	53.00 (11)	55.76 (11)

Question 8 - As a construction client what level of participation in the project, would you prefer?

UK and French construction clients were classified according to expertise; the percentage of cases which selected one of four levels of participation - Total using Total Quality Mangement systems, Total using established in-house systems, Partial using external consultants and Non-participatory - is recorded as follows in Table 7:

Table 7 Preferred Level of Participation

Participation level	UK Exp	UK QuExp	UK NExp	FR Exp	FR QuExp	FR NExp
Total (TQM)	14	8	5	13	18	26
Total (in-house)	66	3	26	26	23	13
Partial	17	58	48	52	52	48
Non-participatory	3	31	21	9	7	13
Totals	**100 %**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 7 shows that UK Expert clients overwhelmingly prefer Total participation using in-house systems whereas all other classes from both countries favour partial involvement using external consultants. Total Quality Management systems are not preferred by clients, decreasing in popularity for UK clients as expertise decreases (from 14% of Experts to 5% of Non Experts) and increasing in popularity for French clients as expertise decreases (13% for Experts to 26% for Non Experts). UK Quasi Experts show a preference for non-participation (31%) which greatly exceeds TQM and other Total in-house systems. French clients are more likely to shun non participation than UK clients Quasi and Non Expert clients.

RESULTS OF STATISTICAL ANALYSIS

Client expertise in relation to client priorities and performance

Statistical distribution analysis using the SPSS package was used to examine relationships between client expertise, client satisfaction and client participation in the project as a priority rating and also as a measure of construction industry performance. Clients' ratings of priorities were translated from ordinal data into a percentage score for comparison with performance ratings in terms of actual client participation, client satisfaction and client understanding.

Expert clients demonstrate disparity between the four main groups. UK Public and Private clients rate client participation highly as a priority but are less likely than French clients to achieve this in construction performance. French public clients rate the priority level of participation at a similar level to performance whereas French private clients rate participation as a priority at a much lower level than actual participation experience and achieve the highest level of client satisfaction (approximately 75%).

Quasi Expert clients show a close relationship between client satisfaction and actual participation for UK Public and Private clients though still operating at a much lower level than the initial priority of participation. French Public clients rate all three components at the same level and French Private clients reverse the trend by demonstrating high satisfaction rates in combination with the lowest and equal ratings for actual participation and participation as a priority.

Non Expert clients shows that UK Public clients rate participation as a priority at the high level of 90% with actual participation and client satisfaction between 60 and 70%. This sub-group represents a small minority of UK Public clients (see Table 2) but reveals a similar range of ratings as for Expert and Quasi Expert clients. French Public clients and French Private clients in this sub-group demonstrate similar characteristics in that they rate satisfaction at a greater level than actual participation and than the priority of participation.

Correlation between client satisfaction and client performance ratings

A correlation matrix using Spearman's Rank Correlation was constructed in order to examine the relationship between client satisfaction and performance ratings for participation, cost, time and quality. The null hypothesis is that there is no relationship between satisfaction and these variables for the client population as a whole. For three main groups, UK and French Public and UK Private, there is 95% certainty that there is a relationship between client satisfaction and client participation, final cost, design and construction quality and delivery on time and this is likely to be true for the population as a whole. In the case of French Private clients, with a sample population of 19, variables of participation, final cost and delivery on time show no significance at the 5% level and the null hypothesis is not rejected in these cases. There is no relationship between satisfaction and the performance criteria indicated and this is true for the population as a whole. The small sample size in comparison

to the other groups may lead to a Type II error in which the null hypothesis is erroneously accepted. As with other groups, design quality shows the highest level of significance with construction quality demonstrating low strength significance and these results indicate a relationship between quality and client satisfaction.

Client groups and expertise - test of association

A chi-square test was carried out to see if there is an association between nationality of clients and the class of expertise which they identify with. The null hypothesis is that there is no variation in the distribution of levels of expertise between UK clients and French clients. In the case of Public Non Expert clients there is no variance between the countries, in the proportional levels of those clients who regard themselves as Non Expert. This is reversed in the case of Public Expert and Quasi Expert classifications and we can reject the null hypothesis and confidently state that the nationality of the client is not independent of the level of expertise.

For Private Quasi Expert clients there is evidence that nationality influences classification at this level. A much larger proportion of UK Private clients regard themselves as Quasi Experts whereas the results for Experts and Non Experts show that nationality does not affect the outcome. The smaller sample of French clients may distort this result especially as there as is a sample size of less than 5 in this group.

Client groups, priorities and performance ratings - test of association

The null hypothesis, with significance set at the 95% level ($p<0.05$), is that client priorities and performance ratings have the same distribution for UK and French Public clients and for UK and French Private clients, classified in sub-groups of expertise. The non-parametric Mann-Whitney U test used for two non-related samples and ordinal data, was applied and the results for two-tailed significance are summarised

In the case of Public Expert, Quasi Expert and Non Expert clients, there is no variation in the distribution of ratings for most performance criteria, between the two countries. The exception to this is the performance of cost as perceived by the Quasi Expert client and there is evidence of variation between the two countries. Chi-square is significant at less than 0.05 for the priority of client participation in the case of Public Expert, Quasi Expert and Non Expert clients. It can be stated with confidence (over 99%), that there is a difference between UK and French Public clients in categorising the importance of this variable as a priority. In the case of Public Expert clients, chi-square is significant at less than 0.05 for the priority of of delivery on time and the same result applies to Public Non Experts in relation to the priority of design quality. It can be stated with confidence (over 99%), that there is a difference between UK and French Public clients in categorising the importance of these two variables as priorities.

The priority of client participation is significant beyond the 0.05 level for Private Expert clients, for private Quasi Expert clients and on the borderline of the 0.10 level (0.1002) for Non Experts. The null hypothesis, that there is no variation in the distribution of results between the two countries, is rejected in the case of client participation as a priority (with the possibility of a Type I error for the small sample result of Non Experts in which the null hypothesis is erroneously rejected). In terms of performance ratings only one variable in the Expert sub-group shows significance beyond 0.05 and that is design quality. The null hypothesis is rejected in this case.

CONCLUSIONS

Classifications of client expertise

UK Public clients are more likely to classify themselves as Expert in contrast with French Public clients who are more likely to see themselves as Quasi Experts. A larger proportion of French private clients regard themselves as Non Expert compared to UK clients who tend to class themselves as predominately Quasi Expert. The chi-square test supports this showing variation in distribution of expertise between the two countries. This may be due to several factors including the most likely ones as follows :

- The sample returns from the private sector are more robust from the UK (49) compared with disappointing returns from French clients (27) which may distort the final readings in the case of private clients.
- UK Public clients have more highly developed structures of design and cost consultancies employed for project management purposes within the company.
- French Public clients tend to use external consultants for consultancy purposes.
- Cultural and behavioural differences between the two nations may account for the level of expertise as assessed and perceived by the clients themselves.

Client requirements

Time, cost and quality persist as the leading priorities for clients in all sub-groups of expertise. UK clients rate participation or involvement as a high priority but it is less important for French clients. Although participation is ranked at a lower level for French clients it is regarded by French public clients as "Important" ranging to "Very Important" whereas French private clients regard it as only "Moderately Important".

Significantly French clients have a higher percentage of priorities rated as "Not Important" notably on the subject of legal safeguards which are classed at this level in more than a third of public client cases and at 25% for private cases. This may be the result of firstly, French legislation which provides more centralised and universal protection for construction clients and secondly, an adversarial culture in the UK construction industry which promotes the need for additional safeguards eg collateral warranties.

UK clients in all classes of expertise rate participation at a higher level as a priority than French clients with the UK Public Non Expert client showing the highest level of requirement. The lowest priority rating is for the UK Private client. French clients rate participation at much lower levels with the Private Quasi Expert client and Public Non Expert client showing the lowest ratings. Expertise does not appear to affect the level of priority required but nationality does.

Client participation and satisfaction with performance

A comparison of client satisfaction with performance in terms of client participation shows that UK clients in all classes of expertise, rate participation lower than satisfaction and this is similar to the result for French Public clients with the gap widening for French Private Quasi Expert clients to approximately 20% difference between the higher satisfaction rate and lower participation rate. There does seem to be a relationship between participation and client satisfaction for UK clients which is not substantially affected by expertise. The degree of relationship reduces slightly in the case of French Public clients and much more dramatically in the case of French Private clients. Spearman's RHO indicates that for all except the French Private client there is a correlation between participation as a performance variable and client satisfaction. The strength of the correlation varies but is of medium strength for Public sector clients from both countries.

Preferred level of participation/involvement

Preferred level of client involvement in the construction process is not related to levels of expertise and there is variation in the distribution of results for both countries which suggests that nationality affects preferences. On the other hand all groups prefer partial involvement except for the UK Expert client who prefers Total participation using established in-house systems.

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A FRAMEWORK FOR QUALITY MANAGEMENT IN TEMPORARY MULTI-ORGANIZATIONS.

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Abstract:

Quality is articulated within the framework of the survival of the fittest that equates it with long-term survival of a focal unit in its environment. Any number of attributes can be identified to define, measure and assess quality, but the most important remains the longevity of the unit. The underlying arguments for quality as a function of longevity/continuity of the focal unit take forms such as 'when a firm succeeds over the long term, it has succeeded on a day-by-day basis' or: 'when an organization delivers a quality product time after time after time, it becomes a long term success'. But what of situations that are temporary, or organizations that may be categorized as 'temporary multi-organizations', such as most organizations assembled to deliver a building project? Do they also qualify to adopt definitions of quality that assume the long-term existence of organizations? This paper proposes a win-win framework, as opposed to the survival of the fittest, as the basis for articulating, assessing and maximizing quality in project organizations in the construction industry.

Construction Industry; Project Organizations; Quality Management; Survival; Temporary Multi-organizations

INTRODUCTION

With the advent of the notion of Quality Management, both as a philosophy and an operational methodology, and with its strong commitment to customers, employees and product, the older ways of improving quality through functional evaluation are rapidly becoming out-dated. However, even though the concept of comprehensive quality management has been around for some time, it has primarily evolved in the manufacturing industry. In the construction industry, as yet, there is no established paradigm to guide its development and use. Our aim in this paper is to fill this vacuum by proposing (i) a comprehensive quality management framework for building projects, focusing on the client/user/community set, and (ii) an operational methodology rooted in the most salient characteristic of the building industry, namely, the temporary multi-organizational nature of project organizations.

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The need to develop a quality management framework with a focus on the *client/user/community set* originates in the complex reality that quality means different things to different participants in the building process. The immediate question is: whose criteria should define quality in such a situation? Considering the observation that "a well-designed project will impact upon the satisfaction, comfort and well being of its occupants, and, if it is a commercial building, upon their productivity and performance" (Latham, 1994), we are reminded of the long standing but often ignored suggestion that the only set of objectives which could have any chance of wide acceptance in the building process has to belong to the client/user/community set (Crichton, 1968).

Furthermore, we also take the position that within the highly interdependent, multi-organizational framework of the project delivery team, the widely accepted social Darwinism, emphasizing 'competition', 'survival of the fittest', and so on, is highly inappropriate, indeed dysfunctional, if the objective is to achieve highest possible aggregate quality at the level of the project. Instead, a framework aimed at achieving cooperation and attaining win-win outcomes for all participating task-organizations is paramount for achieving high over all quality at the project's level (Davidson, 1987; Mohsini, 1989, 1991; Latham, 1994).

Our main contention in this paper, which also underlies our long standing effort to develop inter-organizational cooperation as the basis for designing and managing the building procurement process - is that the win-win paradigm provides a sound basis for achieving high overall performance. This argument contends that where interdependence exists, the *combined* returns of all task organizations who are willing to coordinate their action under some superordinate goal are greater than the combined returns of those who seek to maximize their separate return functions.

THEORETICAL FOUNDATION

Management of quality in the building industry is traditionally circumscribed by an elaborate performance theory, which evolves around the performance evaluation of built facilities or their parts. The main objective is to determine the extent to which the conditions that were intended at the front-end of the building process are actually satisfied in the completed facility, and what technical, human, economic and other consequences follow from various design and technical decisions that were made. To achieve this goal, the building process is conceived of as having two distinct structures (Assimov, 1962; Markus, 1967; Manning, 1987):

1. a *horizontal* structure of iterating (long-term) processes responsible for design and decision making in each of the different phases of the building process; and

2. a *vertical* structure of sequential phases by which the outcome of each of the separate iterating processes is integrated into the project (in the short term, even though the outcome of the project itself may well be - and probably is - long-lived).

In the literature as well as in practice the appraisal of built facilities reflects this dual view. On the one hand, we have post-occupancy evaluation with its concomitant problems of how to use

the information obtained (a point we return to at the end of this paper). On the other hand, there is the measurement of the performance of the parts, at the subsystems' level. The arguments for conducting performance appraisal at this subsystems level recall that the total building process consists of a series of sub-processes, and that each of these sub-processes in turn defines and/or produces a part of the final product. Accordingly, if a building project can be conceived of as a coordinated assembly of a series of products and hardware, then its performance can also be assessed by a linear aggregation of the individual performances of these products and services (Canter, 1977; Crise, 1975; Hartkopf *et al.*,1986; Manning, 1987; Zimmering *et al.*, 1988). Furthermore, the argument goes on, as the products and services are generated by individual firms exercising repetitive processes or providing services on a continuing basis, the feedback from the appraisals can be used incrementally. Appraisal at this level is, therefore, thought to be highly beneficial.

The most significant consequence of the product/services approach, however, lies in the risk of its giving rise to sub-optimization in the building process. As the otherwise interactive phases of the building process are neatly separated into sub-processes, the optimization of products and services produced by these sub-processes tends to become more important than the final product of the building process as a whole.

This emphasis on sub-processes has two implications. On the one hand, as the data obtained from the appraisal of a building subsystem is primarily available to its designers and manufacturers only, it helps *them* further optimize their particular product. On the other hand, the owners and users of the building project do not gain much from appraisal at this level. The data, even if it were made available to them, is too discrete to help them in any way in improving the building process as a whole the next time around - if indeed there is one.

It is important to note that the evaluation model underlying the product/services approach can be, and is, properly used by single organizations, such as, for example, a manufacturer of windows, where permanently established feedback loops are instrumental in continuously improving the performance of the product. However, as most conventional building activity is performed by temporary multi-organizations, too few similarities between the building process and most manufacturing processes exist to warrant the use of the product/services approach. In fact it could be argued that the differences are so fundamental that the use of this model is outright dysfunctional for the very objective of performance appraisal, namely the continued improvement of the final product.

An essential argument in support of this contention is that (i) the total quality of a building is not equal to a simple aggregation of the individual qualities of its various parts, and (ii) a maximization of overall performance in a complex system cannot be achieved by simply maximizing the individual qualities of its parts. In fact, it can be shown that in situations where inter-dependence exists, the combined returns of all task organizations who seek to maximize their separate return functions is less than the joint returns in situations where the task organizations were willing to coordinate their action under some superordinate objective (Warren, 1972).

Thus, two important considerations must be incorporated into the design of an overall frame-

work for quality management in building projects; they are:

1. The strategic decision making in almost all building projects rests with the client/user/community set, and decision makers are primarily concerned with the performance appraisal of the project as a whole and not with that of its individual parts in isolation, however important they might be.

2. In projects procured by temporary multi-organizations rather than by fully integrated firms, greater payoffs are available when jointly optimum returns, as opposed to the maximization of individual returns, are sought.

Furthermore, the quality of a building project is also dependent upon the resolution of the inherent conflict between the goals of the project organization and those of the independent task organizations comprising it. A number of studies of the building industry have highlighted its multi-industry character (Crichton, 1967; Mohsini, 1984; Davidson, 1987) and have contrasted the permanence of the firms that compose it with the 'temporariness' of the temporary multi-organizations charged with designing and constructing each project. These temporary multi-organizations are characterized by the fact that each participating member has to resolve disparities between two different levels of organizational objectives: the temporary objectives of the project and the permanent objectives of the participating task organizations.

This is, inherently, a conflict inducing situation, as the supremacy of the first level objectives may lead individual task organizations to reducing their performance. On the other hand, it is also a challenge for project managers to contain the inter-organizational conflicts and to maintain high levels of task performance as well as overall performance for the greater benefit of all participants, including the 'client'.

TOWARDS A FRAMEWORK FOR AGGREGATE QUALITY MANAGEMENT IN BUILDING PROJECTS

Until recently, one of the main, indeed determining, considerations affecting the design and subsequent assessment of quality in products, services or projects was the satisfaction of peoples' *needs*. As long as basic needs remained unfulfilled, it was deemed sufficient to provide a service or a product regardless of how good it was, how cost effective it was, or, indeed, as we have seen in numerous mega-projects the world over, what the consequences might be. Times have changed; at least in societies where the basic needs of people are more or less taken care of, the need-based paradigms are becoming obsolete. Increasingly, it is not enough just to provide a product or a service; it must be demonstrated to be of sufficient quality to justify its continued existence (ASCE, 1988; Dumas, 1989; Fergusson and Teicholz, 1994; Mathur and McGeorge, 1990).

In recent years a number of theoretical and operational definitions of quality for the post-need context have emerged (ASCE, 1988; Crosby, 1979; Juran, 1988; BSI, 1991). In essence, they all articulate quality in terms of the client/user/community's satisfaction and propose taking care of their *aggregate* objectives rather than seeking optimization of any single attribute. However, in operational terms, i.e. how such an aggregate quality may best be achieved, the single orga-

nization view is most often proposed, even though it is more appropriate to manufacturing than the construction industry. The thrust, as Kline and Coleman (1992) point out, is directed at creating an organization that is capable of delivering a consistently high quality product over a *long* period of time. This view, fully compatible with the product/services approach of quality management prevalent in the construction industry and firmly rooted in the 'survival of the fittest' paradigm, is based upon the supposition that "when such a firm succeeds over the long term, it has succeeded on a day-by-day basis. Just as true, when an organization delivers a quality product time after time after time, it becomes a long term success" (Kline and Coleman, 1992, p. 16)

This operational position, imported wholesale from the manufacturing industry, is also common currency in the construction industry. Accordingly, just as in the manufacturing industry, the discussion is centered around *how* a firm can improve its product to satisfy the customer and "much that is put forward as the way to carry out the goal of Total Quality Management (TQM) is said to depend on an organization adopting a less dictatorial, more participative mode of management. Quality, it is often said, is to be brought about in all its manifestations through [...] complete endorsement of quality from the very top down." (Kline and Coleman, 1992, p.16)

It is ironic that in the construction industry, whose operational mode is project-based, i.e. one that precludes a long-term view based on continuity, a single-firm-centered, top-down model for achieving total quality is accepted without any assessment of this model's relevance to the industry. As Kline and Coleman (1992) point out, even at the firm's level, there are vital differences between construction and manufacturing that must be recognized. Their comparison of the two industries is presented in Table 1.

Table 1. Differences Between Manufacturing and Construction

Manufacturing	Construction
1. Usually medium to huge organizations	Usually small to medium organizations
2. Make many units of product	Make one unit of design
3. Customer unknown	Customer known
4. Limited contact with ultimate consumer	Has much contact with ultimate customer
5. Customer contact: Mostly after sale	Customer contact: Always before sale
6. Sale made after product made	Service done after they are sold
7. Craftsmanship less of an issue	Craftsmanship very important

Source: adapted from Kline and Coleman, 1992

Fortunately, the construction industry is slowly moving away from blindly following the manufacturing industry's models of Total Quality, at least at the theoretical/definitional level. ASCE, in their attempt to tackle the question of quality in the construction industry (ASCE, 1988), is highly perceptive in recognizing that quality must be defined in terms of the obligation to deliver a project, i.e. with reference to a temporary multi-organization created for the specific purpose of designing and constructing the project for a specific client. Within this context, ASCE defines quality as: "[...] meeting the owner's requirements. The requirements may be simple or complex. They may be stated in terms of the end results required or as a de-

tailed description of what is to be done" (ASCE, 1988, p.1). This definition is a very significant departure from those that are focused on the product of the individual firm, in that quality is clearly seen as a function of meeting the client's requirements and demands. At the operational level, however, ASCE's proposals towards the delivery of quality still rest within the context of the single task-organizations such as design and construction companies. The net effect of this hesitation to break way from the old framework is that the supposed optimization of tasks - associated with the traditional belief that the overall performance of a project is a linear aggregation of individual performances of the participating task-organizations - is maintained.

But as we saw earlier, optimization of individual tasks in a multi-organizational situation does not necessarily produce the highest overall quality. Quite the contrary, it is most likely to lead to sub-optimum overall quality. On the other hand, we also noted that the client is primarily interested in the aggregate quality of the final product. This, in turn, places emphasis on developing an operational framework that facilitates attaining the highest quality project, delivered as a product of the *joint* effort by all the task-organizations that are involved.

If the manufacturing model is not appropriate to the construction industry, or at least inapplicable to construction *projects*, then the following question arises: how should one cater for the client/user/community's demands of *aggregate* project level quality?

Kline and Coleman (1992) propose an inversion of the often stated TQM tenet that an organization seeking quality improvement should install its own principals of TQM in its subservient organizations. They believe that this model is counter productive to the goals of total quality in a project situation because the buyer[1] who only seeks to satisfy his own goals strongly encourages the task-organizations to also act in their self-interest. Instead, they suggest three conditions for any operational model to be successful in temporary multi-organizational situations:

1. The owner sets the tone and many of the rules for attaining quality.
2. Quality results most easily when the different parties give teamwork high priority.
3. Quality is meeting the stated and agreed upon requirements of all the parties.

These framework conditions are also echoed in the recommendations of the Joint Review of Procurement and Contractual Arrangements in the UK Construction Industry, which suggests:

> "The review has been about helping clients to obtain the high quality projects to which they aspire. That requires better performance, but with fairness to all involved. Above all it needs teamwork. Management jargon calls that 'seeking win-win situations.' I prefer the immortal words of the Dodo in 'Alice's Adventures in Wonderland,' 'Everybody has won and all must have prizes.' The prize is enhanced performance in a healthier atmosphere. It will involve deeper satisfaction for clients. It will lead to a higher image and better rewards for a great industry" (Latham, 1994).

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1 In building, the lead 'buyer' is, of course, the building owner.

Thus, the emerging paradigm of total quality in the construction industry, as opposed to its counterpart in the manufacturing industry, is increasingly articulated in terms of the utilization of project resources in such a way that maximum benefits accrue to all participants, *not considered separately.* The idea that maximum benefits should accrue to all participants, in turn, rests on the realization that the optimal performance of the building team is not the arithmetic sum of the optimal performances of the set of organizations comprising the building team. Because these organizations are competing for the same scarce resources and because the scope of work is finite, performances are interdependent. Under these circumstances, optimal project performance can occur without any single organization achieving its own optimal performance (Roberts, 1972).

Accordingly, total quality in a building project is emerging as a dynamic concept, reflecting the prevailing circumstances; it is all-encompassing in that benefits gained by one task-organization at the expense of another in the building process are not considered conducive to high overall quality. Conversely, organizational frameworks that maximize first-level (project's-level) objectives while guaranteeing that all participants' second level (firms'-level) objectives will also be achieved, are deemed to lead to higher overall quality.

POST-OCCUPANCY EVALUATION AND PRE-PROJECT DECISIONS

Our interpretation of the win-win paradigm as the framework for project level quality management has evolved from our previous research concerned with identifying some general principles for designing high performing project procurement processes. It may be worthwhile to list some of the fundamental *facts* underlying our chain of reasoning as well as some conclusions from our earlier findings, before summing-up and outlining a possible plan of action. Our work is built on the *facts* that:

* unlike most products, buildings are most frequently purchased before they exist or even have been designed, which places a particular burden on the intending building owner as he/she sets about organizing for, and taking the strategic decisions that best correspond to his/her interests, i.e. in making his/her strategic procurement decisions;

* unlike most industrial products, the design and production of buildings is left in the hands of 'temporary multi-organizations', posing problems of allegiance in the sense that participants have to accommodate their long-term objectives (typically: survival in the market place) to the short-term objectives they accept in choosing to work on a particular project;

* typically, buildings are one-off or 'prototypes', so that problems of learning from experience assume a particular complexity regarding the designation and usefulness of feedback.

These considerations have been at the core of our work in studying the relationships that exist between the performance of the team responsible for carrying out a building project (design, manufacture and construction) and the best procurement strategy to be adopted by the building owner. We have explored the relationships between conflict and performance, and, in turn, have identified the most significant causes of conflict. But our work is limited to the relation-

ship between procurement strategies and the performance of the *process*.

However, the relationship between the *quality of a building* and the most appropriate *procurement strategy* remains to be explored. This relationship is difficult to study, if only for the following reasons:

* the quality of a building is not an absolute consideration; its worth varies, depending on the point of view and interests of the person being consulted;

* the quality of a building (for the users) depends on a complex relationship between (a) *all* the functional criteria that are applicable to each and every activity that take place in any part of the building (heat, light, sound,...) and (b) *all* the performance characteristics of the parts of the building that 'surround' the activities (floor structure, wall construction, finishes, services,...) in a many-to-many relationship (Cronberg, 1975).

Moreover, it is by no means certain that feedback about quality of a building as a whole can be usefully reused because there is 'nowhere' where the feedback can be fed back to, and because of the non-repetitive nature of most building projects - possibly excepting housing. Note that we are *not* discussing here the qualities of its parts; as we have pointed out above, information about windows can easily be fed back into the window design and manufacturing process - since there is a typical manufacturing industry type of situation where there is continuity of operations which can 'receive' the feedback.

In contrast, even if the quality (or, to be more exact, 'qualities') of a whole building can, by systematic study, be identified, the information cannot easily be reused. Post-occupancy evaluation provides knowledge about the particular building and its particular users; it is, however, only useful *if* someone else decides to build an almost identical building for similar clients/users and *if* the information is made completely available to this someone else and to all the designers and decision-makers he/she turns to.

Let us ask ourselves for a moment what can be learnt if the building is found to be of insufficient quality. Who is to blame? Was the brief inadequate (in other words, did the client express his/her wishes inadequately or were they unrealistic)? Did the design team fail to translate these wishes properly into a building description (i.e. did performance characteristics fall short of performance criteria)? Did the contractor/subcontractors fail to produce adequate work and why (were they inadequately supervised or was the procurement/contract strategy inappropriate)? Whatever the answer, who is going to admit to learning from such experience?

What one is looking for, therefore, is some way to find continuity at the building project level, so that this continuity can be the basis not only for obtaining feedback information about building quality but also for ensuring its use.

CONCLUSIONS

We have shown in our previous research that certain project-level relationships seem to be always true, whatever the building may be (Mohsini, 1984; Mohsini and Davidson, 1991;

Mohsini *et al.*, 1995). These relationships are, in fact, independent of the design and location of the building and are only related to the procurement strategy adopted by the intending client. These relationships associate the performance of the building *process* with certain factors that determine the likely level of that performance (such as: conflict-inducing circumstances). However, we have, as yet, neither sought nor found any clear link between the level of the *performance of the process* with the *quality of the building* it produces.

It would be interesting to explore the relationship between the *performance* of the process and the *quality* of the building that is produced by it. It is tempting to hypothesize that *the quality of a building is* (more or less) *proportional to the performance of the process that produces it.* Indeed, one could even suggest that this is a tautology! Were this hypothesis to be true, then one could argue:

1. That the design of an optimum *process* (specifically by adopting an appropriate procurement strategy) ensures the best possible quality of the *product.*

2. That it is sufficient to feed back the combination of (a) information about *quality level* and (b) corresponding information about *procurement strategy* to any intending client to ensure (i.e. predict) optimum chances of success.

3. That here (at last!) we have the continuity that has hitherto been lacking in the sensible use of building quality information, since all buildings require the adoption of a procurement strategy and this strategy can serve as the 'anchor' for a systematic feedback of information.

In other words, post-occupancy evaluation (as it is now positioned in the building cycle - after the fact) would become superfluous, or, better, would serve to check that the relationship between *procurement strategy* and *quality of building* still holds (or, if not, why not).

To achieve this, however, we need a meta-framework that can facilitate the measurement of the overall quality of a building as a product of the design and management of that building's procurement process. What we are looking for here is some kind of 'meta-feedback' of 'meta-quality information'. If our hypothesis should turn out to be verifiable, then the scope for using information generated by 'post-construction evaluation' would be greatly enhanced. In other words, instead of providing information that can only be used: a) if an identical building is to be built by people 'in the know' or (b) if parts of the total information can be extracted to be used in cases where parts of the building are repeated, one could use the information (in a 'meta' form, that is to say at the level of an evaluation of the 'quality of the quality') in *any* case where procurement decisions receive a similar level of attention, that is to, almost universally.

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DYNAMIC CONTRACT MODEL

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Abstract

Presently, most of the contract types and the purchase orders (P.O) are not in rhythm with the total quality management (TQM) and activity – based management (ABM). These types of contracts agreement or documents are static models where a snapshot of the final negotiated agreement between two parties the owner representatives (contract administrator/ buyer) and the contractor (supplier) are documented. These contracts have an introversive management nature, and are difficult to administer. The most known difficulties of the static contract model are the following: the owner might experience unjustifiable cost increases due to scope creeping, and the contractor might face unnecessary fines due to missing schedule target dates.

The paper introduces and develops a dynamic contract model. The backbone of this model is the TQM and ABM. The model is an agreement between the technical team (requisionor and end user), contract administrator (owner representatives), and contractor (supplier). The different phases of the model are definition, development, execution, and feedback/ control/ evaluation. The paper also implements Shewhart's cycle (Plan, Do, Check and Act) PDCA as an improvement feedback/ control/ evaluation phase. Therefore, the dynamic contract model is promising for the future of the contracting method and for the documents exchanged between sustaining and contributory parties.

Keywords:

Contract execution, Performance, Continuous improvements, Contract documents

Introduction:

Selection and management of the contractor, subcontractors, and major equipment suppliers is the key for obtaining the desired level of quality, on meeting milestone dates, and for achieving affordable life cycle cost of the contract's final product. The owner's obligations are to develop a strategy for win–win contract conditions for all of the contract partners (contractor, subcontractors, and major equipment suppliers) to achieve the above. These strategies are built within the dynamic contract model (DCM).

Open books (cost accounting, etc.) strategy between the team partners (contractor, subcontractors, and major equipment suppliers) helps the DCM team leader in identifying the high cost activities and their drivers and setting continuous cost reduction plans. ABM normally gives ways to release the real costs and link them to the different activities of the DCM phases.

This paper discusses DCM strategies and its different phases. The paper presentation for the DCM strategies and phases uses engineering-procurement-construction (EPC) static model contract for a co-generation plant for electrical energy as an implementation example. The paper highlights, how the dynamic contract model shifts the introversive management nature of the static (traditional) contract model to one of an extroversive management nature.

Dynamic Contract Model

DCM is a teaming arrangement between the owner, owner's engineer, contractor, subcontractors, and major equipment suppliers companies. The DCM is not only cross-functional team arrangements within one company but also it is cross-different companies' team. Figure 1 presents the different DCM strategies. The first strategy is breaking the contract elements into work activities. The second strategy is implementing total quality management principles in managing the contract activities. The third strategy is activity costing (ABC) of each of the contract activities. The fourth strategy is implementing PDCA improvement cycle as a feedback loop to tie the different contract activities together. These strategies achieve development of activity costs, cost drivers, and work breakdown structure-schedule of total contract.

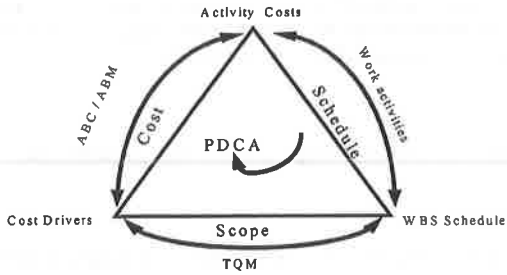

Figure 1 Dynamic contract model

The DCM assumes the relationship between the two parties of the contract influence their ultimate business goals (Dawod, 1996 (1)). The DCM teams goals are minimizing scope ceepage, and completing the milestone schedule activities on time and within the definitive estimate.

TQM Strategy

This strategy is an integrated management of the contract where the sequential process (Figure 2) organization chart fades and becomes a horizontal/circular organization (Figure 3). DCM approaches to TQM consider the entire interactions between contractor, subcontractors, major equipment suppliers and the owner engineer. Also it enforces the importance to conform to customer requirements and needs throughout the different phases of the contract life.

Static Contract Organization Chart

Figure 2 represents a pyramidal organization chart (Kalada, 1996), which operates in a cascaded - type sequential process. This means that each company (consultant, contractor, and subcontractor) is assigned a part of the EPC contract to be done then passes it on to the next company after approval of the owner or the owner's engineer. The owner engineer and the general contractor spend a lot of efforts and time to coordinate the outcomes from each of the involved companies in executing their assigned part of the contract. This leads to introversive management of the contract and to communication barriers.

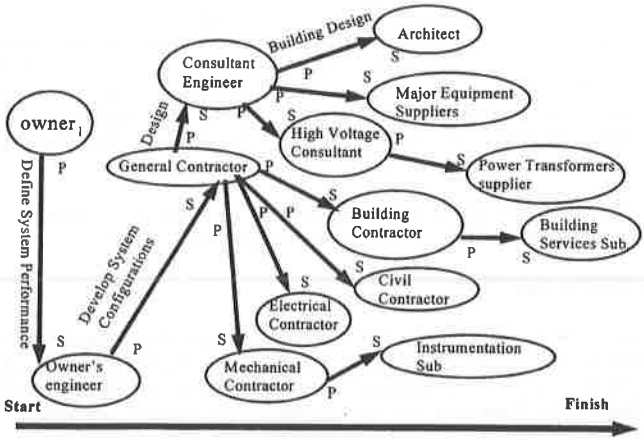

Figure 2 EPC Traditional Contract - Pyramidal Organization Chart for Co-generation Plant

Table 1 Examples of Win–Lose Conditions of the Static Contract

	Win–Lose Conditions
Performance Bond	The bidder submits performance bid price, which will remain in full force for a certain period after the date of issuance of Final Acceptance Certificate.
Guaranteed Performance Levels	The contractor guarantees the substantial completion date and in case of failure to achieve an $xxx per day penalty shall be implemented. Also the contractor warrants and guarantees the agreed certain auxiliary power and water consumption, ..., etc. Liquidated damages for failure shall be enforced if the guaranteed performance has not achieved.
Approval of Change Order	The owner requests the contractor to alter, add to, or deduct from the contract scope of work. Accordingly, the contractor prepares a detail estimate the impact of such changes to the contract price and schedule milestone dates. If the owner and the contractor are in conflict, the contractor shall proceed with the owner's request, pending resolution of such conflict.
Progress Payment	Before making any payment the owner requires the contractor to furnish evidence that all work performed and materials and equipment supplied are free and clear from claims and liens.

The static contract model is based on sequential tendering and bidding processes between two companies (Predecessor and Successor). The Predecessor Company (owner/ contractor) normally prepares the tender. The Successor Company (subcontractor/supplier) bids to execute the tender scope of work. Each of the Predecessor Companies appoints a contract administrator to watch over the Successor Company's performance. To control conflict and eliminate risks the Predecessor Company imposes win–lose commercial conditions. Table 1 presents some examples of such conditions.

For example the predecessor (P) for the consultant engineer (successor (S)) is the general contractor (P) who is the successor of the owner's engineer (P) as presented in Figure 2.

Dynamic Contract Organization Chart

The principles of the DCM organization chart are (1) extensive and effective communications between team members (owner's engineer, contractor, subcontractors, and major equipment supplier companies' teams), (2) appreciation and recognition of outstanding performance and contribution to the other team members, (3) developing common vision, mission target statement, and values for the contract team, and (4) accountability measures for team members.

To achieve all of these principles, the pyramidal organization chart must become a horizontal/ circular organization chart. In the middle of the circle is the top management team, which is composed of the top managers of the different companies. The second circle is composed of team leaders from different companies. The third circle is composed of the technical, cost accounting, construction, operation teams developing and executing different facilities of the co-generation plant. Also this type of organization is the most suitable for implementing ABM/ABC methods.

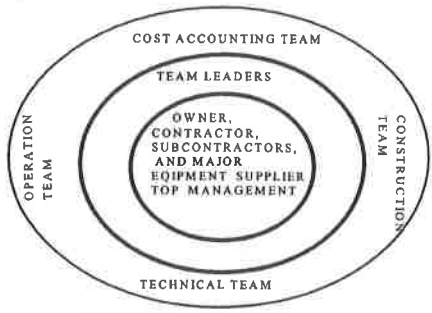

Fig 2 CONTRACT TQM ORGANIZATION CHART

Work Activities Strategy:

This strategy ties the different contract activities schedule to the required cost of materials, equipment and human resources to complete an individual contract activity. The output of any activity is measured by the total cost incurred and the added value to the contract owner and the other team members. The industry's best practices or benchmarks compare the productiveness of each company. The team concept in the dynamic contract model allows the team leader to compare the performance of contractor, subcontractors and major equipment suppliers for similar tasks with the previously agreed benchmarks for different activities. Also this comparison leads to developing internal benchmarks and cost reduction incentives of any the repetitive or similar tasks.

ABC/ABM Strategy

This strategy is the right arm of the TQM strategy, where the scope cost drivers and activity costs are defined for each of the team member's tasks (Hertling, 1993). During the planning phase of the contract the team leaders for each of the companies involved; develops work break down structures (WBS) for their portion of the contract. During the development phase, quantities and cause-effect relationships with costs of the activities must be clearly defined to assign the cost drivers for different scheduled activities. The cost estimate of the whole contract is approved by the owner and is concurred with by the top management team.

PDCA Cycle Strategy

This strategy is a common approach to continuous improvement that will be used throughout the different phases of the DCM by all of the team member's organizations. The implementations of the TQM and ABC/ABM, the PDCA cycle aligns the improvement efforts of the contractor, subcontractors, major equipment suppliers, and the owner's engineer. The benefits of using the PDCA cycle include cost savings and identifying the other team members needs. However the most

important benefit of the PDCA is the systematic and rigorous analysis of activities which otherwise might lead to nonconformance to the required performance and unmanageable cost charges (Johnston, 1993).

Dynamic Contract Phases

Figure 4 presents the different phases of the contract, which are the definition, development, execution, and feedback/control/evaluation phases. The later phase is not sequential after the execution phase; but it is a built in phase within each of DCM phases, activities and/or tasks as indicated in Figure 4. The owner and owner's engineer teams develop these phases for each of the contract, subcontracts, and major equipment suppliers scope of work.

On the other hand the static contract phases are pre-award, award, and post award. The pre-award phase activities generally are request for quotation, prepare tendering documents, pre-qualification of bidders, and evaluation of bids. The award phase activities are interview and notify the successful bidder, and sign the required bonds and insurance policies. The post award phase activities are execution, schedule monitoring, delivery, and acceptance and inspection (Sharman, 1987).

Definition Phase

This phase defines the overall affordable life cycle costs, the needs and the expected return on investment. This provides a yardstick for allocating budget and resources to each of the defined needs and expected performance levels for the co-generation plant different facilities. Also the owner team develops planning assumptions and options, and technical evaluation of the prospective engineering consultant, contractor, subcontractors, and major equipment suppliers. For example the high voltage

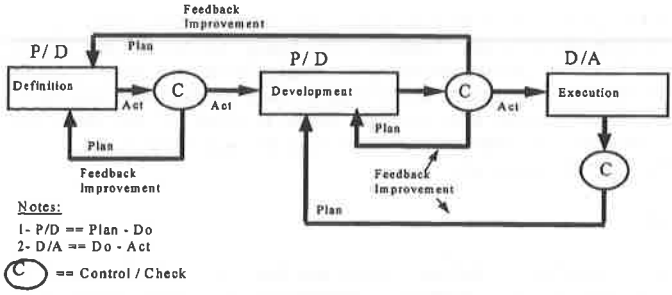

Figure 4 Different Phases of the Dynamic Contract Model

facilities for the co-generation plant; the owner and the owner's engineer define the output voltage levels, the maximum electrical losses, and the power output to the public utility grid. They also

collect benchmarks data and information for different activities costs and its drivers for similar contracts.

This phase is the startup milestone for the DCM, and the sketch for the formal agreement between the different companies on the scope of work. Also the subdivision of the scope into mini-scopes of work is defined.

Development Phase

The steps of developing the DCM are: (1) develop overall schedule, (2) review the adequacy of dividing the scope into different mini-scopes and their terminal points with the team leaders, (3) overall schedule shows the start and finish dates for each mini-scope of work e.g. the high voltage yard (HVY) for the co-generation plant, (4) develop detail schedules, WBS, activity costing for each of the scheduled activities, and cost drivers for these activities. (5) the owner team leaders produce definitive cost estimates for the contract after collecting the definitive estimates for different mini-scope of works, (6) the owner's team verifies the accuracy of the overall schedule with mini-scope schedules, (7) the contract team and the different team leaders for the different companies review and concur on the schedule milestone dates and the cost estimates, and (8) integrate the outcomes from each teams (different companies team).

The team leaders for different companies with the owner's team leader develop a risk management plan for executing each of the assigned mini-scopes of work.

Execution Phase

This phase is similar to the post award phase of the static contract model. However the teams manage and administer the execution of the contract so that it is not a contract administrator who administers each individual subcontractor. The mini-scopes are executed concurrently to save costs and cut execution time instead of sequentially.

Feedback /Control/ Evaluation Phase

This phase measures the progress (check), evaluates what remains to be done (act), plans the necessary corrections to achieve the preset required performance (plan), and directs or feeds back these corrections to the previous phase or activities (do).
For example, the collected benchmarks measure/compare the productivity of a team member for a certain activity (check), the next step of productivity comparison is analyzing causes of the performance gaps (act) (Dawod, 1995 (2)). The gap analysis objective is to get to the root cause of differences and developing a plan to improve the performance of the less productive companies (plan). The team leader and the team implement the plan and monitor the effectiveness of the plan (do).

The inspection activities in the static contract model are replaced by the evaluation/control/feedback phase during execution or after completion of any contract activities/tasks in DCM. This is minimize

the confrontation and conflict situations because the contract teams concur with the developed implementation methods of the PDCA. Also the inspection activities generally had to be done after the fact.

This phase is the "ignition key" for the cost reduction and continuous performance improvement plans for the DCM.

Conclusion

Although each of the four strategies of the DCM is essential for successful contract management and execution today, not all organizations implement TQM and/or ABM. These effect the ability to realize the benefits of DCM. The effect is extant to the cooperative climate between different organizations, and leads to creating a win-win climate during the life cycle of the contract.

The paper does not address the commercial and legal elements of the DCM. This may be addressed in future studies to modify the static contract model commercial and legal elements to suit the DCM concept, strategies, and phases.

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Managing in a Project/Program Environment

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Abstract

The building and construction industry could be more efficient if it used a project/program environment to de-fragmatize its organization. However, in a program environment a large program needs a Program Office in order to be successful.

The body of this paper lays out the structure and the organization of the Program Office.

Introduction

Large corporations such as AT&T and NCR procure and provide services and goods. The larger the corporation the further separated the divisions that procure are from the divisions that provide. NCR's and AT&T"s factories procure goods. NCR's and AT&T's laboratories and factories procure services from numerous contract service providing companies.

NCR's Professional Services organization to which the author belongs provides services to other companies and often facilitates the provisions of goods to these companies. The author's experience is not in the procurement side of corporate business but is in providing services and goods to companies. However, the author feels that the procurement business in the building and construction industry can benefit from understanding the project/program organization and perhaps by adopting the Program structure to run large building or facilities constructions. The author is an experienced project/program manager and provides goods and services in the project/program structure daily.

Corporate Organizations in the Nineties

Project Management is the vehicle upon which the nineties corporations organize their work. NCR and other corporations perform work today through the structure of projects and programs. This project/program structuring allows corporations to move people from different functional areas into a project to accomplish a particular work or job and then to move them back into their functional area for other assignments or off into other projects. Having people on one project from many different functional areas is common in a project. The various skills that each one brings greatly adds to the efficient completion of the project.

For example, a software system development project may have engineers assigned to it from the following different functional areas:

- Network Design
- Operating System
- Hardware Platform
- Software Development
- Project Management.

Each of these separate functional areas contains people with like skills and training. To complete the one project/program, it is necessary to assemble people from all of these different areas. Before the days of project/program management, the job or task might have been divided into different segments and assigned to each different functional area to complete his section. Then the parts might have been assembled and expected to work together in the final development stage. This fragmentation often led to integration problems.

Today the engineers from each of the different areas would be assigned to leave their respective areas for a time to join the project and to work under the project manager. The

responsibility for the completion of the whole project now rests with one organization - the project team. Where in the past the responsibility was placed on each functional department to complete his part of the whole project and it was often times someone else's responsibility to make the whole work.

Fragmentation of the building and construction industry comes about in a project when there is a separation of ownership, design, and construction. Fragmentation can cause a series of problems that untilmately result in waste of time, money, and work. As long as these functions are considered separate projects and not as projects making up a whole program with one program manager, there will be problems - miscommunications, cost overruns, etc.

In the Program environment each of the engineers will be assigned tasks in one (1) project plan and will work as a part of a team of people with one goal which is to complete the project to plan (that means to complete the project on time, to specifications, and within budget.) Taking the afore mentioned separate fragments into the Program environment one should note that each fragment of the process (ownership, design, and construction) can have a different project manager and a different set of tasks, etc. However, the projects in a program must be run by one program plan and by one program manager.

By using the Program organization structure the once fragmented parts can be brought into the whole program. Each separate organization can have people that are assigned to be a member of the Program Team. These assigned people will have only one goal and one project to work on. They are a part of the whole Program team and should be accountable for the success of the whole program.

In an organization that separates parts of the whole program into functional areas, the one team (for example the design team) may be working on several designs for different projects at one time. Priorities may be set by someone else and one project may be delayed because of the importance of another. When one organizes work into Programs/Projects, the team members from the different functional areas are dedicated to one project. The program/project environment promotes individual responsibility and accountability.

Program Management

NCR has changed its management structure to support and to develop this project/program organization. Most corporations use this project/program organization to accomplish work. In the service providing organizations, Project Management is an area of expertise that is sought after.

When one uses a program organization in the building industry to de-fragmentize the projects involved in completing a large facility, a Program Office will probably be needed. A large well run Program Office requires planning experience, and knowledge.

Program Office is Center

The Program Office is the heart of any large program. A large program cannot be successful without a good Program Office (PO). The PO is the communications center of the program. It is the base from which all projects and project team members work. It doesn't matter how diverse the projects are. They are joined to the Program through the Program Office. The PO directly supports all of the projects and all project personnel. If the Program Office works well, communications work and the probability for success in the program is raised.

An analogy that might be used to describe a large program that needs a Program Office might be based upon the structure of a wagon wheel. The PO is the hub of the wheel. All of the individual projects depend on, get information from, and feed information back to the Program Office. The wheel turns and is complete when the hub (the Program Office) is smooth, well oiled, and fully functional. The hub by itself, however, does not make a wheel. The hub is completely dependent on the spokes and the actual wheel that goes around and around. The PO is completely dependent on the separate projects and their successful individual completion's in order to make the program successful. The PO works to make each project manager and project worker successful. If the projects are successful, the Program Office's success is possible.

Program Office Staffing

The Program Office that the writer just finished was staffed entirely by contractors. Most big companies will not keep the quantity of clerical staff that is required to staff a Program Office for a large program. Companies make mistakes by trying however, to run a group of contractors with another contractor. If the PO is staffed with contractors, the PO Manager should be a qualified Project Manager that is an employee of the company who controls the execution of the Program.

The author believes that it is a mistake to have contractors supervising contractors. The PO Manager needs to be someone with long company (NCR) loyalties, a knowledge of NCR internal workings, a respect and a reputation within NCR. A contractor comes into a job without any of these traits. The PO Manager sets the tone and the rules for all of the people who work in the Program Office.

It is important that many of these contractors stay in their positions through the completion of the Program. Training and keeping good team members is important to the smooth workings of the PO. Training new people in the Program Office takes away from the time that can be spent on production. One will want to keep turnover to a minimum in the PO in order to meet productivity goals and, in the long run, to meet cost budgets. Keeping a good staff over the length of the program is a time consuming and difficult job in today's fast turnover world.

The Program Office Manager must work to develop loyalty and teamwork on the staff if a quality job in the PO is ever to be done. Teamwork and loyalty are essential factors for success when times get "tough" on the projects.

When is A Program Office Needed?

Deciding when a Program Office is needed may depend on a number of things. A PO should be organized for a large program that includes multiple projects, that involves substantial moneys to the company, and that is complicated by one or more of the following conditions:

1. Involves projects that are international and national
2. Involves multiple contracting firms
3. Involves multiple companies within the corporate structure (for example - NCR and AT&T and/or Lucent companies) supplying people to work on the project
4. Involves a project plan with extremely tight (bordering on unrealistic) time frames
5. Involves complex customer organizations or multiple organizations with cost/schedule inputs.

Setup Time for Program Office

A determination must be made at the beginning of each Program to determine if the Program requires a Program Office. If it does, time should be allowed within the Project Plan to setup the Program Office and to hire and train its staff. An experienced Program Office Manager should be assigned in the beginning to set up the processes, the organization, and the staff of the Program Office. A PO that is setup well in the beginning should save the program much time and money. PO set up time can be accomplished in as little as three (3) weeks but may require as much as three (3) months depending on the size and the complexity of the Program. Plan this setup time up front.

Database Support

There are many parts of the Program Office that will need organization and record keeping in a relational database. The Program that the author just finished used Access as the program in which to set up the numerous tables and applications that were needed. The database can be used as a library index to document the location of the many documents that the PO will be required to archive. Some of the common databases found in a PO may be (1) Team Member Database used as the location for team member records that contain required information, (2) The Problems & Escalations Database allowed the PO personnel to enter problems and issues so that they could be tracked and reported on easily.

Areas of the Program Office

There are many segments of the program that should be run under the Program Office. These parts are:

1. Project Center
2. Change Control
3. Communications
4. Staffing and Security
5. Supplies and Equipment
6. Problems & Escalation's
7. Documentation
8. Administration
9. Program Finance

1. The Project Center

The Project Center takes care of the master program plan. The author used Microsoft Project, but pushed this application to its limits. All of the individual project plans should roll up to feed the master program plan. Each project plan will probably be very detailed. The master program plan will take a lot of disk space and will require a large, fast computer. From the master program plan, weekly status reports can be produced to enable accurate and complete communication of program progress with the customer. These reports with attached issues produced each week on each of the projects are an effective way of communicating progress.

In order to keep the master program plan updated, weekly project plan updates are required from each project manager. These project plan updates were usually delivered through email, but were sometimes received through phone calls or notes. The individual plan updates are input and then all the updated project plans are rolled up to the master program plan. All of this data must be stored as archived documentation.

The project center should be staffed by a project manager who serves as a leader of the project managers in the field. The project manager of the project center also works directly with the Program Manager and the customer. The project center requires an administrative person who has expert skills in Microsoft Project, Excel, Word, and Power Point.

2. The Change Control Center

The Change Control Center should be staffed by a manager and a Change Control Clerk. The manager of the Change Control Center helps to write, categorize, document, and collect for all change controls on the program. The manager also helps negotiate change controls with the customer, and is in charge to see that requested revisions are made and then renegotiated. After the change control is initially written by a project manager in the field, the Change Control Manager runs the process to its conclusion with the Change Control being either signed or rejected. The Change Control Manager issues weekly reports which include the status of each Change Control. It is critical to keeping a project in control and profitable that tight reins be kept on Change Controls. This requires a strong, capable manager with persistence and patience.

An email address should be set up to be the depository for all change requests. All Project Managers working in the field should be able to reach this email mailbox. A technical writer was used in this department in the beginning of the project to get everyone accustomed to writing legal language in these change controls.

It is important that these Change Controls be written in language that can be defended or that can be the basis for suit if there are problems later in the program. The Change Control Manager often passed critical Change Controls to our in-house lawyer for review if there were any doubts about the terms and conditions of the work or changes we or our customer was proposing.

The Change Control Clerk, an administrative person, assists in logging all of the change controls, keeping the Change Controls filed, in gathering costing and supporting documentation for change controls, and in performing miscellaneous office duties. Gathering costing and supportive documentation for some Change Controls was a far more difficult and time consuming job than this author could have imagined. This hidden cost is seldom considered when figuring the costs of a Change Control, yet it is a cost someone pays to collect on the Change Control. As we become more accustomed to working in a Program Office environment, we will add in these hidden costs more effectively. Collecting on signed Change Controls can be difficult and costly.

At NCR, Project Managers are careful to follow the Change Control Process that is outlined in our Global PM (the NCR Practices Documents for Project Management). The Change Control Clerk needs basic computer skills and good organizational and follow-up skills.

3. Communications

Get a person to help!

The Program Office is the communication center for the program. All project managers and other field personnel on the project should know that if they call the Program Office, they will get someone who can help them. Our customer used this general Program Office number often knowing that they could always get to a real person who would try to help them get the problem solved. This PO phone number should be used similarly to a Help Desk service for the projects team members and should be treated as a critical support item in the Program Office.

Contact List

The Program Office must maintain communications lists of all the people who work on the projects. This author maintained team member information in the program Team Member Database. It was from this database that the Contact List was made. One must be careful not to pull proprietary personnel information such as social security numbers into this report. The author pulled this report only for the people who were currently working on the program.

A contact list may have to be produced each week. These contacts lists can be very valuable in keeping track of people in an international project. It provided a document that contained phone numbers and pager numbers for all of the people working on the program. Various reports could be produced as they were needed from this database.

Email Lists

As the PO Manager, the author kept numerous email lists of everyone on the project. The Access databases that were kept had no simple interface to the mail system was used. It was necessary to manually keep these lists updated. These lists were categorized several different ways. The predominant listing was divided by job function. Email was used as the mass media communication tool for the program, and these email lists were critical to communications.

Viruses

The PO must continually guard against virus's. As the communication hub of the project, the Program Office received close to 1000 emails each day. The author, as the Program Office Manager, received up to 350 emails per day when the project was at its peak. The author was receiving these emails from all over the world from all different kinds of mail systems. With all of this mail coming in daily, the PO was subject to virus attacks. It was necessary to institute very careful virus scans regularly. The author hopes that technology improves to help in the defense against computer viruses soon.

Project News

This author, as PO Manager, started writing a weekly news document about half way through the year long program. Included in this news document was a listing of the latest documentation that was available and where it was located. In this newsletter was invitations to team building events and any other project information that might be important to all. Disk space problems and scheduled maintenance and repairs on the Program Server were examples of other information that was included. This news document was an effective communications vehicle and in this capacity helped the scattered project teams.

Steering Committee Meetings

Minutes of the Steering Committee Meetings that were held each day were taken by the Program Office and were emailed to the team members on the project. This was a good means of overall project status communication as each project was discussed when the project manager called into this meeting each morning. The records of these minutes were filed and stored. Anyone who had to leave the project for a short period of time (1 week for example) could borrow these minutes and read them to catch up on the happenings of the project. These minutes were also a good history by date of when project events and problems happened.

4. Staffing and Security Center

The Staffing and Security Center did not hire people to work on the project. The hiring of personnel was left to the different departments who paid for and directed the people. This center took care of the program staffing documentation and the program security needs. Everyone who came onto the program had to go through the staffing and security center in the Program Office. All of the necessary papers to be filled out and information was distributed, collected, and maintained in this center.

We distributed from this center, the Welcome Packets that we had prepared for each new team member. The Welcome Packet contained all of the forms that had to be filled out, directions and explanations on how to get drug tested and how to take the required classes, explanations of the program in general, a recent contacts list, and other "getting started" information. A short verbal explanation and tour of the Program Office was provided. In the tour an introduction to the Program Office Manager was made if the PO Manager was available. This introduction and tour was good press for the PO.

The administration person who handles the Security and Staffing department had general office skills. This person has to work through screens in Access but does not have to be an expert in Access. This person should be personable with good organizational skills and be able to handle several projects at one time being sure that nothing is left undone at the end of the day.

5. Supplies and Equipment

A program of any size uses a lot of office supplies. It is recommended that someone in the Financial Department of the program Office accept supply requests, inventory supply closets to keep them supplied, obtain appropriate buying approvals, order, and distribute supplies. Even items needed in the field should be tracked and inventoried through the PO.

6. Problems and Escalations

Any program will need a system that will capture and follow through to resolution, problems that arise from the field. This author used an internally written escalation system based on an Access database to handle problems and problem escalation. Anyone on the project could report a problem and expect it to be distributed to the appropriate escalation person within four (4) hours. Rules and regulations were established so that a problem was reported to the appropriate problem solver quickly either by a phone call and/or through email. Each evening a report was printed of all the open problems with their escalations. This report was used in the morning Steering Committee Meetings for discussion and resolution.

A concrete system and resolution/escalation path is necessary in the large program. In a smaller project everyone just learns "the ropes" of whom to go to when they need something done. In a large program that is moving rapidly, there is no time for a new work force to learn these rules. It is much more efficient to have the system clearly defined so that everyone can immediately know how to work to get their problems solved.

7. Documentation

Reproduction

The Documentation Center contained different departments. One part of the documentation center was the Reproduction Department.

Technical Writing

It was in the Documentation Center that we slotted the technical writing section of the PO. Technical writing may not be a necessary component in a program in the building and construction industry. However, in the computer industry where manuals are created technical writing is important to make manuals and other documentation clear, legally correct, and "pretty".

Archiving

The documentation center was responsible for keeping all of the signed documentation. It was important that these original signed contracts and milestone signoffs were carefully

kept in locked cabinets. This center also kept copies of all of the manuals, process documents, standards documents, and other documents that were produced and used in the project. The author recommends setting up an indexing system in an Access database in the ramp-up time of the Program Office.

Program Server

The Documentation Center lead was also responsible for the file structure of our program server. A structure should be designed for this server to keep things organized before the project begins. There should be complete documentation explaining this design and structure so that everyone can use it from the beginning of the project.

8. Administration

PO Manager's Office

The Office of the Program Office Manager is a busy place. Hundreds of calls and emails come into this office. This author quickly discovered that assistance was needed in order to handle the daily operations.

Minuting

The Program Office is responsible for keeping and publishing minutes for the program meetings. Minuting can sometimes be considered a lowly, unimportant task, but this is a mistake. As the project became more complicated and tempers flared, minutes of meetings became an important record of prior commitments and historical information. Program team members often researched minutes of meetings to establish documented points for the customer. Minuting is an important record in a Program Office system and should be carefully kept at all times.

9. Program Finances

All program finances were handled in the Finance Center. Invoicing for the customer, bill authorization of payment, checking and verification of bills, time costing, etc. were handled in this area. The Program Manager and the Program Office Manager must work closely with this department. Executives and higher management will call on the Program Finance Center for reports on program finances regularly. It is important that these reports be delivered in a timely fashion and be professionally done with accuracy and full detail.

This center had to authorize, by getting appropriate signatures of approval, payments of all the bills that the program incurred. This center was responsible for checking contractors time sheets with bills and their expenses. At the close of each month, this center needed additional staff in order to get the end of month work completed. The PO Manager moved qualified people from other centers in the PO to cover this extra work load.

The Finance Center is a very important part of any Program Office. The Program Manager and upper management will depend greatly upon and will work closely with this

area. One must choose a leader in this area that can handle this attention, stress, and scrutiny.

Conclusion

The Program Office is a vital central part of a large program. For the program to be successful, one must have a well run, efficient, and well organized Program Office. The successful execution of the functions of the PO are crucial for the program to be able to be completed "on time, within budget, and meeting specs". Choose the PO Manager carefully. One cannot manage large Programs without the help of a good Program Office.

By unifying the different segments of the job in the building and construction industry under one whole program, different organizations, responsibilities, and project time can be managed. However, in a large program one may need a Program Office to support the program and the Program Manager. Organize and staff it well.

An Investigation into the Relevance and Potentials of Alternative Dispute Resolution in enhancing Construction Project Performance.

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Abstract

The aim of this paper is to investigate the potential of ADR in enhancing cooperation and improving relationships between the different parties to the construction project. The organisational set-up of the construction project can provide the flexibility, resources, knowledge and ability to innovate and develop new ideas. However, the management of conflict between the different groups or/and parties to the project will be fundamental to the success of the project. The paper will also present the results of an investigation of the construction industry's perception of the suitability and benefits of ADR in reducing the level of conflict and enhancing relationships between the different parties. The paper will examine the potential for abuse of ADR as well as the benefits for management in adopting the same fundamental principles of ADR in their management of the project.

KEYWORDS: ADR; CONFLICT MANAGEMENT; INNOVATION; DISPUTES; ORGANISATIONAL BEHAVIOUR.

INTRODUCTION

The need for business to make the best use of the resources available at its disposal may have been given top priority during the recession of the early 1990's, during the recession when business organisations were struggling to survive a severe world wide economic recession. This period was an opportunity not only for businesses to examine the effectiveness and efficiency of the traditional, well established practices and procedures used in providing products and services to their customers, but also this period of reassessment witnessed the emergence of customers (clients) as champions of change. Business clients, competing for shrinking markets during the recession, were demanding better products and higher quality services from their suppliers at a lower cost.

The services and products provided by the construction industry would represent a major capital expenditure for most, if not all, of its customers. It is, therefore, not surprising for the construction industry to come under pressure from its clients to improve its efficiency and effectiveness. There is evidence of clients taking leading roles in facilitating hange

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and encouraging innovation in the UK construction industry (Latham, 1994). Establishing better relationships between the different stakeholders/parties to the construction contract is essential to achieving a satisfactory outcome. It is paramount that the management of the construction project should have the skills and knowledge of how the differences between the different contributors to the project could be used to enhance the effectiveness of the process rather than an obstruction or distraction. Recently, management skills appeared as one of the criteria for selecting suitable contractor by clients such as BAA. This maybe seen as evidence of the industry's increased awareness of the importance of conflict management skills to the successful delivery of the construction project.

An organisation's ability to respond to change, challenges and opportunities effectively, is greatly affected by its ability to create new ideas and innovations. This will be achieved by its ability to harness the different, and sometimes conflicting, views, ideas and behaviours of its members. Conflict, therefore, is beneficial and

> *should be encouraged as sources of additional information for the decision maker, who seeks the best solution from two or more potentially, mutually exclusive alternatives.* (Sing and Vlatas, 1991).

CONFLICT MANAGEMENT

The term conflict has been used to describe a wide range of attitudes, behaviours, organisational and environmental conditions.

> *It has been related to describe the antecedent conditions of conflict behaviour; the effects upon participants as they perceive the conflict situation develop; and the ensuing effects and action with which it is met.* (Griffith, 1984).

Gardiner and Simmons (1992) defined conflict as

> *any divergence; or nonconformance to requirements of a task, activity or process.*

The outcome of conflict may be positive (functional) or negative (dysfunctional). Whether conflict takes a constructive or destructive course is influenced by the sociocultural context in which conflict occurs, because differences tend to exaggerate barriers and reduce the likelihood of conflict resolution. Gordon (1993) suggests that beside the issues involved, the orientation of the parties is likely to effect the outcome of conflict. Parties with cooperative attitudes are more likely to seek a functional outcome than those with individualistic or competitive attitudes. Effective managers need to learn how to create functional conflict and manage dysfunctional conflict. They should develop and adopt techniques for diagnosing the causes, understanding the nature of conflict and identifying the means by which conflict can be transformed into productive forces in the organisation. Therefore, the objective of conflict management should be to ensure that creativity and problem solving is the outcome of conflict. Management needs to reconcile and mediate between conflicting views to allow the cooperation and coordination necessary to implement a desired course of action (Griffith, 1984).

between the different parts of the organisation. Against this background it is important to remember that the organisation of construction projects has been subjected to a number of changes over the last thirty years, through the introduction, development and adoption of different procurement methods. The number of amendments to standard forms of contract used with the different contract systems may be seen as evidence of the manoeuvring by the different parties, through their representatives on the drafting committees, to strengthen their power position in the project organisation. The power structure in the project organisation will affect the behaviour of individuals and groups towards each other. The increased level of interdependence between the different groups will increase the influence of the power structure on the function and effectiveness of the different groups in preforming their tasks(s) and the organisations' ability to achieve optimal co-operation.

The need for the construction industry to improve its performance requires greater cooperation between the different parties in delivering more innovative solutions and products. This has given rise to the use of the principle of "Partnering" in order to create a win-win situation in construction contracts. The adoption of this procurement route is hoped to reduce conflict, and to increase trust and cooperation between the different parties (partners) to the project.

Recent papers and reports have suggested a number of definitions of what partnering is, or what it should be. Current definitions would advocate greater interdependence to stop the struggle for power. Instead of competing and "political manoeuvring" by one party to improve its position at the expense of others, the different parties would look for each other to achieve their individual goals. Co-operative behaviour and relationships would be of interest to all parties.

Mastenbroek (1993) argue that in such situations where the different parties have, or should have, approximately equal power, management should intervene by:

- Changing the network (organisation structure).
- Improving task co-ordination.
- Structuring negotiation.
- Improving interpersonal relationships.

Management will need to mediate and negotiate and/or facilitate negotiations between the different parties to ensure conflict becomes a positive aspect of the organisations' activities before the potential combatants become entrenched in their opposing positions.

CONFLICT RESOLUTION OR CONFLICT MANAGEMENT IN CONSTRUCTION PROJECTS

The different methods that are available to "deal" with conflict in construction adopt a formal process when communications have already broken down between the differing individuals/parties. Litigation and Arbitration and Alternative Dispute Resolutions (ADR) provide the routes to resolve conflict when the disputants cannot resolve their differences. ADR differs from the other two because of its potentially positive effect on relationships.

There are various types of ADR , the four main methods being: Mediation, Conciliation, Mini-trial and Adjudication. Mediation and conciliation provide the opportunity for a third party to intervene and re-establish communication to bring the parties to a settlement. The principle of mediation and conciliation provides an opportunity for management to preserve and stimulate the "we-feeling" in the organisation. Indeed, studies into the experiences of organisations using ADR have pointed out that one of the results of using ADR methods have been improved relationships (Carver & Vondra, 1996). The Centre for Dispute Resolution (CEDR) in the UK has reported that parties that have adopted mediation (an ADR procedure) have achieved success, nine out of ten times in settling disputes (Mackie, 1995).

The principle of mediation and conciliation allows management to intervene in the decision making process in the design, development and construction of the building. A process of teamwork, consensus building and the committed participation of all parties would enhance the effectiveness of the organisations' decision making. Nonetheless, changes during the construction process may will appear to create opportunities and threats to the different parties/professionals. The consequent repositioning and realignment of the rewards/profits and penalties/losses will be the battle ground. Management intervention should ensure that these changes would not disturb the balanced relationships achieved at the start of the project.

THE INVESTIGATION

A survey was undertaken to examine attitudes and perceptions of the relevance and effectiveness of ADR in improving relationships and in increasing cooperation in construction contracts in the UK construction industry. Sixty three questionnaires were sent out to law practices involved in construction and contracting firms. Forty nine valid responses were returned. The sample consisted of twenty nine law practices and twenty contractors. In addition, interviews with four contractors or consultants were conducted to expand on some of the issues and elaborate on the results of the questionnaires. Four main research questions were set. The results from the questionnaire and interviews and their analysis will be presented following a presentation of these questions.

Question one: As the construction industry is traditionally an adversarial industry would the availability of cheaper `without prejudice' forms of dispute resolution create an increase in volume of disputes, as parties maybe more willing to `try their luck' on smaller and less certain claims.

Question two: ADR relies on non binding discussions on a compromise being made between parties in dispute, this is based on rational argument not necessarily on a legal argument. Could good management save cost and time by adopting the same rational stance to manage and resolve conflict and eliminate the need for ADR.

Question three: To what extent small contractors or subcontractors would consider ADR as a tool for securing a quick and cost effective solution, or, a system that can be abused by the more financially powerful party creating further delays and interruption to more definite solutions.

Question four: Would ADR be as effective, or more effective, if the parties were unable to use litigation and arbitration as a tool for bargaining.

Question One

The analysis of the questionnaire showed that respondents' judgement on the effectiveness and cost effectiveness of ADR techniques in resolving disputes in construction contracts has shown an overwhelming opinion that ADR offered a cheaper form of dispute resolution (table 1).

However, the same group was split, nearly 50/50, as to the effectiveness of this cheaper alternative. Further analysis showed that law practices are more sceptical of the effectiveness of ADR techniques (figure 1). Comments from law practices have stressed that ADR techniques are only suitable for a limited number of cases and that they require the commitment of all sides to use a particular technique. A contractor commented that ADR is generally only relevant if there is an existing/continuing relationship between the parties.

Further comments from contractors tend to indicate that their dissatisfaction with available dispute resolution routes arises from their "Lawyerisation". This was reflected on the data which showed that the majority of contractors felt that Arbitration could be modified to eradicate the need for ADR, which was the opposite view of law practices (figure 2).

TABLE 1: THE SAMPLE'S PERCEPTION OF THE EFFECTIVENESS OF ADR

	CONTRACTORS	LAW PRACTICES	BOTH
ADR is a less effective solution to Litigation or Arbitration but cheaper than both.	28	45	40
ADR is a less effective solution to Litigation or Arbitration with the potential to be as costly.	17	13	12
ADR is a solution as effective as Litigation or Arbitration with the potential to be as costly.	10	4	7
ADR is a solution as effective as Litigation or Arbitration and less costly.	45	38	41
	100%	100%	100%

THE CONSTRUCTION PROJECT STRUCTURE

The organisational set-up of the construction project is influenced by several factors relating to the product (i.e the building), customers (clients/end users/stakeholders), the contractor's corporate strategy and the economics of the project (at micro/macro levels). The role of these factors in shaping the procurement strategy would be greatly affected by the orientation of the different parties that will be contributing to the process of development. Whether the parties adopt cooperative or competitive/individualistic attitudes would further affect individual attitudes and relationships within the project and the likelihood of a more positive outcomes from conflicts (Gordon, 1993).

In this temporary multi-system the different parties will have to

> *reconcile their own long-term objectives with the higher level, but short-term objectives of the project. This gives rise to potential conflicts* (Davidson and Mohsini, 1987).

The construction site is a complex inter-organisational world in which many different types of specialist knowledge are required at different stages in the construction process. Therefore, conflict management is an inescapable part of the construction manager's role and responsibility. Griffiths (1984) noted that

> *when confronted with a potential conflict situation, construction management purports to have little knowledge of the theoretical nature of conflict,..... The need for concise understanding of conflict phenomena is demanded. It requires clear recognition, understanding, analytical assessment, and moreover, it must be managed effectively.*

Therefore management has a central role in the creation of an organisational environment conducive to a positive outcome of conflict.

CONFLICT MANAGEMENT AND ORGANISATION STRUCTURE

Organisations are seen as networks of interdependent, co-operating and rivalling groups or subunits that have their own interests. Mastembroek (1993) explain that the systems model, one of the most common paradigms in organisational sociology, which has been used in analysing and understanding organisations is too one-sided and difficult to apply in practice and does not provide a framework for intervention by management. Management intervention could be in the form of organisational development and planned change, both aimed at solving organisational problems and develop stimulating structural and cultural conditions in organisations.

Mastembroek's analysis of the "power and negotiating relations" may be used to explain and analyse the relationships between the different parties to the construction contracts. "Power relations" between individuals and groups in an organisation is categorised by the attempt to strengthen one's influence and position in respect to others. "Negotiation relations" refers to the decision making process in order to share the available resources

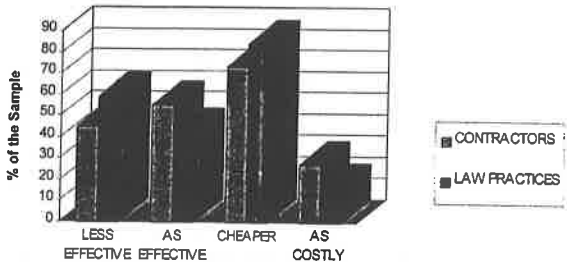

Figure 1: The Effectiveness of ADR compared with Arbitration and Litigation

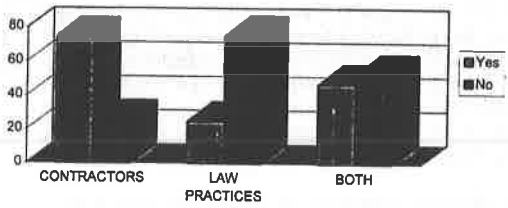

Figure 2: Could Arbitration be modefied to eradicate the need for ADR?

The following comment from one contractor indicates why law practices disagreed.

> *Originally arbitration was indeed designed to be a quicker and more cost effective means of dispute resolution. The inclusion of lawyers and counsel in this procedure has in fact reversed the original objective.*

The availability of a cheaper forum of dispute settlement may make parties less concerned about entering a formal dispute resolution process for smaller claims that would perhaps not be worth pursuing using arbitration or litigation. A suggestion that entering arbitration proceedings with all its associated costs and delays could possibly concentrate the minds of the parties who would then only follow the arbitration path if they really saw no other alternative. There was little evidence from the survey to support the suggestion that ADR would lead to an increase in volume of disputes. It was suggested that when the ADR culture is well settled in construction then more disputes may well find their way to ADR before any of the parties would consider an alternative. A firm of Consulting Engineers stated that:

> *Differences will always occur for one reason or another... Many will be settled quickly without the need for ADR, whether that exists or not. It could be that a higher proportion of differences are referred to ADR than would go straight to arbitration or litigation if there was no agreed ADR procedure, but the proportion going to arbitration and litigation would be less if there was ADR than if not.*

Question Two

Both law practices and construction companies questioned and the parties interviewed seem to concur that management and professionals within the construction system could eliminate the need for systems such as those used in ADR by adopting the same rational stance as, say, the mediator. However, respondents differed in their views of the constraints and obstacles that make this impossible. Tendering systems, procurement methods, attitudes of the different parties were some of the reasons why respondents felt that this question may be asking too much of management. The central issue seems to be the impartiality of the professional team. Architects and consultants were criticised for being too close to the client. One contractor commented:

> *The Architect is supposed to be neutral! So long as the professional team is employed by the employer you will have an adversarial attitude. In the current environment only a neutral could really mediate effectively unless the employer loosens the reins.*

This view is supported by the Construction Industry Council report (1994) as they suggested that the erosion of the contract administrator's role as quasi-arbitrator in contracts, coupled with tender systems backed by government policy on tendering encouraging the type of low tenders which leads to claims, are two of the main causes of dispute.

The need for the integration of the concept of mediation in education was highlighted as an important component of any educational programme for construction professionals. It is suggested that if professionals could develop management skills to manage disputes properly then the need for a third party to act as a mediator would be reduced.

Question Three

The rate of return of the questionnaires from subcontractors were disappointing. The main reason offered was unfamiliarity with ADR. Comments from interviews suggest that small contractors and subcontractors may need a dispute resolution route other than a non-binding method like ADR. Thierer (1992) stated that ADR should not be used when the disputant have very unequal power. There are perhaps more relationships in construction contracts in which the parties have unequal financial stature than not. Standard forms of contract to some extent set out to even any imbalances in risk and burden between the parties, most also have arbitration clauses that will give the parties a structure form for dispute resolution that is less prone to abuse by the stronger party than ADR is perceived to be. Sir Michael Latham suggested that legislation should be used to address some of this imbalance, for example by banning certain practices by which the main contractor can hold the subcontractors' money back and other onerous clauses that are usually added to the contract.

The degree of interdependence that could exist in construction projects between the main contractor and subcontractors would create the setting for collaboration in creating new ideas, innovation and problem solving. Mastenbroek (1993) looked into the contribution of Frederick Taylor to the theory of organisation and how it helped consolidate, may be unintentionally, the unequal power in organisations. This would suggest that in addition to the legal changes, there is a need for a very important cultural change to leadership styles and team building technique if one is to create a more cooperative environment.

Question Four

Comments from the survey and interviews have shown serious concern of the possible abuse of ADR either by parties, using it to prolong non-payment or as a means of getting information about the other party's case. Mackie (1992) suggested that companies should not drop legal action in favour of mediation as it may be a vital negotiating tool during meetings and make the abuse of mediation less likely.

Respondents who expressed support for the adoption of ADR suggested that they would like to see ADR clauses written into standard forms of contract to give it more credibility. However, that would depend very much on the attitude and relationship between the parties. One interviewer commented that;

> *It is not unusual to see mediation being used as part of a process ... People do not usually come to mediation until the litigation process has been under way for some time and has really concentrated their minds. Mediation works because the parties come to appreciate very clearly the balance of cost and risk involved in litigation.*

CONCLUSION

The construction project is an organisation where the different contributors should be allowed, encouraged and motivated to innovate and create new ideas and solutions. Management should intervene by an effective coordination, restructuring and management of the interfaces between the different units. Improving relationships between the different parties either through the establishment and the maintenance of effective communication, formal or informal, or by developing the skills for managing and coping with conflict through training and regular meeting/workshops. Such intervention would contribute to the creation of trust which is essential for cooperative relationships.

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TOWARDS EFFECTIVE CLIENT PROCUREMENT: ASSESSING CONTRACTOR RISK WITH FINANCIAL RATIOS

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Abstract

Evaluation of the contractor by client organisations forms a very crucial part of the client's procurement strategy for construction services. Current practice in undertaking such an evaluation often employs factors that are directly project-related. More important in this regard is the overriding influence of the tender price as a criterion for contractor selection. In the prevailing business climate within construction, the need for such an evaluation to take on board the susceptibility of the contractor's whole organisation to financial insolvency is apparent. This should allow for a clear awareness of the risk of engaging the services of a particular contractor by the client. The paper reviews various financial measures and tools that have been developed, or found application in the risk evaluation of enterprises. It puts forward a case for the incorporation of some of these tools in assessing the overall risk associated with the client's engagement of the services of a particular contractor.

Keywords procurement, contractor, client, ratio models, insolvency

INTRODUCTION

Construction procurement in a very broad sense encompasses the variety of activities needed to acquire the design, management and installation of required inputs to ensure the complete delivery of construction projects for clients (Yates, 1991; Franks 1990). The fragmented responsibility for the design and the implementation of the designs, combines with the uniqueness of construction projects to create an industry environment where the choice of a system for procurement is diverse and often complex. A fundamental activity involved in this complex process is the selection of appropriate contractors to implement the project. This may occur at the early stages of the project or after the project is advanced appreciably, depending on the procurement system adopted. It is essential that the client's decision regarding the selection of contractor is done on a *get-it-right-the-first-time* basis. The impact of getting this activity wrong for procuring construction can range from a litigious climate for

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the project, to the possibility of contractor bankruptcy. The cost of selecting the wrong contractor can, therefore, be immense to the client. To obviate these possible adverse consequences, this paper proposes that bankruptcy risk of contractors that deliver the client's facility should form a crucial part of the selection criteria.

The paper first discusses construction procurement as an investment activity of the client, and reviews the conventional criteria that are employed by clients in the selection of the organisations to fulfil this venture. It makes a case for the inclusion of contractor bankruptcy potential in the selection criteria to reduce the risks borne by the client. Various approaches for undertaking this evaluation of bankruptcy potential with financial ratios are presented, from which client organisations can learn.

CONSTRUCTION PROCUREMENT AS CLIENT INVESTMENT

The greatest proportion of clients engage in primary business activity not directly related to construction. Their investment in construction is often a one-off experience which involves a relatively huge investment in a physical asset, with substantial capital outlay by the client prior to the delivery of the conceived facility. This takes the form of stage payments to the service providers and can result in locked up capital for the client over a considerable period of time. The size of such an investment usually has strategic consequences for the client's organisation. This naturally exposes the client to substantial risks. A significant proportion of this investment risk is managed through the application of contractual conditions. Latham (1994) provides several important suggestions for addressing these contractual relationships to benefit all the participants of the industry's supply-chain. However, it has to be emphasised that such contractual conditions do not eliminate the client's risks altogether, but only ensures that they are mitigated.

Client options for procurement

Of equal importance in managing these risks is the system of procurement for delivering the project. The various options for procuring these services were categorised by Masterman (1992) to include *separated* and *integrated* systems, depending on the project management structure that culminates.

In the *separated* system, responsibility for the design and its eventual implementation are undertaken by several organisations operating from different establishments, but who act in close co-operation to achieve the project. Typical examples of this system of procurement include the *open competitive* and *selective tendering*, as well as most *negotiated* and *serial contracts*. Their major characteristic is that the project delivery progresses as a sequential process, whereby the design is largely completed before work commences on its implementation. Responsibility for managing these two phases is divided between establishments appointed by the client to act as consultants and contractors. Craig and Davenport (1996) describe various factors that should facilitate the selection of contractors for the various *separated systems*. The administration of the *separated systems* however, is often characterised by disputes which increases client risk for projects (Conlin et al., 1996).

The evolution of *integrated* systems, whereby the design and its implementation are retained under the managerial responsibility of a single corporate establishment is a motivation of having a one-stop shop for the client. Examples of these *integrated* systems include the *design and build, turnkey*, and *build-own-operate-transfer* contracts. The single point responsibility of these systems, whilst having the potential to reduce disputes, increases the client's risk regarding contractor bankruptcy. In recent times the need to minimise the client's risks in procuring construction facilities has led to alternative forms of such integrated systems such as *partnering*. The requirement of *'openness and trust'* that is supposed to characterise this voluntary and flexible procurement method has the capacity to minimise the client's risks for the project. In practice however, clients need to establish that such open relationship is entered into with establishments that are not potential bankrupt organisations within the foreseeable future.

CLIENT SELECTION CRITERIA

The contractors selected to undertake this investment are as important as the contractual conditions and other arrangements adopted to manage the client's risks. Irrespective of the system adopted by the client, there are certain features that normally drive the selection of a particular organisation to deliver some or all the activities of the procurement process. The client's criteria often centre on three functions: time, cost, and quality that contractors associate with the proposed project. According to Masterman (1992), these requirements are normally expressed as:

- value for money;
- avoidance of latent defects;
- reasonable maintenance and running costs;
- durability of the facility;
- contractor performance on previous projects regarding time, cost and quality;
- ability to maintain a harmonious business relationship; and
- minimising the client's liability during the project.

The orientation of the client's criteria outlined above is centred on projects. This in itself is very useful. However, the absence or little emphasis placed on the long-term financial viability of the contractor could in some cases prove quite costly, and provides the rationale for utilising bankruptcy evaluation for contractor selection.

Need for long-term contractor evaluation for major projects

Construction has always experienced a relatively high proportion of insolvency compared to the rest of the general economy. In recent times the decline in orders for the industry, as a consequence of the recent global recession, has escalated competition, with record levels of corporate collapses in the industry (Thorpe and McCaffer, 1991). Construction clients need to become more attuned, in such a high risk industry, to the potential for failure of the companies whose services they engage, for which recent events have shown that no organisation can be excluded. This could be accomplished primarily through the application of financial evaluations among other factors.

The incorporation of bid and performance bonds in most international contracts seek to minimise clients' exposure to such risks. These are underwritten by commercial banks and insurance companies. The criteria employed by the financial institutions as a basis for taking on the contractor's liability focus not only on the project specific characteristics, but also encompass the long-term financial viability of the contractor. Their decision to provide the guarantees required by the conditions of the bonds are driven more by the financial stability of the contractor. Their approach presents a good example which should inform the way construction clients evaluate the contractors who undertake their projects.

ENHANCING CONTRACTOR SELECTION WITH BANKRUPTCY EVALUATIONS

The conventional method for predicting the tendency of a contractor becoming insolvent rely on the signals generated by its financial ratios. This are normally undertaken by applying a single ratio measure in isolation. Its inadequacy for providing accurate predictions has led to the emergence of ratio models and other composite ratio measures developed to overcome the weaknesses inherent in the application of single ratios (Inman, 1991). The ratio models have been developed for application in both construction and non-construction industries. The primary motivation for applying such models to the construction industry is to minimise risk for client organisations and corporate lending institutions that usually have a direct business relationship with construction companies (Edum-Fotwe et al., 1995). The next section outlines examples of bankruptcy evaluation methods that have found application both in construction and non-construction industries.

Bankruptcy evaluation methods

Subjective index

The subjective index method employs an expert's perception of an acceptable level for the financial figures of a company, to derive a composite measure of its performance and potential for continued financial stability. These methods are generally applied by corporate lending institutions that have to assess overdraft and bond applications by construction companies.

A notable example in this category is the index of risk approach. This utilises a subjective assessment of a combination of several relevant financial ratios to assess the vulnerability of a company to possible insolvency and hence disqualification for credit. The original concept was developed by Tamari (1978). This work identified the ratios listed in Table 1 as those considered by executives of credit-granting institutions to be relevant, for assessing applicant companies. Table 1 also presents the maximum subjective weighting associated with each of the ratio variables for deriving the index of risk. The Tamari index was composed of two types of variables. The first type comprised the first three ratios in Table 1, and measured the absolute performance of the company. The second type utilised the next three ratios in Table 1, and evaluated the relative standing of a company with respect to other companies in its market sector. A company is allocated points for each variable for these last three variables, based on the statistical distribution of its counterpart ratio value within the

population of its category of companies. Table 2, 3 and 4 present the subjective point system of Tamari to evaluate a company for each ratio variable in the index of risk. To apply the risk of index approach, a company is evaluated for each variable, based on the classification ranges in Tables 2, 3 and 4. The points for the individual variables are then aggregated to obtain the index for the company. The maximum aggregated points for any company is 100. A high index or score of aggregated points, indicates a favourable financial standing, less susceptibility to bankruptcy, and hence less risk for the client. The mean

Table 1. Index of Risk Assessment

RATIO	MAXIMUM POINTS	POINTS AWARDED
Equity as a ratio of total funds	25	
Profits trend to value of production over 3 years	25	
Current ratio	20	
Value of production to inventory	10	
Sales to trade receivable	10	
Value of production to working capital	10	
Total [index -I]	**100**	

Table 2. Subjective point system equity as a percentage of total funds

Ratio	R value (%)	Corresponding points
Equity as a ratio of total funds	R > 50	25
	40 < R < 50	20
	30 < R < 40	15
	20 < R < 30	10
	10 < R < 20	5
	R < 10	0

R represents ratio value for company

Table 3. Subjective point system: trend of profits and current ratio

Ratio	R value measure	Equivalent points
3-year trend of profits/value of production) Current ratio)	Uniform annual rise in profits	25
	Non-uniform annual rise in profit	20
	Profits every year but declining trend	15
	Loss in year 1 followed by profits	15
	Loss in a year other than the first	10
	Loss in the first and second years	5
	Loss in all three, or the last two years	0

R represents ratio value for company

Table 4. Subjective point system: strategic group assessment

Ratio	R value for strategic group	Corresponding points
Value of production to inventory)	Upper quartile	10
Sales to trade receivable)	Second quartile	6
Value of production to working capital)	Third quartile	3
	Lowest quartile	0

R represents ratio value for company

position of the index of risk. 50. represents the position of the average company. Companies scoring less than 50 are considered as potential bankruptcy establishments. It has been argued by Edum-Fotwe et al. (1995), that standardising the subjective assessment for particular industries can provide a greater scope for its acceptance.

Ratio Models

Ratio models are of a more sophisticated nature. They combine a number of single ratios in multivariate analysis to establish mathematical relationships for predicting a safe level above which a company's performance is considered as acceptable. The use of these ratio models to determine chances of survival for a company, has been of considerable interest to researchers in both general business (Edmister, 1972; Altman, 1983; Taffler, 1983), and the construction sector alike (Mason and Harris, 1979; Abidali, 1990; Russell and Jaselski, 1992).

I. Non-construction ratio models

Perhaps the most popular of these models is the one developed by Altman (1983) who employed a multivariate technique to establish a prediction model with financial ratios. His model utilised data drawn from large US companies outside the construction industry. The combination of several weighted financial ratios yielded a single index (Z-Score), which classified companies as failing, at risk, or non-failing. Because of the large number of variables found to be significant indicators of corporate financial problems in previous analyses, Altman (1983) employed twenty-two ratios considered as potentially helpful variables for the purpose. Five ratios were emerged as the best predictors of bankruptcy. His analysis produced the composite model:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5 \qquad \text{Eqn-1}$$

where:
X_1 = working capital / total assets;
X_2 = retained earnings since inception / total assets;
X_3 = earnings before taxes and interest / total assets;
X_4 = market value of equity / book value of total debt; and
X_5 = turnover / total assets.

Accordingly, companies were classified as: Z< 1.8: certainty of imminent failure; 1.8 <Z< 2.7: 'grey area', where companies were deemed to be at risk; and Z> 2.7: long term solvency. Taffler (1983) utilised data from British companies, and developed a four-variable Z-score model in the following form:

$$Z = 0.53X_1 + 0.13X_2 + 0.18X_3 + 0.16X_4 \qquad \text{Eqn-2}$$

where:
X_1 = profit before tax / current liabilities;
X_2 = current assets / total liabilities;
X_3 = current liabilities / total assets; and
X_4 = turnover / total assets.

Taffler (1983) suggested a score in excess 0.2 as being characteristic of a company with good long-term survival prospects. A company scoring below zero was regarded as exhibiting the same characteristics as companies that had already failed.

Edmister (1972) conducted a similar analysis for small businesses, initially utilising a list of 19 financial ratios. Edmister concluded that a single financial function was inadequate to classify small businesses, and that a number of analyses should be combined to discriminate effectively between sound and potentially failing business. Accordingly, Edmister outlined the five methods listed below for the analysis, which are applied individually to each of the 19 ratios. He concluded that at least three such methods were required to effectively predict solvency or insolvency for small businesses. The potential for confusion as a result of the complexity arising from analysing that many ratios with each of the five methods is quite obvious.

- Level of the basic ratio.
- Trend of the ratio over a three year period.
- Three-year averages of the ratio.
- Combination of the ratio's trend and the most recent level.
- Relative level and relative trend compared to industry averages.

Robertson (1984) developed a ratio model which was supposed to have general applicability to all industries. He affirmed that there were *a priori* determinants of corporate failure from their financial ratios. Ratios exhibiting such predictive characteristics were employed. His model, presented as Equation-3, combined five ratio variables. The rationale of a ratio model applicable to all industries assumes that the level for each of the ratio variables in the model should be the same for the commencement of bankruptcy in all industries. This argument overlooks the contribution of industry-specific factors to a company's financial performance.

$$Z = 0.3X_1 + 3.0X_2 + 0.6X_3 + 0.3X_4 + 0.3X_5 \qquad \text{Eqn-3}$$

where:
X_1 = (Turnover - Total Assets) / Turnover;
X_2 = Profit before tax / Total Assets;

X_3 = (Current Assets-Total Debt) / Current Liabilities;
X_4 = (Equity-Total Borrowings) / Total Debt; and
X_5 = (Liquid Assets-Bank Overdraft) / Creditors.

II. Construction specific models

The foregoing models were developed generally for other industries. Mason and Harris (1979) developed a six-variable model specifically for the construction industry. Their model was established with a multiple regression approach and presented as:

$$Z = 25.4 - 51.2X_1 + 87.8X_2 - 4.8X_3 - 14.5X_4 - 9.1X_5 - 4.5X_6 \qquad \text{Eqn-4}$$

where:
X_1 = profit before tax and interest / opening balance sheet net assets;
X_2 = profit before tax / opening balance sheet net capital employed;
X_3 = debtors / creditors;
X_4 = current liabilities / current assets;
X_5 = (days debtors); and
X_6 = creditors trend measurement.

A positive Z-score is indicative of long-term solvency whilst a company with a negative value was classified as being potentially insolvent.

Abidali (1990) developed a Z-score model to be used when vetting construction companies on tender lists, and ended up with a seven variable model. He suggested a score of 2.94, as the least value for long-term solvency to be used in his model, which was expressed as:

$$Z = 14.6 + 82.0X_1 - 14.5X_2 + 2.5X_3 - 1.2X_4 + 3.55X_5 - 3.55X_6 - 3.0X_7 \qquad \text{Eqn-5}$$

where:
X_1 = profit after tax and interest / net capital employed;
X_2 = current assets / net assets;
X_3 = turnover / net assets;
X_4 = short term loans / profit before tax and interest;
X_5 = tax trend over three years;
X_6 = profit after tax trend over three years; and
X_7 = short term loan trend over three years.

Abidali (1990) equally recognised the inadequacy of single spot values as absolute measures of future solvency, and recommended that his model should only be used to gauge the financial health of a company when combined with other social, economic and managerial factors.

A multiple model approach was adopted by Edum-Fotwe et al. (1995) for bankruptcy evaluation. This was based on the concept of *different phases of contractors' financial profile*, and developed as a series of functions. It incorporated three linear discriminant

equations of annual ratio differences (Z_d), three-year averages (Z_a), and the basic ratios (Z_b), in the form shown below.

$$Z_d = 0.587X_{d1} + 0.910X_{d2} - 1.154X_{d3} + 0.576X_{d4} + 0.130X_{d5}$$ Eqn-6.1

where the variables are annual differences of the appropriate ratio values:

X_{d1} = EXP(Liquidity Ratio);

X_{d2} = EXP(Net Worth / Total Assets);

X_{d3} = LN([Working Capital / Total Assets] + 1);

X_{d4} = EXP(Profit after tax / Total Assets):

X_{d5} = Total Asset Turnover.

$$Z_a = 0.454X_{a1} - 0.562X_{a2} - 0.001X_{a3} + 0.352X_{a4} + 0.869X_{a5}$$ Eqn-6.2

where the variables are three-year averages of the appropriate ratio values:

X_{a1} = LN(Liquidity ratio);

X_{a2} = Net Worth / Total Assets;

X_{a3} = Working Capital / Total Assets;

X_{a4} = SQRT([Profit after tax / Total Assets] + 1);

X_{a5} = Total Asset Turnover.

$$Z_b = -0.359X_{b1} + 0.007X_{b2} - 0.352X_{b3} + 1.091X_{b4} + 0.729X_{b5}$$ Eqn-6.3

where the variables are values of basic ratios expressed in the form of a decimal:

X_{b1} = LN(Liquidity ratio);

X_{b2} = LN([Net Worth / Total Assets] + 1);

X_{b3} = LN([Working Capital / Total Assets] + 1);

X_{b4} = Profit after tax / Total Assets:

X_{b5} = Total Asset Turnover.

Table 5 presents the corresponding cut-off points for the three functions. A company is evaluated with the model by applying the three functions, and comparing the result with the evaluation options in Table 6.

Table 5. Cut-off scores for classifying with multiple model

Discriminant function	Minimum cut-off	Maximum cut-off
Annual Differences-Z_d	1.8	2.0
3-Year Averages-Z_a	1.5	2.4
Basic Ratios-Z_b	2.2	3.4

Table 6. Evaluation options for multiple model

Difference	Average	Basic	Evaluation
+	+	+	Financially sound phase
-	+	+	Starting phase of failure
-	-	+	Intervening phase of failure
+	-	+	Intervening phase of failure
-	+	-	Intervening phase of failure
+	+	-	Intervening phase of failure
+	-	-	Final phase of failure
-	-	-	Final phase of failure

+ > maximum cut-off point value, - < minimum cut-off point value

CONCLUSION

The need for comprehensive evaluation of contractors as a basis for their selection cannot be over-emphasised. Conventionally, this is undertaken by utilising project related criteria. The extent of the risk to the client of a contractor going bankrupt, however, provides a compelling argument for the inclusion of the potential for such an event in the evaluation. The methods for undertaking bankruptcy evaluation rely on financial ratios among other factors. Examples of the models developed for such evaluation have been presented, to provide the construction client with options to undertake the assessment. Combined with the well accepted criteria of project time, cost, and quality, the evaluation of bankruptcy potential can facilitate improved client decision-making at the tender stage. This will ensure that the risk to clients' investment in construction is ameliorated.

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MEASURING SUSTAINABILITY USING TRADITIONAL PROCUREMENT METHODS

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Abstract

This paper outlines and evaluates current environmental impact schemes based on the type of impact assessment offered, the consideration of location and monetary measure, along with consideration of future benefits and detrimental effects. The paper goes on to analyse how existing procurement arrangements are able to accommodate environmental assessment and looks at how construction industry organisations can develop policies based on the environmental impact schemes.

INTRODUCTION: THE SUSTAINABILITY PROBLEM

Focus on the environmental impact of both the process and product of construction in the UK and globally is intensifying as its huge impact is realised. Among major environmental problems caused by construction are the use of non-renewable energy sources and materials, production of CO_2 as a by-product of their use, generation of waste and resultant occupation of landfill sites and destruction of greenbelt land. As an example, the occupation of domestic buildings alone in the UK accounts for around 29% of the UK's total CO_2 emissions (CSO, 1995). Property and construction are therefore critical to the UK government's target of reducing CO_2 emissions to 1990 levels by the year 2000 (DOE, 1994). In addition to government targets, the way in which the construction industry affects the environment is also coming under increasing scrutiny by the public.

> "In order to function more effectively the industry needs to consider different strategies when interacting with the external environment. The construction industry is inextricably linked to the communities within which they operate.... As communities become more sophisticated they acquire the means to disrupt, delay or ultimately stop projects....It would therefore be logical to acquire the support of local communities to ensure projects are completed satisfactorily." (Moodley and Preece, 1996)

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Public intervention in construction has, in the main, been largely limited to road projects such as the Reading Bypass. These interventions however raise public awareness of the effect of construction on the environment and will most likely extend to projects other than roads. Public intervention is usually based on two major issues: the disruption of communities and environmental impact. The effect of the former is usually limited, directly affecting relatively few members of society. Financial incentive can often ease this problem in terms of either planning gain, or direct financial payment.

The situation with environmental impact is different, as those members of the public who do intervene are not generally motivated by purely personal reasons. The view of environmentalists is often related to preservation of the Earth for future generations. Such utopian ideas cannot generally be weakened by financial reward. It is therefore the environmental impact of construction and building use which will become the major issue between the construction industry and the environmental lobby. Moodley and Preece (1996) interpreted this as meaning that in the future, construction industry companies, be they clients, contractors or occupiers, will need an environmental policy that includes procedures relating to renewable resources, pollution, energy consumption, fossil fuels and transportation.

One of the problems with such a policy is that it will ultimately need some means of assessing environmental impact. Traditional methods of assessment have tended to be descriptive, although quantitative methods are now also being developed. Within any of these systems, the need to balance the assessment against some monetary measure is recognised, as is the need to see the project in terms of future benefit or detriment as opposed to merely giving a snapshot at some point in time (Stovin et al., 1996). The problem for the construction industry is which assessment method to use, since there are now a plethora of techniques available. Some of these are outlined below.

Environmental impact assessment

Environmental impact assessment (EIA) is used to identify the potential effects of a project so that informed decisions can be made with respect to it.

EIA was developed in the United States in the early 80's and was adopted and modified for European policy and legislation from 1985. It reached the UK statute book in 1990 in the form of the Environmental Protection Act (DOE, 1990). The system of analysis is administered through the town planning framework and is designed as an aid to planning and decision-making. It is regarded as being broad in scope and non-quantitative, particularly compared with other planning tools such as cost benefit analysis.

EIA has been defined as "an assessment of the impact of a planned activity on the environment" (Glasson, 1994) and is an activity-orientated exercise. In the UK, trunk roads, oil refineries, manufacturing processes and other projects with significant potential ongoing impacts are cited for compulsory assessment. The actual envelopes, if required, containing such activities (i.e. buildings) are almost incidental to the focus of the exercise.

One potential use of EIA in terms of national policy and strategic planning is a complementary tool known as "strategic environmental assessment" which goes beyond individual project analysis to look at aggregate impact of projects arising from implementing a particular policy.

BREEAM (Building Research Establishment Environmental Assessment Method)

BRE first introduced their own system when they produced a method of environmental assessment of the impact of supermarkets (BRE, 1991). A number of further studies which followed considered additional types of commercial and residential buildings. The basis of evaluation varies with the type of building and succeeding "methods" have become more sophisticated. In terms of meeting particular objectives however the analysis is consistent throughout and seeks a healthy environment within the building envelope, along with a greater awareness of buildings' impact on the global environment. The overall aim is to move towards a long term reduction of such impacts.

The BREEAM system divides effects into 3 categories; global, neighbourhood and local. Impacts of construction are essentially contained within the global impacts BRE prescribe as CO_2, CFC, timber and timber products and recycling of materials. Neighbourhood effects cover health factors such as noise pollution and threat of disease and that of water economy. Indoor effects relate mainly to items of health such as lighting, hazardous materials and indoor air quality.

The assessment method is a credit based system and environmentally friendly aspects of the building contribute to a "score" that will determine whether the building qualifies for award.

The BREEAM scheme is wholly voluntary and is promoted to contractors, developers and occupiers as an environmentally conscious method of providing accommodation. Financial benefits will normally flow to users in terms of reduced energy consumption as well as healthier spaces for employees and residents. BRE are hoping to address such issues as transport and embodied energy in later editions of the assessment scheme.

Environmental value engineering (EVE)

Environmental value engineering (EVE) deals with the environmental impact of building waste from processes which occur during all stages of the life cycle (Roudebush, 1995). These stages run from natural resource formation, through to disposal, and processes include all those which require an input of environment, fuel energy, goods or labour. In terms of these inputs EVE converts them all into energy and makes a quantitative assessment of impact based on the energy used (measured in solar joules). The EVE system can also be used for comparing alternatives schemes.

Stovin's method

Stovin et al. (1995) developed a spatial framework for environmental impact assessment and decision making. The environment is separated into a number of significant variables such as air quality or woodland and each variable is then mapped, given a numerical grading depending on the impact of the scheme on it. The maps are then combined to show the total effect; a high number indicating that the overall impact is greatest in that particular area. The technique can be used to optimise the variables or, in the case of road development, to study the impact of a set of alternative routes.

Total Property Audit

Elliot (1995) developed a framework of impacts arising from construction and property. Application of the audit procedure requires the following steps to be carried out:-

1. Establish the proposed property decision to be audited. This requires a specific proposal such as change of site or building.

2. Critically analyse all the steps, actions and outcomes arising from the proposed change.

3. Identify the significant 'net' impacts within each sector e.g. global, environmental.

4. Identify any relevant standards and tests.

5. Assess each category in terms of :

I. beneficial impact:	a net benefit is anticipated
II. detrimental impact:	a net detriment is anticipated
III.very detrimental impact:	a serious detriment is anticipated triggering abortion of scheme.

6. Weigh up all category assessments to review decision.

7. (Alter proposal and return to 5.)

8. Arrive at audit decision.

Total property audit is most closely associated with environmental impact assessment and both systems deliver a matrix of impacts but fall short of a quantitative result. It is useful for examination of alternative projects such as refurbishment as opposed to new build, or for examining the impact of siting the building at different locations.

Total resource assessment

Total resource assessment is the evaluation of raw materials, energy, and pollution used for, or generated by, the construction of a project. The bill of quantities is used to assess the raw materials used and these are given a rating based on their sustainability and degree of reuse. For the purpose of assessing energy use, the amount of embodied energy that goes into the individual materials is calculated and based on this a further calculation of CO_2 emission is made. Total resource assessment, like many of the techniques outlined in this paper, is still in the early stages of development and it is hoped later to also make allowances for the amount of waste generated. As yet however it does not do this.

Elliot and Palmer (1996a) attempted a total resource assessment of a steel framed industrial unit. They selected the main quantities from the projects bill of quantities and allocated them a sustainability and re-use rating. Based on embodied energy values they then calculated the energy consumption and CO_2 output of the entire building. They then re-calculated the quantities substituting the steel frame for a concrete frame. The results are shown in Table 1.

Table 1 Total resource assessment. Steel and concrete frame

Total resource assessment								
	Steel frame				Concrete frame			
Material	Quantity (1)	Sustaina bility (2)	Reuse (3)	Total (4)	Quantity	Sustaina bility	Reuse	Total
Hardcore	1784	5	9	24976	1784	5	9	24976
Concrete	2702	4	8	32424	3878	4	8	46524
Steel	238	1	9	2380	73	1	9	730
Brick	32	4	9	416	32	4	9	416
Softwood	6	9	1	60	6	9	1	60
Block	14	4	9	182	14	4	9	182
Total	**4776**			**60438**	**5786**			**72888**
Average rating/Kg material (5)				**12.65**				**12.59**
Energy (6)				**1**				**0.58**
CO_2 (7)				**1**				**0.57**
Total resource assessment (8)				**12.65**				**4.16**

Legend

1) Quantity is the quantity of the material contained in the bills of quantities in Kg.
2) Sustainability is a rating based on the degree of sustainability of the material. 10 Represents a totally sustainable resource and 1 represents a non-sustainable resource.
3) Reuse is a rating based on the ability to reuse the material. 10 represents total reuse and 1 represents that no reuse is possible.
4) Total is the sum of (Quantity x Sustainability) + (Quantity x Reuse)
5) Average rating/Kg material is the sum of the totals/total weight of material.
6 & 7) Energy and CO_2 is based on the difference in the energy used and CO_2 produced between the steel and concrete frame. Concrete therefore used only 58% of the energy of the steel frame and produced 57% of the CO_2
8) Total resource assessment is the average rating/ Kg material x energy use x CO_2 use.

The results showed that in terms of resource use there is little difference between using steel and concrete because although steel is less sustainable than concrete its degree of reuse is much higher. The real difference in impact is in the energy use, with concrete using only 58% of the energy required to manufacture steel and producing only 57% of the carbon dioxide. Elliot and Palmer's work, being based on steel and concrete frames, only considered capital energy input, since there is no life cycle energy consumption attributable to this component. However this is not sufficient for components which use energy in their life cycles. They therefore extended the technique to include an assessment of life cycle energy use. (Elliot and Palmer, 1996b)

EVALUATING THE ASSESSMENT METHODS

The two major procurement arrangements, namely traditional and design and build, both separate the early stages of project planning from the construction stage. Traditional procurement does this to a much greater extent than design and build but from the environmental viewpoint the effect of the separation is the same. That is, any client organisation's policy may not easily be carried through to the construction stage. This separation is reflected in the available methods of environmental assessment, some of which are geared towards policy, some of which are geared towards planning in the early stages, and others are geared towards the construction stage. There is no scheme which incorporates all. This problem is compounded by the fact that the different methods include different items. Some methods are quantifiable and make an allowance for waste whereas others are qualitative and exclude waste. The different methods and there inclusions are summarised in Table 2

In order to achieve a total environmental policy, construction organisations need to include an environmental assessment at the project planning stage, coupled with a more detailed examination of the resource use of the building and the activity within, over its entire life cycle. In order to do this it will be necessary to combine one or more of the above schemes.

In making any environmental impact assessment, one of the most difficult items is that of measuring the energy consumption and resultant pollution caused by the transportation of materials. This may include the transportation of raw materials to the factory, or may be the transportation of finished goods from the factory to the site. This aspect of the environmental problem is expanding with the globalistion of markets and will at some point need to be addressed. To put the problem in context, the transportation of building materials accounts for 4% of national energy consumption (DLE, 1996).

In terms of location of the project there is also the issue of transportation of the building users. Reduced emphasis on the car for commuting is important and this will require a rethink in policy on location of buildings. At present, energy for travel is not usually considered as part of the impact of the buildings within impact assessment schemes. However the impact of energy use by commuters can be much greater than anything that the building consumes in its construction or life cycle.

Table 2 Evaluation of environmental impact assessment methods

Method	Type	Monetary measure	Accounts for either waste transport energy pollution	Accounts for future benefits/ detriment	Comments
EIA	Descriptive	No	Energy Pollution	Yes	Broad scope Based on the activity as opposed to the building
BREEAM	Quantitative	No	Energy Pollution	Yes	Based on completed project. (Product of construction)
EVE	Quantitative	Yes	Waste	Yes	Deals only with construction waste
Stovins	Descriptive	No	No	No	Based on completed project. (Product of construction)
Total property audit	Descriptive	Yes	Waste Energy Pollution Transport	Yes	Based on completed project. (Product of construction)
Total resource assessment	Quantitative	Yes	Energy Pollution Some transport	Yes	Concentrates on the impact of construction materials Building based

CONCLUSION

Greater consideration of the environmental impact of construction projects cannot happen based on goodwill alone. There needs to be the correct policies, organisational structures and techniques of assessment in order to achieve it. The question is: how will existing procurement arrangements allow this to be achieved? As outlined earlier, the division between early project planing and construction in traditional procurement can result in diversity of environmental objectives. On the other hand, traditional procurement does allow the client to maintain control over the specification and design of the project. In the case of design and build, the planning and construction stages are closer, and as such may allow client and contractor to marry objectives more closely. Contrary to this, the client does lose some degree of control over the design and specification of the project. This could create a problem if the contractor's own environmental policy is limited.

As shown in Figure 1, there is a need for environmental assessment schemes to include analysis of the strategic, project, building envelope and user activity issues. This cannot be achieved through the application of any one of the assessment schemes and will need to include a combination of them. Further to this, traditional procurement methods and design and build are not particularly conducive to the application of a total policy. As such the mechanism for linking schemes needs to be addressed. One possible way this may be achieved is through application of the new construction management techniques which take a more holistic approach to management than has traditionally been the case. Partnering, for example, by joining the client and contractor at an early stage, could include minimisation of environmental impact as one of the project objectives and this could be included in the partnering charter.

One final point needs to be added and that is the danger of measuring environmental assessment against monetary equivalents alone. Although there is a need to quantify there are potential risks in doing this based on financial considerations alone as often environmental impact issues are not subject to monetary equivalents.

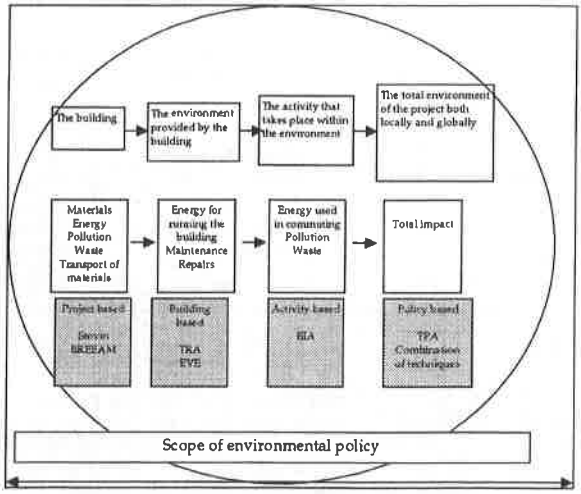

Figure 1 Scope of environmental policy

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ARCHITECT AND CLIENT - ADOPTING A SIMPLE APPROACH TO PROCUREMENT.

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Abstract

Whilst it is generally accepted that building procurement has become more complex, there are a few architectural practices in the UK that have attempted to simplify the process by using construction management techniques. This paper presents a view, based on a case study of an architectural practice with a major 'repeat' client. The role of both the architect and the client in adopting an innovative approach to procurement is described whilst issues relating to 'ownership', cost reduction and quality are discussed.

Keywords: Construction Management; Innovation; Ownership; Procurement; Quality.

INTRODUCTION

The very competitive nature of the building industry has manifested itself in the growth of a variety of new disciplines and a host of procurement systems. The growth of new intermediaries and the wide choice of procurement options has led to increased complexity in the manner in which buildings are procured. Proponents of the intermediate positions, for example project managers, have claimed a variety of benefits for their respective roles, despite the fact that they have added further complexity to the product information chain (Wyatt & Emmitt, 1996). I have argued previously that if quality is to be achieved in construction, a simpler model with fewer links in the chain is required (Emmitt, 1995): a model which relies on close co-operation between client, architect and tradesmen.

Through a case study of an architectural practice with a 'repeat' client the paper looks at the role of both client and architect in adopting an innovative procurement route and the consequences of such action. The paper is based on the author's experience whilst working with the architectural practice at a senior level (1991-1995) and also on a series of interviews conducted from an academic vantage point (1996).

BACKGROUND

The architectural practice which is the subject of this case study was a medium sized architectural practice located in Manchester. It has attempted to retain its market share and improve the quality of the finished buildings through the adoption of a number of management innovations. Over a six year period the firm developed from a traditional

architectural office (design orientated) into an architectural practice that designed, costed, project managed and constructed buildings.

This development was made possible through the implementation of management systems, namely architectural management, project management and construction management, all against a background of a certified QA system. The practice employed the skills of project managers, construction managers, cost managers, site agents, planning supervisors, architectural technologists and architects within an architectural managed environment, held together by a very special ingredient, the architect's design vision.

The architectural office was engaged by a major 'repeat' client to both design and project manage 'identical' retail units. The client's programme called for the opening of ten retail units each year within demanding time constraints and to stringent cost limits. Following a five year period, which saw a concerted attempt to reduce building costs and improve quality through traditional competitive tendering with a main contractor, the architects decided, with approval from the client, to use 'in-house' construction management techniques.

CONSTRUCTION MANAGEMENT BY ARCHITECTS

One way of overcoming the potential problem of conflict and ineffective communication is to build using a limited number of intermediaries. Some have claimed that 'design and build' is one way of achieving this, although this contractor-led system of building has often been criticised for the quality of the finished product and tends to be disliked by architects because they are not in a contractual position to control quality. An architect-led method of reducing the number of intermediaries is to use construction management: a procurement route which allows the architect to communicate directly with trade contractors and eliminates the main contractor (sometimes referred to as 'design and manage'). Using construction management, the architect can control the whole construction process, thus ensuring a certain degree of continuity in the product quality chain. It is their design vision which separates it from a contractor-led system, in that the team is led by a design conscious professional rather than just a cost conscious one.

On first impression, the thought of architect's dirtying their hands with building may be, perhaps, a little unusual. Architectural education does not teach architects to build, it teaches them to design, therefore the adoption of construction management by architects is a new direction in architectural management. However, there are a few architectural practices that have adopted management contracting and construction management techniques in order to achieve quality. For example Michael Hopkins and Partners have employed construction management systems to ensure that quality is transferred from the architect's office to the building site and hence to the finished product (Ruth Slavid, 1996).

ARCHITECT AND CLIENT - GENERATORS OF INNOVATION

Identifying the source of innovation is rarely easy. In this case the architectural practice had managed to reduce the cost of successive retail units whilst increasing the specification

through close liaison with the building product suppliers and keen competitive tenders from the main contractors during a period of economic recession. However, both architect and client knew that it was only a matter of time before prices would rise as the UK economy started to move out of recession.

The architects felt that there was a limit to the amount of money and the amount of time that could be saved through careful detailing, constant revision of the specification and careful programming - a limit which had been reached using a traditional procurement route. Around this time there were a number of articles in the building press about cost reduction and attention was focused on the comments coming out of the work chaired by Sir Michael Latham, comments which were noticed by the client. Despite considerable cost reductions made to the retail units over the previous five years, the client seized on the 30% reduction in costs mentioned by Latham (1994) and highlighted by the construction press.

Over the course of some months the architects and client discussed various options of reducing costs and reducing construction times. The most radical proposal (as viewed at the time) was for the architectural practice to adopt construction management as a procurement route and thereby eliminate the need for a main contractor. Feasibility studies carried out by the practice indicated that there would be a cost saving to the client and the architectural practice would be able to charge a fee for carrying out such a service. Such a venture was not without risk for either party.

Apart from the obvious dangers of exposing the practice to additional risk, which had to be balanced against additional income, there were two more fundamental problems to address. First, was the difficulty of convincing the client that such a procurement route could be managed by an architectural practice: a difficult task since at that time the practice were unaware of any other architects using similar techniques for comparison purposes. Thus the client was concerned that the practice was venturing into an area in which they had no previous track record.

Second. the practice knew that they were in the minority of architectural practices who had adopted QA and project management (Emmitt, 1995), thus the implementation of construction management was a further innovative step for the practice. This had to be implemented from scratch which required considerable investment, with no guarantee that the venture would be successful.; it resulted in an adjustment of core staff skills with more emphasis on qualified construction managers, site agents and administrative staff. In the process of adopting construction management, the office had become multi-disciplinary.

In an attempt to reduce the amount of risk to both parties, early forages into the world of construction management were restricted to the 'fit out' (internal walls and finishes) of the retail unit's structural shell. Since earlier units were constructed using a traditional route, with a main contractor and sub-contractors, there was a basis for objective comparison between the two procurement routes. The practice had kept detailed records of these buildings, used for their own internal comparative assessment exercise, which were made available for the purposes of this research.

In addition to the author's personal experience of implementing this procurement system, a number of interviews were conducted after leaving the practice for an academic position. The interviews were conducted with the architects, the client and a number of trade contractors who had worked for both a main contractor and for the architectural practice on comparable contracts. The interviews were structured with open ended questions which had been designed to collect subjective and objective data.

OWNERSHIP

The construction management system used by the architects placed a great deal of emphasis on co-operation and understanding by the client. For example, whilst the payment of trade contractors was certified by the architect, payment was made directly from the client to the trade contractor within a set time period. This meant that the client had to be conversant with the way in which the building industry functioned, (the client's previous experience of the industry helped in this case) and also be prepared to act, essentially, in the role of the main contractor.

The construction management service provided by the architectural practice was agreed on a lump sum basis with the client. As for the contract itself, this was administered on an 'open book' policy, where the client could see exactly what was being purchased and at what cost. There was no price mark up by the architectural practice. The open book approach was important in maintaining trust between client and architect, encouraging the concept of 'ownership' to develop. It also ensured that the architectural practice did not have any conflict of interest (it would be easy to abuse this system and design for profit) and thus retained its professional integrity.

The client was encouraged to partake in the decision making process throughout both the design and the construction process. There was a considerable learning curve for the client, but the feeling of greater involvement and greater responsibility for the project contributed to the client's satisfaction with the finished product. Thus the sense of 'ownership' of the project by all parties was particularly important in quality terms.

QUALITY

For purposes of assessment and comparison of these buildings a check list was compiled of objective and subjective criteria. The objective criteria comprised, (1) quality of workmanship, (2) cost control and delivery, (3) information flow and control, whilst the subjective criteria addressed was (4) 'Quality of Life'.

Quality of workmanship

One problem associated with the building industry is the length of time taken by the main contractor to pay the sub-contractors, (Cheetham et al., 1995). The delayed payment is recognised as leading to company failures, conflict and poor morale in the industry. The construction management system sought to overcome this by direct payment from the client

to the trade contractor once the work had been approved and certified by the architect. This had two positive contributions to overall quality.

First, the tradesmen provided a cheaper price to the architect than that previously submitted to the main contractor for carrying out the same work, primarily because they were told that they would be paid within 14 days of submitting an invoice for work carried out - and they were. This meant that the quality of the building, assessed against cost, improved because the client was paying less money for the same product. Second, because the tradesmen were paid quickly, as promised, the quality of the work on site improved. When the tradesmen were questioned about this they associated prompt payment with job satisfaction: since they were keen to tender for further work they felt that it was worth putting in the extra effort.

Cost control and delivery

There was a considerable cost saving to the client, compared with the traditional route, despite the payment of a construction management fee (lump sum) on top of the contract sum. An indication of the scale of cost saving can be seen by direct comparison of final account figures. The traditional contract managed by a main contractor resulted in a final sum of 300,000 pounds sterling, the lowest sum received under competitive tendering conditions. An identical contract run under construction management resulted in a final account of 230,000 pounds sterling, a substantial 70,000 pounds sterling saving, or 23%. This is a figure approaching the magical 30% proposed by Latham (1994), which was achieved through closer liaison with the tradesmen and closer negotiation with the building product manufacturers. However, the largest contribution to cost reduction was the exclusion of the main contractor from the team.

In terms of delivery, comparison showed that there was no overall saving on the contract period, although a few subtle pointers are illuminating. The snagging list, prepared one week before practical completion, and the snagging list prepared at practical completion were more indicative of the delivery and quality aspects of the project. Both lists contained just over 50% less defects/outstanding work on the construction management contracts than the traditional contracts. Outstanding work/defects list has been reduced from 5-6 (A4) pages of comments to 2-3 (A4) pages. On closer inspection the list compiled under the construction management contract contained items of a more minor nature, for example, chips to paintwork, therefore the reduction in defects was nearer to 70%. Although this was a relatively rough method of comparison, it did indicate that there was a cleaner handover of the building to the client.

Information flow and control

Construction management is a system that is inherently simple in that there are fewer intermediaries involved in the process. One obvious benefit was the reduction in adversarial behaviour, by removal of the main contractor, which allowed the architect time for more creative or productive pursuits, normally spent dealing with claims from the main contractor. There was also the potential for greater communication exchange between the client and architect and between the trade contractor and the architect. The architects felt that through improved communication they were able to make better informed decisions during the design

and the construction phases of the contracts, a decision making process which included the client.

A direct benefit of face to face communication with the trade contractors was an improvement in feedback, so often lacking in the product quality chain, between the building site and the design office. Feedback, often transmitted by the architect's own site agent, had been encouraged and suggestions to reduce cost or save time made by trade contractors have been adopted where applicable.

A positive benefit to the architectural practice came from being the team leader, in control of finances, in control of programme and ultimately in control of quality. Control of the process was seen to be important, not because of prestige or social status, but to ensure that the building was built as designed and specified. For example, it eliminated the main contractor's penchant for switching specified materials for cheaper, and often inferior, products, thus reducing quality.

'Quality of life'

The term 'quality of life' arose (unprompted) during the interviews, where everyone involved in the construction management contracts said that it made their work more enjoyable, primarily because of a regained pride in workmanship and having a sense of ownership in the finished building. Other factors, such as a reduction in conflict, and a desire for the whole team to strive for quality in the finished product were noted. It is a system close in philosophy to total quality management (TQM) and one which has achieved similar objectives to those claimed by the promoters of 'partnering' techniques (Baden Hellard, 1995).

When interviewing the various parties involved in these projects, there was clearly a bias strongly in favour of this procurement system. An attempt was made to try and identify any problems. The tradesmen couldn't find any fault with the system and put in a request for other architects to use construction management techniques. The client, although initially sceptical about the system was also very positive.

AN INNOVATIVE MODEL

The architect's philosophy was to reduce the number of players involved in the building process in an attempt to improve communication, to improve cost control and ultimately to improve the quality of the finished product, the building. In addition to the significant cost reduction achieved, a major benefit to both the architect and the client was the removal of the main contractor from the building chain which had eliminated conflict from these building projects.

It was noted that this form of procurement suited small jobs, up to approximately half a million pounds sterling, but the practice was unsure as to how large a project it could handle using this system, for that size of office. However the practice was still very much on a learning curve in terms of the system's potential.

Promotion of construction management techniques to clients, both new and existing, is less of a problem now that the practice has some experience and has proved that it can deliver. However it did say that there is still a great deal of resistance by clients to this procurement method. First, it is still an innovative procurement route for architectural practices. therefore the client's perception of risk is high due to lack of knowledge. Thus the architects now have a role as educator, providing the client with enough information to enable him to make an informed decision. Second, the system requires a great deal of involvement on behalf of the client. Not all clients are prepared (or have the time) to be involved in the design and construction decision making process. and as such these clients still favour a more traditional (supposedly less risky) procurement route.

The architectural practice now has a number of both new and existing clients who have commissioned buildings using this method, because it has proved to be a procurement route that has provided the architectural practice and the client with a certain degree of competitive advantage in a fiercely competitive environment. Word is spreading, because there is evidence that other architectural practices, especially those who have already adopted architectural management systems, are looking at construction management as a feasible procurement route.

CONCLUSION

This paper has been concerned with the innovative use of a procurement system rather than procurement as a key to innovation. Both the architectural practice and the client in this case study could be classified as innovators in their use of a procurement system rarely used by architects. The paper has shown that quality in building is achievable if both client and architect are prepared to work closely together and share in the ownership of both the process and the product.

Designers must provide leadership and seize the position of product champion if 'quality', in terms of aesthetics, function and sustainability, is to exist within the product quality chain. The problem facing the architectural profession is that so many architects have abrogated responsibility for management and building quality to their (non design trained) competitors, that it will be difficult to regain lost ground. The case study has illustrated one way forward in a competitive environment, an approach which requires considerable effort, vision and commitment on behalf of both client and architect. Whilst the model may not be to everyone's liking, the opportunity for architect's to claim the role of the product champion and deliver quality is there to be seized.

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THE CULTURE OF PARTNERING

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Abstract

Over recent years, formal arrangements for partnering have developed. This paper argues that partnering has arisen out of the long recognised advantage of collaborative approaches to the procurement of construction projects and can be regarded as an underpinning of other 'joint venture' initiatives. However, it is argued also that, for partnering arrangements to succeed, it is essential to appreciate cultural factors so that they may be incorporated appropriately; hence, dimensions of culture must be considered in conjunction with issues of management, economics and legal requirements to forge the win-win results sought from the widely hypothesised non-zero-sum game of partnering.

INTRODUCTION

For many years, the notions of teams and teamwork have been recognised to be important in the construction industry. Whilst such notions may be operationalised in the microcosmic work situations of gangs (or crews) of operatives, or, even, small managerial groups, realisations at the macro level of the organisation - project, firm, profession etc. - remain, at best, sparse. Well-known mechanisms to develop teams and teamworking have been attempted, such as the Marks and Spencer arrangement with Bovis (Ministry of Public Buildings and Works - MPBW, 1970), recently the concept of partnering has emerged.

Japanese conglomerates have been studied to determine their 'recipes for success' and transferability of approach, structures and organisational arrangements to other industries and other countries - e.g. Bennett et al (1987). Design and construct, (project) management, BOT, BOOT, DBFO and many other arrangements for procuring construction work are being attempted - all with an underlying perspective of encouraging team formation, teamworking and team retention in an attempt, thereby, to secure consequent benefits which, almost invariably to date, have proved highly elusive.

The gains from invoking teamwork concern motivating people to operate effectively and efficiently towards known and accepted goals in which those people have an identity/ownership and hence, appeal to their values to engender enhancement of directed behaviours. Unfortunately, the construction industry is epitomised by high levels of fragmentation. The consequences of fragmentation - including poor communications, uncertainties, mistrust and 'individual commercialism' - have been considered by many; notably Higgin et al (1965, 1966), Cherns and Bryant (1984) and Powell (1991, 1993).

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Mackinder and Marvin (1982), for example, consider the consequences of insular and conservative design practices; they are in many ways similar, and with commensurate consequences, to productivity impediments discussed by Bishop (1975).

The macho, adversarial nature of construction is notorious; anecdotally, there are forces amending the essentially 'co-operative', claims-shunning practices of Eastern societies towards adversarial practices - market-capitalist short-termism gaining ascendancy over long-termism.

Fortunately, attitudes and behaviours do not change rapidly and hence, do not respond readily to the 'lurching' of the market place. However, market changes may provide the catalyst for emergence and pursuance of suppressed desires and beliefs (e.g. UK society in the 'Thatcher era'). Perhaps, due to the (pseudo-) committee process of decision making - NB. formulation of strategy and tactics - in organisations, organisational responses to (market) environmental changes may be relatively rapid - caused by changes in personnel and/or power structures.

Culture is a group concept which is manifested in behaviours, language and other symbolic indicators of the underlying beliefs which generate a collective value structure. Lack of collaboration may arise for a number of reasons, cultural and otherwise, but, if teams are to be formed and teamwork is to ensue, a team must have a culture (intra-team) and the broader the cultural base, the greater the inter-team co-operation which should occur. As partnering is about 'total project teamwork', a cultural foundation appears to be essential.

PARTNERING

Partnering has been defined in several ways but the most explicit definition is that of the Construction Industry Institute (CII) (1991):

> 'A long term commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organisational boundaries. The relationship is based on trust, dedication to common goals, and on understanding of each others individual expectations and values. Expected benefits include improved efficiency and cost effectiveness, increased opportunity for innovations, and the continuous improvements of quality products and services'.

In UK, the Partnership Act, 1890, defines a partnership as: 'the relation which subsists between persons carrying on a business in common with a view of profit'. The focus is the primary business objective for organisations in a market economy; otherwise, unless considered in comparison with alternative forms of firms, the definition is, hardly, revealing!

Joint venturing (JV) may be regarded as the (most) generic form of business unit, encompassing all forms with the exception of single person enterprises. However, the term has evolved to indicate a collaboration between two or more individual business units, perhaps involving the formation of a separate, jointly-owned unit, to carry out a business undertaking.

A JV may exist in diverse guises - from a casual arrangement to a formal corporation (company); it may be temporary (for a specified period, a purpose or a project) or permanent.

Thus, partnering is a particular development of JV which is a vertical integration of members of a project supply chain (in this context, regarded, most appropriately, as a value provision chain), whether for a single project or at the strategic level (if a long-term arrangement).

Whilst joint venturing has employed the concept of pooling resources (including expertise) and spreading risk for the objective activities - commonly coupled with transfer objectives for technology and expertise in the context of developing economies - the development of partnering has embraced the progressive concept of continuous improvements. Procedures for, and consequences of, more common partnering arrangements are discussed by Lorraine, (1994) Bennett and Jayes (1995), Matthews et al (1996).

Latham (1994) is a reserved advocate of partnering. The reservations, expressed for both the public and private sectors, concern the operation of established relationships which dispense with awarding each package of work based on (price) competition, on the apparent assumption that lack of competition will invoke the complacent, inefficiency problems of monopolies. However, in contrast, it is worth considering whether efficiency or effectiveness should be the primary target; in 'developed' environments, effectiveness may be more important than traditional notions of economic efficiency, especially in the context of globalisation.

Bennett and Jayes (1995) note the main requirements for partnering to be top management commitment (with appropriate delegations), potential for improvement in product and process, recognition of the long term requirements to maximise benefits, commitment and championing by senior management. The emphasis on management to make partnering work recognises behavioural impacts on performance - objectives, leadership, motivation etc. - all of which are manifestations of cultural factors and changes which must be secured to obtain the benefits.

The essential factors of partnering - mutual objectives, problem resolution and continuous improvement - represent incremental advances from other, more familiar, procurement arrangements. Mutual objectives have been acknowledged as a pre-requisite for the, largely, unrealised teamwork on a project. Equally, problem resolution, preferably in a pro-active mode, (which should follow from mutual objectives) is a primary element of successful risk management (see, for example, Hayes et al, 1987). The third element, namely, continuous improvement, derived from Japan but originating from Deming (Deming, 1986) is the particular feature manifested for partnering. Continuous improvement, concerning all facets of product and process, within the partnering procedures, costs about 1% of project price but yield benefits of between 2 and 10% of price for individual project partnering and up to 30% for strategic partnerings (achieved after about 15 projects/5 years) (Bennett and Jayes, 1995).

A particular benefit attributed to partnering, and, presumably, contributing to lower prices, is the reduction of claims - by around 75% in number and 60% in price. Project administration - exemplified in reduced numbers of letters - is simplified also (Bennett and Jayes, 1995).

Clearly, the publications present a strong case of net benefits for partnering. However, the questions of causation and applicability to partnering remain.

CO-OPERATIVE ENTERPRISES

Joint ventures, franchising, sub-contracting, management contracting and similar arrangements all indicate that a form of collaborative venture has been adopted - a type of, albeit casual, partnering. The common factor amongst the array of alternatives is that a business form is adopted which is different from the full equity ownership of the business unit by a single organisation/group.

Construction partnering seeks to bring project participants into closer relationships - epitomised by a high level of commitment to common goals (appropriately, client-dominated) for one project, a number of projects or a period of time (initially, with opportunities for renewal). Hence, partnering may constitute a combination of joint venturing and serial contracting.

Buckley and Casson (1988) provide an economic analysis of JVs on the basis of two participants, each with a 50% equity share. Such ownership implies mutual interest in the outcomes of the JV and the consequences thereof (acknowledging that is not so, necessarily). Partnering demonstrates a distinct analogy with the 50% equity share JV analysed, despite the fact that forms and proportions of stakeholdings in the partnering may vary greatly.

Buckley and Casson (1988) define co-operation as 'co-ordination effected through mutual forbearance', in which co-ordination produces a Pareto improvement in resource allocation hence, incorporating the concept of mutual benefit to the participants. They classify impediments to co-operation as:

1] Externalities - compensation for the consequences of the project or stopping the project by organised external groups; unorganised groups may lose; issues of equity and valuation are paramount.

2] Political Manipulation - to make the project attractive relative to alternatives via opportunity costs/gains.

3] Perceptions and Expectations - information released and perceptions by actual and potential participants; ex-ante expectations may not be realised ex-post! Forbearance is refraining from 'cheating', where 'cheating' is behaviour detrimental to other participant(s). Cheating may be strong or weak. Given a usual construction situation in which a formal (project) agreement is supplemented by an array of informal obligations, strong cheating is failing to honour the obligations in the formal agreement, weak cheating is failing to honour the informal obligations, whilst forbearance is honouring both formal and informal obligations.

Formal, legal sanctions act as a basis or framework for enforcement, protection and recompense only; real success occurs through realisation of and performance against informalities (a reflection of, e.g.. Higgin et al, 1965, 1966) hence, self control is essential.

The less vulnerable a participant is to the acts of others, the greater is that participant's incentive to cheat and to cheat first. (The incentive to cheat is magnified if the participant's vulnerability increases over the life of the project and/or if profits accrue early in the project.) Dawkins (1976) notes that recognition of mutual dependence fosters forbearance and 'punishment' of cheating - in extreme cases, cheating groups of species become extinct. However, the various costs of legal (and quasi-legal) actions encourage cheating; hence, quicker and cheaper remedies (e.g. Alternative Dispute Resolution - ADR) and mechanisms which internalise otherwise external costs (consequences) of cheating - such as the principle of the 'polluter pays' - both mitigate cheating and encourage forbearance.

Axelrod (1981, 1984) examined cheating and forbearance in connection with the 'Prisoner's Dilemma' exercise. Single encounters foster a short term perspective for individual gain maximisation and, thereby, encourage cheating. Numerous encounters foster a long term perspective involving recognition of mutual dependence (akin to oligopoly's hypothesis of qualified joint profit maximisation) and so, favour an holistic view which encourages forbearance. Axelrod notes the advantages of a 'tit-for-tat' strategy - forebear but cheat if cheated - as being cheap, quick, recognisable, simple and, thereby, a 'self-policing' approach.

For relationships in which it may be difficult to identify cheating and its protagonists, it is likely to be advantageous to adopt arrangements of sharing of residual risks and profit sharing - i.e. to focus returns on the final outcome (albeit financial). The problem of cheating is enhanced as (almost), by definition, cheating is a covert activity and so, may be undetected for some time after its occurrence (if detectable at all); hence, monitoring should occur to detect any cheating early. The alternative is the vulnerable situation (if, morally, highly desirable) of trust in the other participant(s). Clearly, it is advantageous if the formal agreement minimises any incentive(s) to cheat and, if possible, provides disincentives!

Joint ventures occur through combinations of internalisation economies, coping with indivisibilities and obstacles to merger of the participants. The participants bring various expertise/resources to assist others in coping with particular market conditions. Co-operation depends on the motives of the participants and the nature of the main activity. Partnering, even if for a single project (initially) may, especially if 'successful', help to provide a level of workload and so, encourage/maintain economies of scale, of obtaining work and of work execution through trust in and knowledge of other participants and enhanced co-operation (greater forbearance - such as fewer claims etc.).

CULTURE AND PARTNERING

The underpinning aspects of culture - beliefs structured as a hierarchy of values - which become manifested and articulated through behaviours, language plus other symbols and norms, are discussed in Liu and Fellows (1996). The need for sensitivity to others is of acknowledged importance, as is the socialisation process which precedes any relationship under examination, yielding consequences such as indexicality (see, for example, Clegg, 1992). Acceptable behavioural norms and parameters are articulated formally in professional institutions' codes of conduct, legal systems, contracts etc., whilst meanings of language and terms are manifested in project agreements and associated documentation.

Despite project participants' being variously involved with the construction industry, communications and relationships commonly break down, as discussed in Higgin et al (1965, 1966), resulting in norms being transgressed and formal (legal) solutions instigated. Anecdotal investigation indicates that a particular cause is the lack of identification, agreement and communication of project goals - leaving participants to act on assumptions and to pursue individual objectives.

Buckley and Casson (1988) note that, 'the sharing of information often leads to the emergence of shared values. Cultural attitudes are certainly likely to dominate in respect of the disposition to co-operate with other firms...it is clear that JV operations involving firms of different cultural backgrounds are of particular long term significance. Once established, they provide a mechanism for cultural exchange, particularly as regards attitudes to co-operation. The success of this mechanism will depend on how receptive each firm is to ideas emanating from an alien culture; where the firm is receptive, participation in international JVs may have long lasting effects on its behaviour...'.

Hofstede (1980) proposed the dimensions of culture to be:

Power Distance
Collectivism/Individualism
Masculinity/Femininity
Uncertainty Avoidance.

In 1994, he added Long-Termism/Short-Termism.

To analyse organisational culture, he employed:

Process Orientation/Results Orientation
Job Orientation/Employee Orientation
Professional/Parochial
Open System/Closed System
Tight Control/Loose Control
Pragmatic/Normative.

Clearly, such dimension can be aligned with the task/human dimensions of managerial action analyses.

Theory Z (Ouchi, 1981) asserts that involved personnel are key to productivity and, thence, organisational efficiency and effectiveness.

Considering that 'Management is making and implementing decisions concerning people,' and that construction projects bring together collections of diverse organisation, understanding group behaviours' (cultures') impacts on decision making and implementation is essential. The goal-oriented approach (as discussed by, e.g., Liu, 1995) coupled with bounded rationality, yields a paradigm which seems to be adopted widely in the industry.

Buckley and Casson (1988) note that reciprocal forbearance is encouraged by serial decision making in which the array of participants employ an inter-linked chain of decision; hence, the individual decisions must be open (as well as related). Whilst each participant may retain a different focal mix of mutual and self interest, and the effects of bounded rationality (information constraints etc.) and habitual behaviours remain, the opportunities to cheat, by

transgressing norms of behaviour (perhaps newly established and tighter, due to awareness of common goals etc.) are constrained. Thus, co-operation on projects, enhanced by serial decision making, is fostered by decision makers regarding it as a goal (a project output) rather than a means (an element of the project process to achieve output).

Sekaran (1983) notes that, '...culture has an impact on an organisation because cultural norms, values and roles are embedded in the way that organisations develop, organisational structures emerge and informal and formal patterns of behaviour occur'. Marcoulides and Heck (1993) note that organisational performance may be improved by managing particular aspects of its culture strategically because effective organisations share a variety of attributes involving their cultures (Bolman and Deal, 1984).

A pivotal construct of culture is the hierarchy of values shared by the group. Values at the top of the hierarchy are central to the culture and are likely to be virtually fixed; however, values which are more peripheral may be changed. Here, impacts and influences to effect cultural change occur on the peripheral values (Tierney, 1988); analogous to effecting behavioural changes by incrementally altering a person's 'comfort zones'.

Thus, behaviours which involve forbearance and, thereby, generate trust are likely to be perpetuated through demonstrable 'win-win' outcomes hence, impacting on underlying values and effecting a cultural, perhaps self-perpetuating, movement. Blois (1972) and Richardson (1972) note that a party with a reputation for forbearance obtains JV partners more easily and the partners will predict fewer problems with the JV relationship in security performance. Thus, forbearance is the foundation of JVs but its effect is enhanced (in forming JVs etc.) if the participants are known to carry out reprisals against cheating also - tit-for-tat! Further, forbearance behaviour must be considered as an investment because early cheating often yields short-term gains.

CLIENTS

Cherns and Bryant (1984) note that, for many clients, once a project reaches the construction industry, it represents the 'resolution' of internal conflicts. That project, then, is communicated, translated, interpreted and realised by various construction participants, often in (virtual) isolation from the client. Satisfaction of all is hoped for but realised 'rather infrequently'.

Mackinder and Marvin (1982) and Lera (1982) note issues concerning briefing and design whilst Bresnen et al (1990) consider on-site realisation aspects. More experienced clients obtain better time and cost performance, which is enhanced if clients use in-house project procurement and management systems. Previous experience of working with the contractor is advantageous to performance also. Teamwork was found to generate good time and cost performance.

Bresnen et al found a positive relationship between client satisfaction, direct control of the project by the client and use of alternative contractual arrangements. Private clients tend to be more sensitive to time outcomes whilst public clients are concerned more with price. Latham

(1994) advocated that evaluation of tenders should consider quality as well as price. Clearly, there is an issue of emphasis concerning the hierarchy of time, cost and quality variables which may be resolved best by establishing and agreeing the hierarchy of variables for the project at the outset and using that hierarchy as criteria (and parameters) for all decisions.

Certain clients desire, and others are obliged to adopt, overt competition in project allocation. Desires for price reduction, effectiveness and efficiency, coupled with questioning of the assumptions underlying the advocacy of competition is necessary to allow appropriate work allocation mechanisms to be developed and employed. Perspectives of long term net benefits are forcing a (cultural) shift from 'Thatcherite' short-term, individual gains perspectives, despite a variety of legal and other impediments.

Major, influential clients (e.g. British Airports Authority - BAA), reinforced by the recommendations of Latham (1994), seem to be the current engines of change.

CONCLUSIONS

Long term change can be effected only by amending the values which underpin behaviours. Such changes are likely to occur at behavioural peripheries (and so, will be incremental) but must be sustained if they are to yield long term consequences.

By providing a good co-operative framework, which encourages forbearance and yields an output of enhanced trust between participants, partnering yields performances and outputs which result in lower transaction costs of projects.

The widespread use of competition should be challenged so that it is employed only where it will maximise net holistic benefits (long term) to the participants (including wider society) and secure best performance against agreed and expressed goals for the project.

Net benefits - ultimately expressed in financial terms to project participants, especially those able to exercise power in project relationships - are likely to be the most effective short term mechanism to instigate changes. Forbearance, co-operation and trust are factors necessary to secure extensions of long term benefits.

The major benefits available to partnering (JVs secured through vertical integration's) appear unlikely to be realised extensively unless cultural changes occur - especially manifested in the development, communication and pursuance of common goals for projects. Such goals must be reasonably compatible with the individual participants' goals, within culturally based norms of behaviour/performance and pursued through forebearing behaviours.

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RHETORIC AND REALITY: A SOCIAL CONSTRUCTIVIST RESEARCH AGENDA FOR BUSINESS PROCESS RE-ENGINEERING IN CONSTRUCTION

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Abstract

Despite the rhetorical claim that business process re-engineering (BPR) represents a 'radical new beginning' its dominant technical emphasis reflects a return to the simplistic machine metaphors of Taylorism. The process-mapping techniques of BPR offer little other than a high-tech rehabilitation of work study. From a social constructivist perspective, business processes do not exist independently of the perceptions of social actors and are therefore continually renegotiated as part of the never-ending flux of organisational life. Irrespective of the originality of BPR, its persuasive rhetoric has already significantly influenced the mental constructs of practising managers. The reality of the modern construction industry therefore cannot be understood without also understanding the underlying metaphors of BPR. The persuasiveness of BPR has further influenced government and industry-sponsored research agendas. Construction academics are therefore pressurised to adopt a similar kind of language to secure research funding. Those who resist the simplistic images of BPR risk being labelled as 'out of touch'. Whilst it is important for academics to respond to the perceived needs of industry, they must also have a commitment to developing long-term research which is independent of the 'flavours of the month' propagated by the management gurus. Research cannot be judged solely in terms of efficiency gains for industry. Academics also have a responsibility to develop the intellectual capital of the construction industry.

Keywords: business process re-engineering; social constructivism; rhetoric; research; management gurus.

INTRODUCTION

The concept of business process re-engineering (BPR) is attracting a significant amount of interest within the construction industry. Client organisations increasingly refer to their 'construction procurement processes'. Contractors are also attracted to BPR in the hope that it will make them more competitive. Despite this current high level of interest, the theoretical basis of BPR remains strangely underdeveloped. Whilst the construction industry has a tendency to adopt the latest management fashion in the hope of finding quick solutions to long-term problems, it is the responsibility of the academic community to adopt a more critical stance. Of fundamental importance is the need to make explicit the assumptions upon which so-called 'radical' approaches such as BPR are based.

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The specific purpose of this paper is to establish a social constructivist research agenda for BPR in construction. The paper also seeks to explain why the images of BPR are so popular amongst practising managers. Initially, the underlying assumptions of BPR are critiqued and an alternative social constructivist perspective is developed. The phenomenon of the management guru, is considered followed by a discussion of the way in which rhetoric influences the perceived research needs of the construction industry. Consideration is also given to the way in which academics are obliged by both industry and government to respond to research agendas which owe more to the vagaries of fashion than to a commitment to theoretically rigorous research.

BUSINESS PROCESS RE-ENGINEERING

BPR is undoubtedly the latest management fashion within management and business circles. Whilst the origins of BPR can by traced back to the 1960's tradition of process consultation, the current stimulus was provided by Hammer and Champy (1993) who define a process as 'a set of activities that, taken together, produce a result of value to the customer'. Hammer and Champy further claim that re-engineering provides 'a new beginning' which involves 'rejecting the conventional wisdom and received assumptions of the past...[and] inventing new approaches to process structures that bear little or no resemblance to those of previous eras'. BPR itself is defined as 'the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements on critical, contemporary measures of performance such as cost, quality, service and speed'. However, an increasing number of authors are beginning to doubt the extent to which BPR really does provide a new way of thinking. Davenport and Short (1990) present BPR as part of the established field of Industrial Engineering (IE). Johansson *et al* (1993) also see little which is radically new in BPR, arguing that it provides a natural extension to the efforts of Just-in-Time (JIT) and Total Quality Management (TQM).

With a view to making explicit the underlying assumptions of BPR, Tinaikar *et al* (1995) have conducted an extensive review of the BPR literature. They analysed 248 articles which were published in a three-year period from 1991-1993. They found that an overwhelming majority (95.9 per cent) of the BPR literature was concerned solely with 'hard' technical issues rather than the social aspects of business organisations. On the basis of their analysis Tinaikar *et al* offered the following conclusion:

> "BPR is a purely top-down approach to restructuring organisations in order to increase efficiency on the basis of technical design criteria. In this sense the principles of BPR are no different from the principles of Scientific Management espoused by Frederick Taylor."

The above interpretation of BPR is in sharp contrast to the claims of Hammer and Champy (1993). Rather than offering a 'new beginning', it would seem that BPR offers little other than a return to the simplistic machine metaphors of Taylorism. It is interesting that Johansson *et al* (1993) also concede that the origins of most of the techniques of process mapping lie within the methods of work study initially developed by Frederick Taylor (1911).

RETHINKING BPR: A SOCIAL CONSTRUCTIVIST PERSPECTIVE

On the basis of the preceding analysis, it would seem that BPR shares many of its underlying assumptions with the broad tradition of systems engineering. Important insights can therefore be gained by applying Checkland's (1981) critique of 'hard systems thinking' to the process modelling techniques of BPR. Within the BPR literature, it is invariably taken for granted that the definition of the process of concern is in itself unproblematic. The underlying process objective is taken as an absolute given and the problem is therefore reduced to one of technical efficiency. The modelling techniques of the systems engineering tradition are only meaningful when applied to *designed technical systems* which operate independently of human involvement. Typical examples of such systems would include automated assembly lines and petro-chemical process plants. However, the techniques of systems engineering have consistently failed when applied to the social aspects of business organisations, i.e. *human activity systems* which include people as purposeful components (Checkland, 1981). The strategic decisions which occur within human activity systems are invariably multi-perspective in nature and tend to be characterised by conflict, political action and vested interests. The various actors may not only disagree as regards the comparative merits of alternative process designs, they are also likely to disagree on which processes should be addressed and the objectives which they are supposed to achieve. It therefore follows that the technical orientation of BPR is relevant only to tactical problems of little consequence; i.e. to *puzzle-solving* in situations where the problem can be isolated from the perceptions of the stakeholders and an agreed organisational objective is accepted by all.

Checkland (1981) has further suggested that the methodologies of systems engineering are underpinned by a positivist epistemology in that 'systems' are seen to exist 'out there' independent of the perceptions of human actors. The same positivist position is also dominant within the BPR literature. It was in response to the continued failure of systems engineering when applied to social problems that Checkland developed his soft systems methodology (SSM). In contrast to hard systems thinking, SSM is underpinned by an epistemology of social constructivism. Systems are no longer seen to exist 'out there', but are seen to be epistemological devices by means of which we can *learn* about a multi-perspective social reality. The systems models of SSM are therefore not perceived to be models *of* reality, but models which are *relevant to the debate about reality* (Checkland, 1995).

The same change in thinking from positivism to social constructivism also underpins the redefinition of BPR presented by Tinaikar *et al* (1995):

> "BPR is the reconstruction of organizational processes through a mutually integrated effort by various organizational coalitions to achieve and maintain negotiated improvements."

In accordance with this interpretation of BPR, reality is created and continually renegotiated by social actors. Processes are therefore not seen to be objective realities, they are seen to be *socially constructed*. The acknowledgment of the need to integrate organisational coalitions is in harsh contradiction to the simplistic machine metaphors of Hammer and Champy (1993). On the level of strategic management it would therefore seem to be the social constructivist interpretation of BPR which offers a more meaningful framework for

action. From this point of view the 'process re-engineer' is less of a technocratic systems expert and more of an integrator who makes use of subjective sense-making mechanisms (Tinaikar *et al*, 1995). BPR therefore becomes a highly participative process which only becomes meaningful through the active involvement of the process owners. When described in these terms, the social constructivist interpretation of BPR can easily be subsumed within the framework offered by SSM (Wood *et al*, 1995). Indeed, if the word 'process' is replaced by 'human activity system' then the two become almost synonymous. However, unlike BPR, SSM not only possesses a well-developed theoretical justification, it also has a twenty-year history of successful application within the context of complex organisations.

WHY HAS BPR BECOME SO INFLUENTIAL?

In the light of the doubts expressed above regarding both the originality of BPR and extent of its theoretical justification, it is pertinent to ask why the rhetoric of BPR has been so influential amongst practitioners. Prior to considering the specific impact of BPR, it is appropriate to consider the way in which popular management gurus influence industry. Huczynski (1993) has suggested that management gurus play on the uncertainties and self-doubt of practising managers. The gurus tend to offer simplistic and easily digestible models which are seized upon by insecure managers who increasingly feel overwhelmed by complexity. Whilst the managers are generally cynical of new fads, they feel obliged to pursue them just in case they might work. Jackson (1996) also compares the rhetorical devices employed by management gurus such as Michael Hammer, James Champy and Tom Peters to those used by evangelist preachers. The gurus are seen to use fear to attract the attention of managers in the same way that an evangelist preacher would typically begin a sermon by invoking images of hellfire and eternal damnation. The evangelists deliberately create an initial sense of anxiety so that their audience will then become much more susceptible to their subsequent message which offers a 'path to salvation'. The gurus of BPR use exactly the same approach. They initially gain the attention of their audience by claiming that re-engineering is a survival issue. Managers therefore have no option but to re-engineer. The choice is between BPR or corporate extinction. It is noticeable that the prime candidates for downsizing are usually middle-managers. The underlying metaphor is one of 'cutting out the fat' to make the organisation more lean. The implied threat is that if middle-managers do not themselves become the proponents of BPR, then they will become its victims. In simple terms the message is '*do it to others before they do it to you*'.

Of further significance is the way in which the rhetoric of Hammer and Champy appeals to the patriotism of American managers. Re-engineering is seen to be part of the American ideal. Rather than seeking to change the intuitive practices of American managers, it '*takes advantage of American talents and unleashes American ingenuity*' (Hammer and Champy, 1993). The sub-text is that American productivity has in some way been hindered by external parties who are by inference 'un-American'. BPR is therefore not only a survival issue for individual firms, it also becomes a survival issue for American industry. The final persuasive technique identified by Jackson (1996) is the way in which Michael Hammer and James Champy dramatise the historical significance of BPR. The argument is made that re-engineering is a 'new beginning' which represents a decisive break with existing management theory. The language used by Hammer and Champy (1993) is the language of revolution. A

recurrent theme is the way in which BPR seeks to overturn the outdated functional divisions which emerged from the Industrial Revolution.

The success of the leading BPR gurus, and the influence of their rhetoric on industry, has been remarkable. *Reengineering the Corporation* (Hammer and Champy, 1993) is the biggest selling management book of the 1990s. Michael Hammer reportedly charges up to US$50,000 for a one-day seminar. The core messages of BPR have undoubtedly captured the imagination of practising managers in the 1990s in a way that previous manifestations of the same ideas did not. Pidd (1996) has suggested that the ideas of BPR are currently in vogue due to the way in which they reflect the shift in industry away from batch production towards flow-line manufacturing. The modern capabilities of information technology (IT) also make it feasible to 'radically re-design' processes in ways that were not previously possible. In this respect, perhaps the most vivid example of re-engineering is provided by the re-organisation of the British newspaper industry in the early 1980s. Had it not been for the fact that these events pre-dated Hammer and Champy (1993) by several years, they would undoubtedly have provided a classic case study illustrating the radical nature of BPR.

RHETORIC AND REALITY

A number of important issues emerge from the preceding critique. Firstly, it is apparent that the concepts of BPR have achieved a significant degree of acceptance amongst practising managers. It would also appear that this acceptance is largely due to the persuasiveness of the BPR rhetoric rather than to the originality of the underlying principles. There are now many managers and senior executives who seek to influence their organisations by invoking the language of BPR. The *reality* of modern organisations is therefore at least partially constructed by means of the metaphors and rhetoric of re-engineering. From a social constructivist perspective, reality cannot be isolated from the mental models by means of which social actors make sense of their environment. The 'theories' of BPR have therefore already influenced the reality of modern organisations. This remains true irrespective of the level of sophistication of the BPR literature. Once the epistemology of naive positivism is abandoned then it must be accepted that organisations cannot be understood in terms of 'objective' characteristics alone. The rhetoric and metaphors of BPR are now part of the reality of the modern world and as such they cannot be ignored by researchers.

The notion that reality is socially constructed and therefore continually re-negotiated is widely accepted within the interpretive paradigm of management research (e.g. Denzin and Lincoln, 1994). On a more popularist level, Morgan's (1986) concept of organisational metaphors is useful in supporting the philosophical argument that the 'reality' of an organisation does not exist independently of the theories which managers use to guide their behaviour. Morgan contends that practising managers make sense of organisation life by invoking metaphors, i.e. by thinking about organisations as if they were something else. Different organisational theories are seen to be underpinned by different metaphors. Reference has already been made to the machine metaphor which underlies scientific management (Taylor, 1911). Managers' rhetoric and the meaning which they ascribe to events is therefore dependent on their preferred metaphors. It follows that the nature of organisational reality is influenced by the theories adopted by managers. If an organisation's

management consistently acted (and talked) in accordance with the narrow interpretation of the machine metaphor, then the organisation would become increasingly machine-like in nature. Those employees who objected to being treated as mindless components would seek employment elsewhere. Management would then replace them with people who were comfortable with being treated in this way. The machine metaphor would therefore tend to become a self-fulfilling prophecy. In retrospect, McGregor (1960) was undoubtedly before his time in recognising that the adopted management theory will influence 'reality'. The assumptions of the machine metaphor regarding human behaviour are neatly encapsulated in McGregor's well-known 'Theory X'. McGregor argued that *if management acted as if these assumptions were true, there was a likelihood that they would indeed become true.* In other words, McGregor recognised that the metaphor which we use to make sense of reality is likely to influence the behaviour of others, and therefore the nature of 'reality' itself.

RHETORIC, REALITY AND RESEARCH

Given the current popularity of the rhetoric of BPR within the construction industry, it is no surprise to find that government-sponsored research initiatives are also starting to reflect a similar logic and language. Within the UK the influence of BPR is especially evident within the Engineering and Physical Sciences Research Council's (EPSRC) innovative manufacturing initiative (IMI). The IMI programme is an industry-led research programme, the publicity material for which positively abounds with the rhetoric of BPR:

> "Business processes may be viewed as those procedures, practices and methodologies that companies use in employing their assets to gain a competitive edge in the translation of raw materials into finished products which satisfy the customer/consumer demand in the market-place. This approach is used within the IMI to identify the manufacturing challenges and research priorities for each of the sector targets in order to improve industrial competitiveness." (EPSRC, 1994)

A similar rhetoric of process improvement is also very evident within the publicity literature produced by the recently formed UK Construction Research and Innovation Strategy Panel (CRISP) (1996):

> "Very substantial improvements in value are to be gained through rationalising the construction process to deliver higher levels of quality and safety".

The above quotation is interesting in that it contains very few words which are not loaded with symbolic meaning. It is also of note that both of the above documents have clearly been influenced by the work of Porter (1985). References to 'value chains', 'added value' and 'competitive advantage' are almost as popular as those to business processes.

The spread of the rhetoric of BPR into the research agendas of the construction industry has a very direct implication for the work of academics, if only because their careers depend on their ability to secure research funding. The academic research community is therefore under an obvious pressure to submit research proposals which echo a similar kind of rhetoric. Researchers will also be encouraged to disseminate their results to industry using a frame of

reference which is compatible with the currently fashionable way of thinking. If researchers were to invoke metaphors which were too unfamiliar, then they would risk being labelled as 'out of touch'. Seymour and Rooke (1995) have argued that the dominant culture of the construction industry favours rationalist research to the detriment of interpretive inquiry. The challenge for academics is therefore to offer practising managers new perspectives in a language they understand without being too radical. This interpretation of the constraints within which researchers operate is a direct challenge to the positivist model of research which assumes that 'objective facts' can be collected and then 'transferred' to the collective knowledge bank. Kuhn (1970) has famously argued that the majority of scientific research is similarly constrained by the currently accepted dominant paradigm. It is therefore important that construction academics are free to disseminate alternative theoretical perspectives within other less industrially-constrained forums (such as CIB conferences and academic journals). The careers of academics clearly do not only depend upon their ability to communicate with industry, they also depend upon peer group recognition. Successful academics are of course very adept at framing their work in different ways in order to satisfy different audiences. Nevertheless, these two activities should be seen to be complementary rather than in conflict. The author would argue strongly that his previous work in developing the theoretical basis of value management has enhanced rather than diminished his ability to communicate effectively with industry.

As a caveat to the above, it should be emphasised that the recognition of the role that popular rhetoric plays in the formulation of research agendas in no way reduces the value of the research outcomes. Funded research of this nature encourages a dialectic interaction between academics and industry by means of which both parties *learn*. The resources provided by such funded programmes provide academics with the time to construct the theoretical frameworks which enable them to continue to offer new ideas to industry over a time frame of several years. Furthermore, whilst BPR may well offer little other than a return to the machine metaphors of Taylorism, this does not necessarily mean that it cannot provide practising managers with useful insights in the short-term. Many of the benefits realised by old-fashioned work study techniques have been lost simply because 'scientific management' has become unfashionable. If BPR achieves nothing else other than a rehabilitation of work study techniques in the light of modern IT capabilities then it will have made a worthwhile contribution.

TOWARDS A SOCIAL CONSTRUCTIVIST RESEARCH AGENDA

The social constructivist interpretation of BPR developed in this paper has important implications for future research. Given that research into BPR in construction is still in its earlier stages of development, it is not surprising to find that, as yet, there is relatively little work in the area of theory development. An important early contribution to the role of BPR within the construction domain is provided by Betts and Wood-Harper (1994). Betts and Wood-Harper begin their argument with the assertion that construction management is in urgent need of new ideas and exposure to 'new theoretical paradigms' from outside current construction practices. They then follow with a well-balanced review of the popular BPR literature before considering how the themes of BPR might be applied to construction. Whilst specific emphasis is given to the importance of the 'human dimension', there is little

recognition of social science methodology. They also seem unsure whether BPR constitutes a 'new theoretical paradigm' or whether it re-packages old ideas. In the final analysis, they quite rightly conclude that this is less important than the need continuously to revisit the foundations of construction management as a discipline. Betts and Wood-Harper (1994) also consider that BPR is intrinsically linked to the use of IT, although there is little recognition of the need to integrate IT with an organisation's soft systems. It is interesting that Wood-Harper subsequently co-authored the previously cited paper by Wood *et al* (1995) which argues in favour of a multi-perspective approach to BPR incorporating the interpretive methods typified by SSM. Whilst this social constructivist approach has yet to receive any recognition within construction research, it would certainly seem that Wood-Harper has sympathies in this direction.

An especially interesting current research trend concerns the possible application of BPR for the purposes of client briefing (Atkin *et al*, 1996). Given the propagation of the rhetoric of BPR amongst industry leaders, it is not surprising that clients are increasingly criticising designers for failing to understand their 'business processes'. Designers would therefore be well advised to respond to such clients using the language of BPR. If construction professionals are to understand their clients then they must also understand the ways in which a client's managers make sense of their own organisation. If clients therefore use the metaphors of BPR to articulate their requirements, then designers must respond using a language based on the same metaphors. It is also interesting to observe the way in which Atkin *et al* (1996) use rhetorical devices to sell the importance of BPR to an industrial audience. For example, the adoption of benchmarking is sold to the readership as being a 'question of survival'. Atkin *et al* (1996) therefore serves as a good illustration of the way in which successful academics invoke rhetoric both to influence industry and also to produce industry-sponsored reports which are acceptable to their target audience. Of course, this is not to say that these same authors do not also have a long-term commitment to theory development. Nevertheless, it is evident that the ability of academics to influence industry depends not only on the rigour of their long-term research, but also on their understanding of which ideas are currently in vogue.

In developing the argument for a social constructivist research agenda, it is important not to belittle the contribution which can also be made by positivist methods. Indeed, it has already been suggested that there are many useful insights to be gained by a rehabilitation of work study techniques. It must also be recognised that interpretive research cannot be seen as a *replacement* for positivist research. Different paradigms are based on different assumptions and will therefore accentuate different aspects of reality. The two research paradigms should be seen as complementary rather than as harsh alternatives. Whilst this paper has pointed out many of the limitations of the positivist paradigm, for the sake of a balanced argument it is also necessary to be aware of the limitations of the interpretive paradigm. Interpretive research is especially susceptible to the criticism that 'any one interpretation is as valid as any other'. Although an ontological position of social constructivism does not deny the existence of substantive data, the interpretive paradigm severely underplays its importance. In seeking to construct a shared social reality on the basis of inter-subjective agreement, interpretive methodologies make no distinction between a biased interpretation of data and an unbiased interpretation. Social constructivism also tends to ignore the structural aspects of social situations. Whilst these may be less important within the domain of individual

organisations, they will be of paramount importance when BPR is addressed at the industry level. In this respect the research of Lahdenperä (1995) stands as an excellent example. Gray (1996) also addresses the structural barriers to achieving value for money by taking a holistic view of the 'value chains' which exist at the industry level. When addressing structural issues of this nature, the positivist perspective of 'inquiry-from-the-outside' cannot be ignored. However, when looking at strategic business processes *within* organisations, the argument in support of a social constructivist research agenda is considered overwhelming.

CONCLUSION

This paper has developed a radical interpretation of business process re-engineering (BPR) in construction. It has been argued that the reality of the construction industry cannot be understood in isolation from the rhetoric propagated by the management gurus. From a social constructivist perspective, the 'problems' of construction procurement do not exist in isolation from the cognitive frames of practising managers. The mental constructs adopted by practising managers are continually influenced by the popular management gurus. It therefore follows that rhetoric and reality cannot be separated. Supposed innovations such as BPR will never 'solve' the industry's problems, they will merely contribute to the inseparable flux which interweaves rhetoric and organisational reality.

Whilst the research agendas of industry and government may be influenced by the rhetoric of the management gurus, this does not imply that such research is without value. It is not necessary for popular fads such as BPR to offer anything which is new in terms of theory, providing they can encourage practitioners to think about their work in different ways. Collaborative research programmes between academia and industry can play a worthwhile role in spreading these different ways of thinking within the more specific domain of construction. However, it is important that research of this nature should not replace the 'ivory tower' theoretical development traditionally undertaken in universities. Academics gain acceptance from industry by disseminating their research in accordance with the current paradigm of 'best practice' as advocated by industry leaders. However, their reputation within the academic community depends upon their ability to develop research frameworks which are much more theoretically rooted than those which are demanded and valued by industry.

Ultimately, the value of research outside of the constraints imposed by the perceived needs of industry has to be a matter of trust. If all intellectual activities were to be appraised in terms of efficiency gains for industry then civilisation would undoubtedly be in retreat. The development of intellectual capital has to be recognised as a worthwhile end in itself. The evidence that society does still value intellectual capital is provided by the continued existence of universities. A healthy dialogue between academics and industrialists is of course an invaluable part of the ongoing cycle of research and education. However, universities must be independent of industry and academics must be free to develop their ideas in isolation from the currently popular 'flavours of the month'. The work of construction academics cannot and must not be assessed solely in terms of their contribution to the narrow and short-term perceived needs of the construction industry.

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DEVELOPMENTS IN DESIGN & BUILD CONTRACT PRACTICE IN NORTHERN IRELAND

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ABSTRACT

This paper presents the results of a recent (1996) survey by the authors of procurement practice in Northern Ireland, which found that Design & Build work now constitutes over 30% of the local market for New Build contracts. Both client and contractor respondents wished to see an even greater rise in the proportion of such contracts.

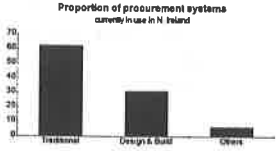
The research examined the potential for conflict in these projects owing to variations and competition on price. Deficient briefs, with vague quality specifications, unrealistic programmes and poor information flow were also identified as contributory factors to dissatisfaction with the overall process. The work identified a growing realisation that the expertise of the contractor is of prime importance in achieving full client satisfaction.

The recommendations arising from the research include the need for a standardised client briefing guide coupled with the need for a code of practice for a design and build tendering procedure. It should have incentive clauses, consistent appointment procedures for consultants, clearer responsibilities for all parties and a more realistic, client-orientated service. In conclusion, the research identified an ever-increasing role for design and build, based on the improved professionalism of the contractor and a more educated and decisive client organisation.

Keywords: Design/Build, Northern Ireland Practice

INTRODUCTION

Recent research by Gunning & McMullan (1996) identified that Design & Build contracts, in one variation or another, now account for approximately one third of all sizeable building work in Northern Ireland. The aim of this follow-up research is to examine the evolution of this procurement system by a detailed survey of contractors and client organisations.



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The modern design and build method, formerly known as "contracting in gross", bears little resemblance to the old "measure and value" system of the Napoleonic era, from which it has evolved [Powell (1980)]. It has gained a significant foothold in the Northern Ireland Construction market over the past quarter of a century, possibly owing to high inflation in the 1970's, and to the growing desire of clients for single-point responsibility for the entire construction process and for performance guarantees. This preference has been increased by the adaptability of the approach, using a variety of alternatives such as turnkey projects, package deals, "novation" (using clients' choice of designers) and Build Operate Transfer contracts (BOT, BOOT, DBFO, DBOM) with concession periods for contractor operation of the new facility. The system can also accommodate single-stage tendering, two-stage tendering or negotiated methods of selecting the contractor.

Sawczuk (1996) has highlighted the difficulties experienced by consultant designers on design and build contracts, because of the commercial pressures which may be imposed by a contractor, and because of the problems of defining responsibility for design coordination, especially if large elements of design are to be carried out by suppliers and sub-contractors. Akintoye (1994) has established that the majority of GB architects tended to favour "novated" design and build, with little liking for conventional design and build, presumably because of their reduced authority in this latter version. This programme of research has concentrated on the views and practices of the two most important organisations in any design and build project - the client and his contractor.

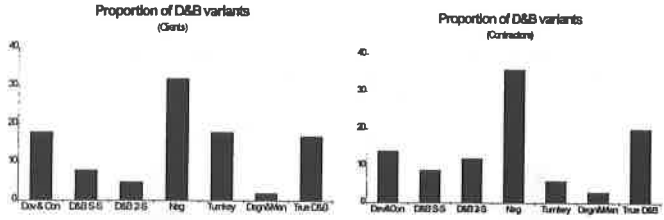
RESEARCH METHODOLOGY

The research consisted of issuing two detailed questionnaires to a representative sample of 30 client organisations and 30 contractors which constituted most of the major organisations in these categories in Northern Ireland. 63% of the contractors returned their completed questionnaires, whilst only one third of the client bodies did so. From personal knowledge of the firms involved, most the clients who did not return the forms were of the more "amateur" type, where construction was essentially a "secondary" interest. Time did not permit a detailed follow-up on non-respondents to increase the rate of return.

The questions mainly used a Likert type of scale for easy completion, but there was space for respondents to state more general view on aspects of the topics. Statistical analysis of the results was carried out using SPSS, but the limited sample size rendered this rather academic. However there is no reason to consider that this sample size had distorted or invalidated the research, in view of the size of N. Ireland (1½ million population) and hence, of its construction industry. Indeed, the findings of this study proved almost identical to earlier research by Gunning & McMullan (1996) in those instances where similar topics had been examined. Equally, responses from clients were almost identical to those of contractors on questions such as proportion of variants used, thus proving the internal validity of this study.

POPULARITY OF DESIGN & BUILD

Whilst some contractor respondents had been involved in design and build contracts for more than 25 years, the majority were relative newcomers to the field, with less than 10 years experience. However, such work now represents more than half of their current workload for several contractors. Most firms reported an increase in their design and build turnover in recent years and forecast a likely continuation of this trend. Unsurprisingly, there was very little use (2%) made of the design and manage approach, a similar result to the findings of Akintoye (1994) for the GB market. Negotiated design and build was the most popular variant (32%), possibly because of the generally harmonious relationships within the Northern Ireland construction industry, and because of the loss of time and effort involved in seeking competitive tenders.



Novation of design, as described by Chan (1995), is proving increasingly popular. This approach had been used occasionally since 1975, when the one of the authors of this paper had been Project Manager for a Government contract in Northern Ireland. Sawczuk (1996) attributes this growth in popularity to the employer's loss of confidence in the contractor's ability to get the design right, and to the encouragement of consultants to promote continuity of design, with the prospect of a larger fee for themselves! Understandably, contractors were not overly keen on this approach, since it limited their own capacity for creativity and innovation and prevented them from choosing their preferred consultants. The term "novation" has obscure origins, with the RIAS (1994) declaring that its use in the design and build context is inaccurate. The word does not appear in most dictionaries, but since most practitioners appear to understand what is implied by it, one can continue to use it.

FORMS OF CONTRACT

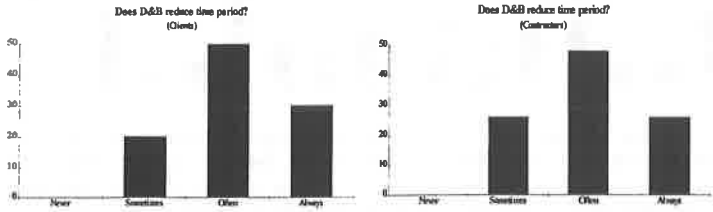
The JCT 1981 form for Contractors Design was reported to have gained steadily in popularity since its introduction. 53% of contractors reported this to be the most common form used for design and build. The BEC form for smaller contracts has the benefit of brevity but was perceived by clients as being contractor-biased. The BPF/ACA form, by comparison, was seen by contractors as very biased towards the client, and not really aimed at the situation where the contractor takes responsibility for the entire design. The GC/Works/1 conditions are widely applied to Government Contracts in N. Ireland, but again do not fully address the contractor-design situation.

The ICE Design and Construct conditions of contract put no limitation on the proportion of design carried out by the contractor, or on the number of stages of design or tendering. In essence it represents a lump sum contract subject to variations and is quite popular for civil engineering works in N. Ireland.

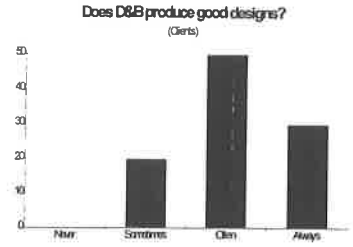
In recent years, the Contractor's Designed Portion Supplement to JCT '80 has increasingly been applied to situations where the contractor has a limited design input. However, the JCT '81 (CD'81) form is clearly the dominant set of conditions of contract applying to design and build projects in N. Ireland. This is consistent with the situation in Great Britain, as reported by Ndekugri & Turner (1994).

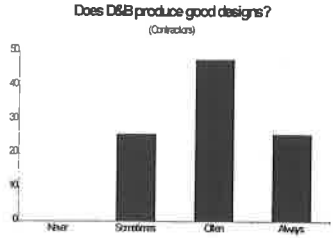
PROJECT PERFORMANCE

Prior (1993) claimed that design and build could reduce project durations by around 30%. The great majority of respondents from both categories agreed that time could be saved, but could not quantify the savings. Chevin (1993) estimated them to be in the region of 6-15%.



Gosney (1990) suggested that the majority of design and build projects had a quality of design which was at least comparable to those produced by the traditional system. A rather surprising finding of the authors' research was that most clients were in agreement with this, but most contractors expressed some reservations - 63% felt that designs were only "sometimes" equal to or better than those of traditional procurement methods. Selection of designers is obviously of paramount importance here, and the degree of commercial pressure arising from tight competitive pricing is also a key factor in design and constructed quality. Contractors felt that designs proved more "buildable" in practice on design/build projects. In particular the develop and construct approach permitted a more functional and better quality design to evolve.

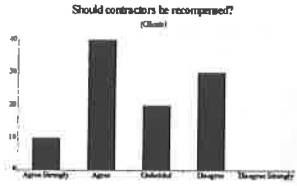


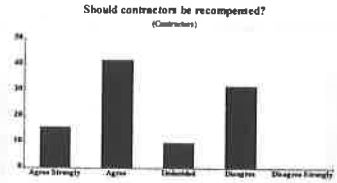


Boudjabeur & Skitmore (1996) identified the major factors affecting performance on a design and build project as being primarily related to the management of the information flow. By far the most significant factor affecting this was the adequacy of the client brief, which could cause untimely or insufficient information and lead to late changes and variations. Variations, and their valuation, represent a frequent cause of dispute on design and build contracts. The majority of clients and contractors agreed that contractors should be entitled to charge day work rates for revisions. What is important is that a client be advised of procedures and rates in advance, so as to dispel potential disputes so far as possible.

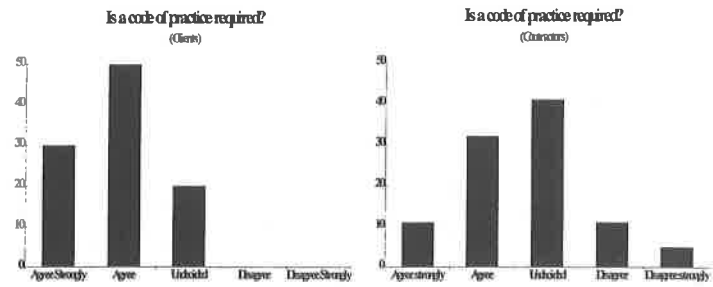
TENDERING PROCEDURES

Approximately 2/3 of design and build contracts in Northern Ireland were found to be subject to competition at tender stage. The preference was for a limited number of tenderers (preferably three), but one recent major project had had thirty three competitors! On occasions, tenderers had been reimbursed for the cost of tendering, but this was rare. There was a surprising majority of clients in favour of compensation for contractors if it would ensure price certainty. Contractors had some reservations about a rigid price, and there is a perception that price rigidity leads to higher quotations in most cases.





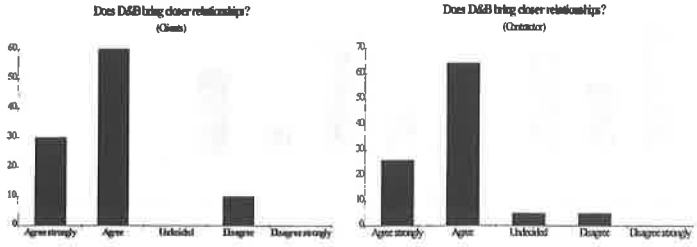
The more established contractors gained the majority of their design and build work by negotiation, and had established a type of partnering arrangement with selected clients. This is unsurprising, given the cohesive nature of the industry in Northern Ireland, as discussed by Gunning & Courtney (1994).



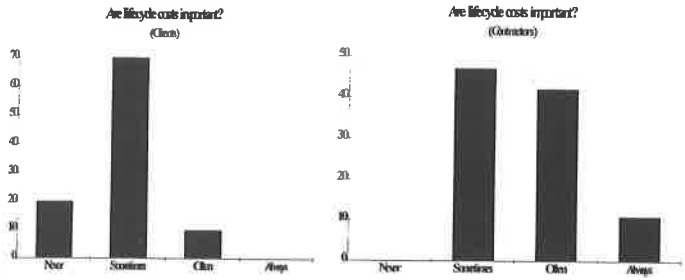
Clients almost unanimously expressed a desire for a Common Code of Practice for Tendering for design and build contracts. Contractors were less decided about this, although only 16% disagreed with the concept. CIRIA Special Publication 15 (1985) already contains the basic elements of such a Code of Practice, in the form of checklists.

PROJECT RELATIONSHIPS

Most contractors considered that a successful partnership with designers on a design and build project would enhance the likelihood of further joint projects, but did not consider that this possibility would significantly affect the design freedom afforded by the contractor. Contractors thought that designs were more buildable on design and build projects, and that the architects' changing role was leading to a more cohesive and professional project team. Other surveys such as that of Akintoye & Fitzgerald (1995) have found that architects generally perceive that product quality and design innovation can be reduced, and that their own professional identity and status are being eroded by design and build. Obviously, much more needs to be done to bridge the gap in perceptions between contractors and designers, and a form of "partnering" may well be the best way to achieve this. However, nearly all of the respondents to this survey thought that design and build projects brought closer relationships within the project team.



Clients almost universally preferred to retain an independent professional adviser, typically a quantity surveyor. It would appear that clients like an independent "referee" unless they themselves possess sufficient expertise in-house to play this role.



This should not really be necessary with a truly reputable contractor, but it seems to give peace of mind. Clients universally accepted that contractors designed to suit their customers, but were subject to conflicting pressures from their own commercial profit motivation and technical specialisms. The obvious means of ensuring that clients get the building they want is through comprehensive briefing at the outset, together with a clear project management structure and effective channels of communication. Disputes occasionally occurred where some contract communications failed to go directly through the main contractor.

FINANCIAL ASPECTS

Almost all clients were satisfied that the involvement of the contractor in design led to more cost-effective projects, a view with which contractors, not surprisingly, universally concurred. However, some contractors highlighted that the application of the design and build procurement approach to refurbishment/upgrade and renovation contracts had not proven cost-effective. This appears to be one type of project where a traditional approach would continue to be more suitable.

There was an identified lack of client confidence that contractors paid much attention to life-cycle costs of buildings on design and build projects, particularly in a competitive tender. Contractors disagreed, and claimed that they would do so if the client brief required it. Again this highlights the paramount importance of an effective client brief in minimising costs and in achieving the desired quality of the completed structure. Late design changes were the other major source of escalating costs and consequent conflict on design and build contracts.

In summary this survey confirmed the findings of Rowlinson (1988) that clients pay less using the design and build approach.

CLIENT/CONTRACTOR SATISFACTION

Very few clients expressed any dissatisfaction with design and build as a procurement system. The only two reservations were the costs of late design changes and lack of independent advice. However 50% of contractors considered that the method contained some "unfair" features including:

imposition of a designer through novation,
limited client briefing,
lack of client understanding,
risks involved in preliminary stages,
costs of tendering when not reimbursed,
competition based on lower quality specification by others,
fixed price quotations for risky or poorly described work.

Nevertheless, most contractors still enjoyed the challenge of this type of project, and merely wanted the practice to be improved. Interestingly, 70% of clients and 47% of contractors agreed with the suggestion by Spencely (1991) that "with a good team of architects and builders, the method of procurement is irrelevant; with a bad team, or a badly paid one, disaster will strike whatever system is used".

FUTURE DEVELOPMENTS IN N. IRELAND

Franks (1993) predicted that the UK market for design and build should reach 35-60% of all contracts by the year 2000. The local N. Ireland market has already reached over 30%, so this prediction may well prove to be accurate. Masterman (1992) reports a 30% market share in GB, similar to the findings of this survey.

90% of clients and 84% of contractors in this survey wanted to see more design and build projects in the future - the remainder were those who rarely used the method in any case. However, there was a strong opinion that it would not be suited to all types of projects, and that the public sector market lagged far behind the private sector in use of design and build.

Some contracting firms in the survey carried out all of their work by the design and build approach. The negotiation of contracts is preferred, but competitive tendering is becoming more common in the present economic climate. Payment for abortive tendering seems to be in decline, despite the support for this from most respondents. Development of a Code of Practice for Design and Build contracts is currently taking place, and this may promote the retention of an independent professional adviser by the client. It should also lead to improvements in the vitally important client brief. Reduction in costly late variations in design should also result, leading to improved project performance and better value-for-money for clients. In turn, this should further encourage growth in popularity of this procurement path. Whitelaw (1991) has predicted that it could well become the most popular of all methods, owing to client satisfaction with it.

CONCLUSIONS

The feedback obtained through the responses to this survey supports the hypothesis that design and build has become the major alternative to the traditional method of project procurement. In the space of 30 years, it has gained one-third of the market, and it is expected to continue to grow in popularity.

However this research has identified some deficiencies in design and build contract practice in Northern Ireland, as follows:

1. Payment procedures for late design variations prove costly for clients.
2. Competitive tendering is often based on minimal design work or site investigation, but with estimates inflated to cover consequent risks.
3. Life-cycle costing receives limited consideration by contractors in pricing, particularly with poor client briefs.
4. The quality of design and construction is related to the adequacy of the client brief and the professionalism of the project team. This "professionalism" can be strongly challenged by commercial pressures and by poor communications.
5. Clients are often ill-informed about the implications of the design and build approach, and about the importance of a comprehensive brief for the designer and the contractor.
6. Contractors perceive some aspects of this procurement path as being unfair or onerous to themselves (as outlined above). Hence they may take action to compensate themselves, thereby raising the cost to the client.

In summary, these deficiencies and perceptions need to be resolved if design and build is to continue to grow in popularity in Northern Ireland. Clients, designers and contractors should be more open about the problems which are encountered, and work together to solve them. Contractors are increasingly being recognised as possessing creative ideas which often prove to be more cost-effective and easier to construct than those of the designers alone. Their project management expertise is seen to equip them for the contract administration roles required during the planning and construction of a design and build project. Increased client-orientation by contractors will ensure that this procurement arrangement will prosper in the future. Clients can help this by selecting the most reputable contractors to do their work, and rely on effective teamwork between all of the professionals (contractors and designers) to deliver their projects as promised to realistic programmes, specifications and budgets.

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THE USE OF PERFORMANCE AIDED SPECIFICATION IN THE PROCUREMENT OF PUBLIC SECTOR HOUSING

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Abstract

The Northampton Development Corporation, a UK New Town Development Corporation, sought to both stimulate competition in the semi-industrialised production of public sector housing and to improve the quality (performance in use) of the houses it was providing. This paper describes the performance aided specifications used and some of the benefits. The result of successive tender programmes was that mass concrete housing, timber frame with plywood sheathing and timber frame with bitumen bonded fibreboard sheathing were chosen. Each system satisfied the performance standards specified and was cost competitive. Problems identified and lessons learned are reported.

Keywords: *Public Sector, Housing, Industrialised Building, Housing standards, Performance specifications.*

INTRODUCTION

The United Kingdom had a long tradition of public sector (social) housing provided by elected town and city councils. This provision was supplemented by the creation of new towns and expansion of existing towns by Central Government. The New Town Development Corporations, though subject to strict government financial control, enjoyed considerable autonomy in land use planning, design and provision of all infrastructure and buildings associated with a town. The social engineering associated with creating towns was not matched by a centralist approach to employing construction workers through Direct Works departments. Almost all public housing was constructed by firms successful in competitive tender to construct completed designs to standards laid down in traditional specifications.

There has been a gradual change in emphasis in building regulations from prescriptive descriptions of approved constructions using specified materials to a performance based approach. This gives designers greater freedom to satisfy client requirements through innovatory forms of construction, encourages use of new materials and components combining many materials in an innovatory way. When supported by defined test methods and acceptance criteria, performance specified construction ought to result in a better building, more able to satisfy the initial requirements.

The traditional procurement route does not encourage innovations successfully used by the private sector for private sector housing to be applied in the public sector. Completion of design before contractor involvement does not allow a contractor's management expertise in use of designs with enhanced "buildability" or adoption of "system" building techniques developed by a particular contractor, for if the designers were to design with a particular system in mind, the tender competition would be restricted to that one firm. Thus the idea of inviting contractors to bid competitively against performance specifications came into being.

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The events described in this paper took place in the late 1970's and early 1980's. Although new social housing is no longer provided by UK public authorities and the Commission for New Towns has been created by the government to sell or otherwise dispose of the assets of the former Development Corporations, the lessons of this innovatory procurement method has considerable relevance to the Housing Associations who currently provide property for rent to low income families.

HOUSING STANDARDS

Housing standards have been largely expressed in terms of (i) the spaces allocated to different functions and (ii) minimum sizes of rooms. A major review of changes in living patterns, domestic activities and expectations, (Parker Morris, 1961) recommended an upgrading of minimum standards; not only of minimum overall sizes of dwellings related to the size of family but also of storage space and sanitary provision. Heating standards were expressed in performance terms, specified room temperature to be achieved at given outside temperatures and precise numbers of electrical fittings were recommended. Particular issues of sound insulation, lifts, private balconies and refuse disposal in flats were discussed. The Government of the time required that Parker Morris Standards be adopted for all publicly funded housing. It was hoped that private sector developers would also adopt them. Parker Morris standards, in conjunction with the Building Regulations, became the main determinants of dwelling design adopted by all New Town Development Corporation Architect's departments.

The Building Regulations traditionally prescribed product specifications. Those initially introduced to London following the great fire in 1666 specified particular thicknesses of brick-work for various heights and lengths of separating walls, stone and fired clay tiles for roof coverings and prohibited the use of thatch. Building Regulation gradually extended to national coverage of regulations created locally for local need. The Building Research Station (Department of Scientific and Industrial Research, 1937) advocated the use of regulations based on performance requirements because the then existing Building Bylaws' product specifications inhibited the development of new techniques and materials.

Since 1965 Building Regulations have been written in terms of performance requirements. They say what a building shall do, not of what it should be made. For example, external walls are required to exclude moisture. As regulations drafted in this way can be difficult to apply most performance requirements were initially supported by "deemed to satisfy" clauses. Since 1985 (Secretary of State, Department of the Environment, 1985) they have been supplemented by Approved Documents which suggest constructions and materials that will satisfy the regulations and receive automatic approval from Building Control Officers. There is no requirement to use particular materials or forms of construction. Indeed there is no obligation to adopt any particular solution contained in an Approved Document if the designer prefers to meet the relevant requirement in some other way. The building regulation requirements for acoustic attenuation, fire endurance of separating walls, thermal insulation and many other detailed performance requirements all influence the constructional design and, in some cases, the layout design of dwellings.

PERFORMANCE REQUIREMENTS

Performance requirements can be considered at several levels, primarily those for the building as a whole: structural strength and stability, durability, adequate thermal and acoustic insulation, safety in the event of fire and so on. These generate requirements for the various building elements, components and sub-components and for the behaviour of the materials from which they are made. Figure 1 over-simplifies the many aspects to be developed in a design.

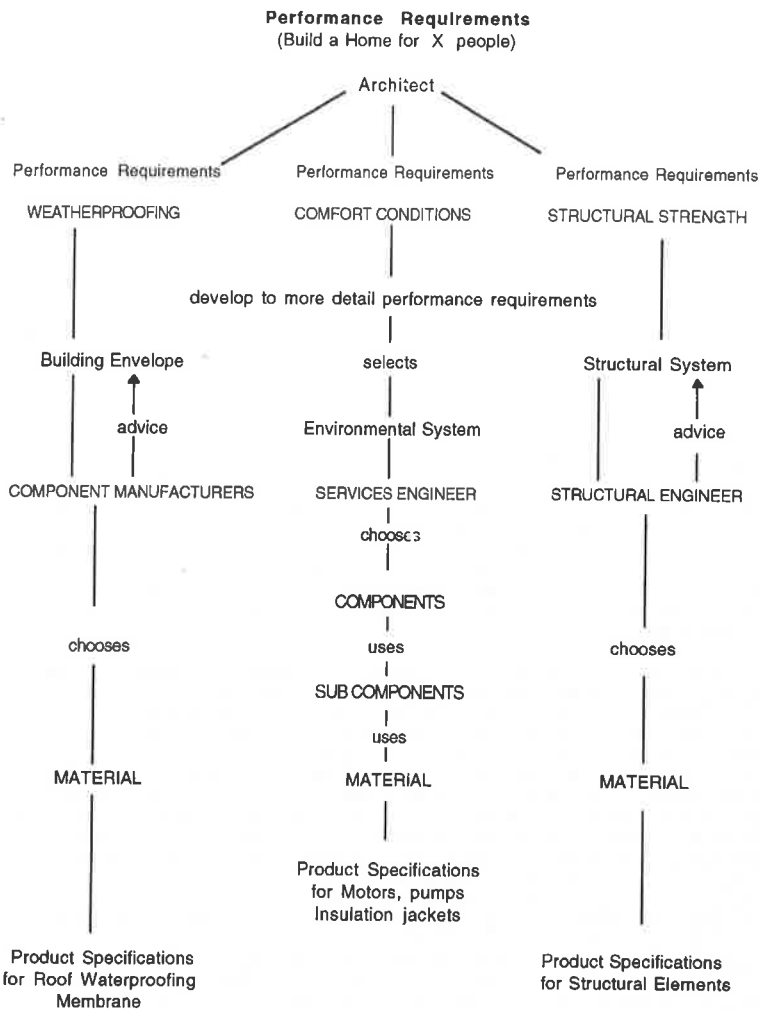

Figure 1. Performance Requirements develop to Product Specifications

This approach concentrates attention on essential facts among the mass of detailed facts about particular constructions and materials. It gives a guide to what must be known and what can be found out when needed. It assists the evaluation of new constructional methods and materials as they are met, for buildings are highly interactive systems and their design is intellectually very demanding. Optimising solutions to particular performance requirements can have detrimental effects on others. For example, increasing levels of thermal insulation may increase condensation risk at cold bridges, providing opening windows for natural ventilation will reduce acoustic privacy. The performance concept provides the only logical basis for Building Regulations which does not explicitly restrict the designer on his choice of materials and their arrangement. It focuses attention on the basic necessities for Health and Safety, while leaving the designer free to meet them in the most effective and economical way for particular needs.

The idea of whole house performance specifications has been promoted by the Building Research Station (Harrison and Keeble, 1983).

NORTHAMPTON DEVELOPMENT CORPORATION

The provision of public sector housing in the aftermath of the First World War was undertaken by locally elected councils. The "garden city" movement was private sector led. Following World War Two, the New Towns Act 1946 enabled central government to designate certain areas, in practice mainly 'greenfield' sites, for new towns. These sought to satisfy national objectives of providing improved housing with a full range of local and town centre amenities and employment possibilities in industrial zones for an expanding and previously badly housed population. They sought to maintain green belts round existing cities and avoid inter war "ribbon development". Many New Towns were in the South East of England and sought to ease congestion in London. By 1968 the emphasis had changed from developing greenfield sites to the planned expansion of existing towns, the 3rd phase of New Town development, through partnerships between Borough Councils and temporary quango's - the Development Corporation. One such expansion was that of Northampton where the Northampton Development Corporation (NDC) shared a new purpose-built office with the Borough Council. Co-operation between the two bodies facilitated a smooth transfer of assets and responsibilities on completion of its work.

The story of the classic case-history of expanding Northampton is reported by Barty-King (Barty-King, 1985) from the crude planning assumptions, the agreements between Central and Local Government to the successful expansion of the town from 120,000 in 1970 to a population of 170,000 in 1984 at "no undue burden to the ratepayers". Land, purchased typically at agricultural value of £1,500 per acre, was sold fully serviced with planning permission for industrial development for between £80,000 and £100,000 an acre. Though partly due to inflation, a rented new town house readily appreciated in value once bought by a tenant. A house which cost £6,000 in 1970 was worth £80,000 in 1990. It was a development in which virtually nobody lost and government gained. Progress reports on the expansion plans appeared in the technical press (Whittle, 1971). The Chief Architect and Planning Officer, Gordon Redfern, had a staff of almost 200 persons at the peak of development. The organisational structure was consciously streamlined (Anon, 1972) so that any member of staff could directly approach him. He was responsible for teams of Architects, Quantity Surveyors, Services Engineers, Clerks of Works, Landscape Architects and, uniquely, an archaeology unit. The Northampton County Borough provided engineering and legal services. The task was to implement the Master Plan design, construct public sector housing for rent and to agree layout solutions and other matters with private house builders. The Architect's department of the Northampton Development Corporation was a progressive organisation. As well as employing the best available staff and maintaining a very good technical library, it employed a scientific adviser, the principal author of this paper.

Modified Radburn Plan layouts (which separated pedestrian routes from road access to houses) with site densities of approximately 14 dwellings per acre were adopted. Housing cost yardsticks promoted the use of two storey terraced housing (linked) with occasional 3 storey houses for large (8 person) families with many children or adult dependents. By varying block heights and 'steps and staggers' in plan, an attractive appearance was created, albeit much aided by landscape planning. Kitchens were placed at the front of housing so mothers might observe their children in communal play areas. There were no high rise dwellings but some 4 storey walk-up one and two bedroom flats for single people were built. There was much idealism, a desire to build quickly, promote social integration among new inhabitants and between new and older parts of the town, to produce attractive homes set in an attractive landscape with the full range of services, amenities and employment prospects. To create real environmental quality.

The Chief Architect was aware of the deficiencies in traditional contracting based on completed design and had been interested in the use of proprietary system building techniques as a means of improving site productivity and reducing costs. He sought to make use of technical input and innovation knowledge dispersed through component manufacturers' and contractors' organisations. The need to achieve a rapid rate of construction encouraged the use of Performance Specifications in Bills of Quantities, this in turn encouraged the large-scale use of system building with a major innovative content.

PROCUREMENT METHOD

Traditional Bills of Quantities

The system of housing procurement initially adopted relied on professional staff employed by the Development Corporation providing a design service and, following completion of design, contractors bidding competitively for the construction contract. The allocation of work by tender after completion of design precluded the builder from directly bringing production engineering expertise to the design. The contractors undertook to construct the buildings in accordance with given drawings and specifications contained in Bills of Quantities. Contract conditions required completion by a certain date and attempted to unambiguously state the duties, responsibilities and actions that must (or may) be taken by the parties to the contracts in the event of various events, both foreseeable and unforeseeable, occurring. The lack of building process knowledge by designers and accurate feedback to them on how contractors actually incur cost often results in the precarious balance - between commercially viable building and the artistically satisfying one - coming down unprofitably (for the developer) in favour of the latter. By the time the cheapest bid on a given design is secured by competitive tender the cost effectiveness of the design is frozen. This system, while not precluding feedback from site activities to designers to facilitate improvements in subsequent designs, did not encourage it. While general contractors receive payment, in the form of profit, for providing the management skill to provide the building described in the contract documents, the contractor has no incentive to influence design, for payment is made for the design described on drawings, in bills of quantities and specifications.

The procurement methods for the early housing estates in Northampton were therefore based on completed drawings and associated specifications in Bills of Quantities. Although the specifications mainly consisted of the traditional descriptions of sizes, types and qualities of materials to be used, there were some examples of specifications by performance. eg. softwood was described by stress grading. Specification by performance was most marked in connection with electrical and heating services systems. Detailed requirements of control and distribution equipment for electrical systems, required accessories and their mounting heights, requirements for earthing and a requirement to design to IEE Regulations were given, but detailed design, cable sizing and run positions were left to be decided by the bidding contractor. The heating systems proposed by contractors simply had to satisfy Parker Morris requirements.

Invariably the contractors' tender prices exceeded allowable expenditure and reduction in specification would be negotiated to reduce cost while attempting to maintain standards. Typically central heating systems circulating hot water through radiators would be replaced by a less expensive warm air system.

In reality no bill is totally 'traditional', even for those items specified in the traditional manner; for as soon as variations are issued or sought by the contractor equal performance of the substituted component or material is sought by inference if not explicitly. This is often only fully realised when a failure leads to a dispute!

Performance Specification in Tender Documents

In the early nineteen seventies it was decided that to increase the rate of construction by use of system building techniques, competition between contractors would be based upon performance specifications. Typically, the Architect for a particular scheme, which might be for a phase of some 200 to 500 dwellings, would design the site layout and house types in terms of their floor plans and elevations. These ensured that the contractors' proposals would satisfy the space requirements of Parker Morris and the NDC's urban design requirements. Visual control would be exerted by, for example, facades being brick of a certain colour and texture, or surface colour-washed blocks and by colour and texture of roof tiling. The Chief Architect specified, for a number of years, that facing bricks, from whatever maker, should be a textured buff brown to achieve a sense of overall visual continuity. It was for the contractor to propose the bricks to be used, though in practice the choice would be agreed with the architect; actual house construction would not be specified. The specifications stated the performance required of the houses and included overall clauses, such as: "The houses must comply with the Building Regulations." "There must be no condensation." "All constructions must be fully in accordance with BS Codes of Practice, recommendations of (BRE Digests)...." These clauses implied a need for and required the existence of coherently worked-out, inter-related, internally consistent sets of legislation and Codes of Practice. Experience showed these exist in the UK and cover most, but not all, eventualities. The required service life of the structure and main fabric was 60 years, that of components 20 years. The form of tender required the contractors to submit dimensioned drawings, materials specifications and test results to support claims that they achieved the required performance.

Contractor Responses

In three tendering exercises in the mid seventies the most competitive proposals were:

i) An insitu cast concrete system.
ii) A plywood sheathed timber frame system.
iii) A timber frame system incorporating bitumen-bonded fibreboard as sheathing and utilising diagonal steel straps to provide racking resistance.

All bids offered a similar standard of sanitary fitting, kitchen units, fitted cupboards and ironmongery, since products of suppliers and manufacturers previously acceptable to the NDC were generally offered. The contractors' assumed these could continue to be acceptable. Similarly, the contractors' previous experience of negotiated price reduction by omission of hot water radiator central heating systems was reflected in proposals for warm air heating systems.

In effect, the contractors' were competing on management skill and technical knowledge of their preferred construction systems. The competition was primarily on materials used and methods of production of house shells, roofs, internal walls and floors.

The finished houses looked very similar. At the time bricklayers were in short supply and commanded high wages. This encouraged contractors to minimise their use. All the above

systems eliminated a masonry inner leaf, leaving brickwork to part clad the outer leaf. The demand for construction was bouyant at the time and most contractors were assured of work.

Manufacturers of housing systems were endeavoring to increase their share of the housing market and were not only giving competitive prices to contractors prepared to use their products but also very good credit terms. It may well be that the three month credit given by timber frame manufacturers to contractors, when combined with the monthly payments to contractors by clients, in itself gave the use of timber frame construction the price competitive edge by maximising return on capital invested in a contract by a contractor. One certain conclusion is that, at the time, all three systems were price competitive and cheaper than conventional houses constructed of two leaf masonry external walls.

Thus, in a changing market situation, the client obtained maximum value for money. This would not have been achieved had the designers specified the product by its materials rather than its performance.

Client Assessment of Contractor's Proposals

In common with a limited number of other public authorities ie. the Greater London Council, the Scottish Special Housing Association and the City of Birmingham, the NDC used its in-house Scientific Service to assess technical aspects of contractors' proposals. This enabled less reliance to be placed on 'deemed-to-satisfy' constructions described in Building Regulations, and more on test results of, for example, fire resistance, movement susceptibility, thermal and sound insulation of particular generic forms of construction, notably timber frame. By feeding back the conclusions from such assessments, the NDC design team was able to give advice to the contractors on the likelihood of the contractors proposed constructional design achieving the required performance standards. There was input from many members of the NDC's Architects's department, and from the Borough Councils' engineers and building control officers into their assessments. The NDC did not possess large scale test facilities but made use of the results of tests undertaken elsewhere on the proposed or similar elements of construction. The NDC systematically made timber frame houses available to the Building Research Station for studies of acoustic attenuation of separating walls.

Some contractors were inexperienced in the concept of performance specifications and of being responsible for design. They tended to propose Building Regulation "deemed to satisfy" solutions even though the associated details did not necessarily assist the optimisation of site assembly. There was a positive interaction between the contractors' knowledge of their proposed systems and the project architects' who sought to achieve certain visual design intentions. The contractors revised their details of construction, jointing and assembly in response to suggestions which made it more likely that their systems would be acceptable. In this way designs were evolved which better exploited advantages associated with various constructional techniques and sought to avoid problems before work started on site. The revised drawings formed part of the contract documents as did the material specifications associated with the drawings. It was the drawings and materials specifications that were used to monitor and control the quality of the site work. The welcoming and reception arrangements made by the social development workers employed by the NDC encouraged feedback from tenants. Sometimes changes in constructional details were made by contractors at NDC request after completion of the initial blocks in a scheme to improve performance in use.

OPERATIONAL EXPERIENCE

Poor Workmanship

Some joints and components are always susceptible to incorrect assembly. For example, in the construction of timber frame separating walls, fire stopping of asbestos board required particular care in installation so as not to bridge the cavity and reduce acoustic attenuation. In practice the boards often bridged the cavity for the detail was found difficult to achieve. Re-design replaced the asbestos board with a flexible thick rockwool fire blanket. Another contractor, in experienced in the technology of timber frame housing, failed to ensure that site operatives constructed the houses with adequate allowance for differential movement (Hall and Cheetham, 1984).

In contrast to the usual specification of painting by number of coats, without reference to film thickness, the NDC specifications required explicit thicknesses of paint or stain films. Examples of diluted paint were found which prevented any possibility of correct film thickness being formed. The use of simple wet film thickness tests using calibrated 'combs' took the contractors by surprise. Once they were aware that such tests might be carried out at random by Clerks of Works, the problem ceased to occur.

Correct and appropriate use of materials

Early experience of NDC architect designed windows of redwood with low build stain finish proved unsatisfactory. The micro-porous finish allowed excessive dimensional change due to excessive variation in moisture content of the timber this resulted in premature failure due to surface checks and rain penetration of joints. Many windows needed to be prematurely replaced. The performance specification of windows, a development which was occurring at the same time at the Building Research Station and in paint manufacturers' laboratories resulted in the adoption of improved timber profiles with appropriate coatings which better withstood rain and UV degradation.

Unforeseen side effects of innovation

Failures can arise when a change to construction is made for a particular purpose but has an unintended side effect. Such a change was the substitution of plasterboard and glass fibre quilt for a top floor ceiling by a monolayer foam plastic board. Its lightweight and single operation fixing made for cost and time savings. The board satisfied the U-value requirement for roofs. Unfortunately the lightweight board caused sound transmission between top floor rooms of dwellings to fall well below the required standard. It was fortunate that a performance specification had been used in the contract for it placed the responsibility for correcting the defect firmly on the contractor who had proposed the construction.

Unsatisfactory thermal performance leading to condensation and mould growth was a problem in some timber frame houses. The concrete ground slabs had vertical perimeter insulation, and all parts of the construction exceeded the required U-values. Despite this, serious condensation occurred because of the thermal inertia of the floor slabs. In winter months their temperature would remain below the dewpoint temperature for some hours after the heating had been switched on. No performance requirement had been created to cover this aspect at that time. In completed houses remedial installation of insulated ground floors (chipboard on polystyrene) was carried out at the NDC's expense and in subsequent housing the contractors were instructed to instal horizontal perimeter insulation while constructing the ground floor slabs. In subsequent contracts changes were made to the performance specification.

Manufacturers' Technical Competence

If the principle of a Performance Bill is to work satisfactorily, all parties involved in its operation are fundamentally dependent on the reliability of the manufacturers technical competence. This means that not only must components or assemblies be produced to the necessary standard, but the scatter of test results must be small and the failures must be few. Large manufacturers, tending as they do to be intimately involved with the setting up of standards and operation of standards committees, usually meet these criteria, not the least because they have test facilities and have pushed for standards they know they can reasonably meet. The problems arise with the smaller manufacturers who, without such overheads, may be able to undercut the larger firms on price but provide products which are less reliable. The standard of the manufacturers technical information system is also of key importance; there is no point in an excellent product being available if technical data is not provided. Literature must be detailed and there must be a technical support department providing adequate answers to queries.

CONCLUSIONS

Construction is one of the most innovative of activities despite its sometimes superficial appearance to the contrary. The rapid development of many new materials and techniques in recent decades has strengthened this and it has been further encouraged by the need for higher technical performance, particularly in relation to energy economy. In addition, the tendency of firms to be under-capitalised and operate on a relatively low return on investment creates a continuous incentive to consider profitable alternatives with low initial costs.

Performance based specifications are one of a number of means of achieving the desired end of a completed building which satisfies the user requirements in the many ways which are necessary. Amongst other things, these requirements include that the building should work well, look good, be inexpensive to run and maintain and remain in that condition for its design life, be capable of erection to the cost and time targets.

The need for a "deemed to satisfy" product specification of components that satisfy the performance specification remains. It is an essential guide to manufacture, site assembly and quality control. The tests needed to check a product specification are usually simpler and quicker to carry out than performance tests and equally satisfactory for control of uniformity. For elements of construction for which skill and care in assembly have a considerable impact upon performance, such as sound insulation, post-construction performance testing should be introduced as a routine procedure.

The successful use of performance specifications requires improvements in Building Technology and this, in turn, requires considerable improvement in the technological education of designers, component manufacturers and constructors. The use of performance based specification encouraged the input of ideas from a broader range of people, not only architects, than the conventional procurement routes.

This paper supports the hypothesis that the procurement strategy adopted by a large client can positively promote innovation. The formulation of appropriate performance requirements is a slow, time consuming and iterative process.

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THE INTERNATIONAL CONSTRUCTION INDUSTRY, COMPETITION AND CULTURALLY DIVERSE ENVIRONMENTS

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Abstract:

Cultural diversity has long been recognised in many industries as a major determinant of an enterprise's success when operating internationally. This is reflected today in extensive training of personnel in cross-cultural issues and in company policies generally, when working overseas.

However, organisations in the architectural, engineering and construction (AEC) sector are only just beginning to realise that they too, will have to address this issue as their industry becomes increasingly competitive at a global level.

Based on the initial literature findings of an ongoing research project, this paper seeks to outline some of the main concerns for the future of the international construction industry. In doing so, it aims to demonstrate that a strategic approach to working overseas is essential and that cross-cultural management should be an integral part of this strategic approach.

Keywords: ***International Construction Procurement; Cultural Diversity; International Business Strategy; Globalisation***

INTRODUCTION

This paper explores some of the issues involved in the globalisation of the Architectural Engineering and Construction (AEC) industry (Betts & Ofori, 1992), with emphasis on the understanding and appreciation of different cultures as a key feature of the competitive strategy of such an enterprise. As such, it follows on from earlier research concerning the effect of cultural diversity on UK construction consultants operating internationally (Hall & Jaggar, 1996). Furthermore, a number of issues from the remit of the International Construction Procurement Group (IPRG) are addressed by the paper, including the effect of "psychological and behavioural issues" and "philosophical and ethical influences" on international procurement practices (Hibberd *et al*, 1996).

The ongoing process of globalisation of industries throughout the world is well documented. As Waters (1995) notes:

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> "...globalisation may be *the* concept of the 1990s, a key idea by which we understand the transition of human society into the third millennium."

The consequence of this has been a rush for companies and organisations the world over to tackle the issues and problems in globalising their operations and activities (Ohmae, 1990).

The process of globalisation is now beginning to have an impact on AEC enterprises, as the various "trends and currents" (Porter, 1986) of this process make themselves felt in the construction industry. The particular emphasis for this paper is on AEC enterprises from the developed world, who are seeing demand for construction in their domestic markets entering what could be a protracted period of decline (Bon, 1992). If they are to survive into the future, these organisations must seek to take a more global approach to their business (Yates, 1994).

An important aspect of international business strategy is the cultural dimension (Ketelhöhn, 1993). In order to succeed in business around the world, companies need to be aware of and take account of cultural differences in all their operations. This has led to the development of a substantial body of knowledge concerning the impact of cultural differences on international business activities (*inter alia*: Hofstede, 1984; Adler, 1991; Trompenaars, 1993).

However, the impact of culture on AEC enterprises has yet to be considered within a business strategy perspective. The unique nature of construction activity (Abdul-Aziz, 1991) means that the advantages which companies in other industries have seen when applying cultural management techniques to their non-domestic business could be even more beneficial in a construction procurement situation.

A GLOBAL FOCUS FOR CONSTRUCTION ENTERPRISES?

An Ongoing Process of Globalisation

With the signing of two major trading treaties: the General Agreement on Trade and Tariffs (GATT) and the General Agreement on Trade and Services (GATS), and the establishment of the World Trade Organisation (WTO) to implement these (Yates & Tissier, 1996), there is a definite move towards globalisation of world trade, with implications for all parts of the construction industry.

The internationalisation of industry in general can be said to be part of an ongoing tendency towards globalisation, a phenomenon which has been proceeding for a number of decades and the consequences of which are increasingly important to the management and operation of enterprises.

Waters (1995) defined globalisation as:

> "A social process in which the constraints of geography on social and cultural arrangements recede and in which people become increasingly aware that they are receding."

Porter (1986) described this process as being in a state of flux and continual change, identifying a number of "currents" and "cross-currents" which characterise the nature of modern international competition and give rise to this increasing sense of globalisation. Principally these currents are (*ibid*):

- A growing similarity of trading conditions in different countries.
- Fluidity of global capital markets.
- Falling tariff barriers.
- A restructuring by and through technology.
- Technology taking an increasingly integrative role.
- New, and increasing, global competition.

Over and above these primary features of globalisation, Porter (*ibid*) identifies a number of "cross-currents" which make the patterns of international competition different and more complex. These include:

- Slowing rates of economic growth.
- Erosion of traditional sources of competitive advantage.
- New and more subtle forms of protectionism.
- A changing and increasing role for government.
- Proliferating coalitions between companies from different countries.
- A greater ability and imperative to tailor products and services to local conditions.

Trends in the Global Construction Industry

Many anecdotal sources point to the increasingly global nature of the construction industry. For example, it was recently reported that "...chartered surveyors cannot afford to ignore the globalisation of professional services..." (CSM, 1996) and, elsewhere, that "...the British construction industry is about to follow the British car manufacturing industry. From a one-time thriving motor car industry, not one major British company remains" (Horner, 1996). It could be said that, just as we have seen various other manufacturing and service industries become dominated by a small number of globally orientated organisations operating in all parts of the world, the same is occurring in the construction industry.

This view is supported by analysis of secular tendencies for the construction industry. Bon (1992) shows that as countries develop, the level of construction within that economy diminishes. He describes this phenomenon as an 'inverted U-shaped relationship' (see figure 1). Furthermore, Bon (1990) suggests this relationship may switch from relative (share of GNP) to absolute (by volume) decline at some level of economic development.

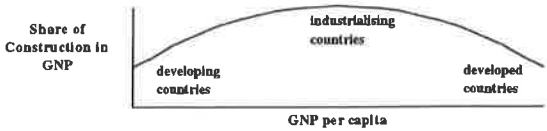

Figure 1. Share of Construction in GNP versus GNP per capita (adapted from Bon, 1992)

In North America, for example, the construction industry is the only major sector of the national economy that displays protracted declining productivity (Arango, 1991). Furthermore, whilst the construction sector cannot be said to be technologically stagnant, its technological development tends to be less impressive than other major economic sectors (Bon, 1992).

A projection of these trends may result in a pattern of worldwide construction activity as indicated in figure 2, over the next 25 years or so. Note, that the designations of country development refer to the present status of a country, not its past or future status.

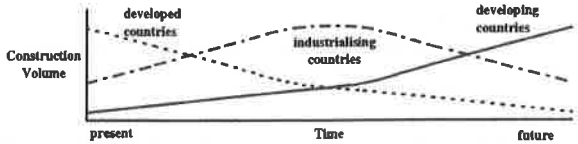

Figure 2. Construction Volume over Time and Level of Economic Development - Future Projections (adapted from Bon, 1992).

Drewer (1990) indicates that the market for construction services is far from restricted to countries from the developed world. Both industrialising countries and developing countries already play important parts in the global market and it is, perhaps, more accurate to think of these countries as part of the "international construction system" (*ibid*).

Bon (1992) argues that this potential pattern of change in share of total construction activity will have profound implications for the nature of future trade in construction services. Based on figure 2, the present pattern of trade in the global construction market is dominated by countries from the developed world, such as those in North America and Western Europe, together with Japan. Industrialising countries, such as those from Southeast Asia, currently have a small proportion of the global share of construction activity but their share will grow until, eventually, they could eclipse that of the developed countries and become a dominant force in the market for construction services.

In the distant future, Bon envisages a world where today's developed countries could have very little involvement in international construction activity and the market will, consequently, be dominated by countries from the developing and industrialising world. Over time, the only

involvement developed countries may have in the world market for construction services would be focused on high-technology or capital intensive projects, as well as in the highly specialised maintenance and refurbishment sector, which is growing in developed regions of the world.

To prevent this outcome, AEC sector enterprises from the developed world can no longer rely on traditional competitive advantages such as superior technical expertise and historical market connections. They will have to adopt a more strategic approach, focusing on aspects of management which have previously received little attention.

BUSINESS STRATEGY AND THE INTERNATIONAL CONSTRUCTION ENTERPRISE

The term 'business strategy' is ambiguous in nature, although many have attempted to develop a definition that suitably expresses what we mean by the phrase. As Moore (1992) noted, in their simplest form, the different terms e.g. general management, business policy, corporate strategy, long-range planning, corporate management and so on - all address the same issue: the determination of how an enterprise, in its entirety, can best be directed in a changing world.

Ketelhöhn & Kubes (1995) see strategy in an international context as being a 'strategic management process' which adapts the company's basic posture to the different environments in which it operates. A good strategic posture is seen today as being vital to a firm's long-term competitiveness.

Ramsey (in Hillebrandt & Cannon, 1989) identifies two broad aspects of management in the construction industry. The first is project management, "which is concerned with managing people, developing loyalty and team spirit, and with the efficient logistics of individual assignments". The second lies at the head office and involves the strategic thinking necessary to "achieve a better sense of direction, thereby, increasing long-term financial returns for the total company".

Langford and Male (1991) state that, in the construction industry in particular, strategic decision making occurs at a number of levels:

- Corporate or Enterprise level - decisions about the organisation as a whole.
- Business level - decisions about which market segments the firm will operate in and how it will approach operations in that market segment.
- Operational or Project level - decisions made at departmental or site level.

In considering how to address strategic decision making, Langford and Male recommend that construction enterprises pose the following questions:

1. What is the nature and structure of the construction enterprise and what does it do?
2. What environment does the construction enterprise operate in and how does that environment behave?

3. Where does the boundary between the enterprise and the environment occur and what is its nature?

Hillebrandt and Cannon (1990) found that, in large UK construction firms, there was much confusion about strategy and strategic planning, as well as about the terms associated with them. Lansley (1987) suggests that, whereas the industry as a whole has been slow in reacting to change, some firms have been very successful in responding to changing needs and opportunities. However, the general experience of strategic planning in the construction industry is of it being a low-profile activity (Betts and Ofori, 1992) that faces notable restrictions at many levels.

Betts and Ofori (*ibid*) note that, whilst in the UK, competition on the basis of far more than price is becoming increasingly important, perhaps the best illustrations of strategic planning in construction come from Japan. Bennett *et al* (1987) note the emphasis Japanese construction companies place on long-term research and development (R&D). The consequent possession of advanced and special technologies has been an important tool for competition both in their domestic market and overseas. In an analysis of competitive strategies adopted by a number of leading Japanese contractors, Hasegawa (1988) identifies a number of approaches including product diversification, business diversification and market segmentation, employed to deal with competitive forces such as the level of domestic and international competition and the threat of new entrants to the industry through diversification by non-construction companies. Japanese construction enterprises adopt what Betts and Ofori (1992) term an integrated strategic approach in that they seek to combine a variety of strategic techniques into an overall 'strategy mix'.

As in other sectors of the economy, a key aspect of the globalisation of construction activity is the increasing tendency for construction enterprises to operate strategically across national borders. The creation of multinational consortia and joint ventures enables firms to pool technical expertise, reduce risk exposure and circumvent trading barriers (*ibid*). Such elements have become principal features of the geographical diversification of construction enterprises. True multinational construction enterprises are those for whom overseas activities are not peripheral, but central to their operations (Strassman & Wells, 1988). They have geared their business towards solving their clients' problems and needs, thereby adding greater value to their services. In addition to product differentiation, diversification, acquisition and mergers, these firms form collaborative relationships with manufacturers, financiers, research institutions, policy makers and other contractors (Betts & Ofori, 1992). For example, a complex weave of relationships and mergers exists in Europe which strengthens these organisations against increased competition from outside the European Union (in particular, Japan) and has enabled them to exploit opportunities in new markets such as Eastern Europe (Sommerville, 1995).

CULTURAL DYNAMICS AND THE INTERNATIONAL CONSTRUCTION INDUSTRY

It is clear that international business cannot be reduced to foreign trade, currency speculation, accounting or politics, but that the international business enterprise must operate successfully within a foreign environment, where culture, economics, politics and other events interact with

the strategic posture and operations of the firm (Ketelhöhn, 1993). The model (figure 3) illustrates an elegant conception of international business strategy which incorporates the key elements of strategic thinking together with the additional variable factors relevant to an international context, providing an integrated view.

Strategy must be dynamic because it evolves as environmental conditions evolve. Aldo Palmeri, chief strategist of the Benetton family said "the nature of an organisation changes in different environments: what works well in Italy may not do so in Japan and vice versa; that is why we must adapt our organisation to local conditions and culture." Thus, the concept of international business strategy must be adaptable to different cultures (Ketelhöhn & Kubes, 1995).

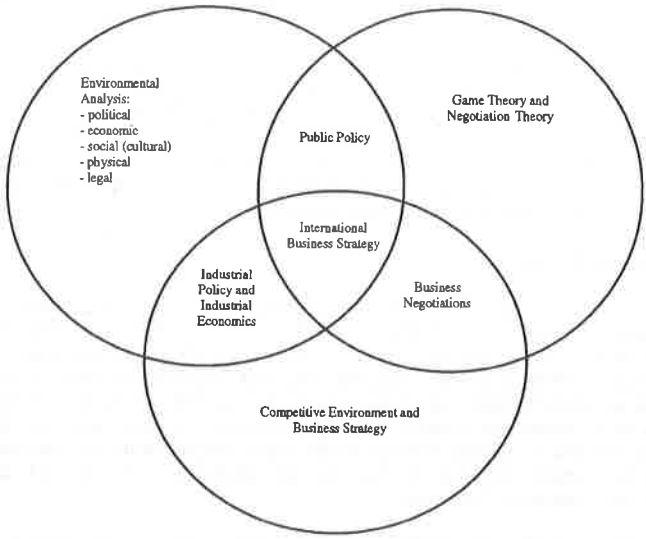

Figure 3. A View of International Business Strategy (Ketelhöhn, 1993).

It has been said that "culture is one of the two or three most complicated words in the English language" (Williams, 1976). The idea of culture embraces a range of topics, processes, differences and even paradoxes. The concept is, at least complex and, at most, so divergent in its various applications as to defy the possibility of a singular designation (Jenks, 1993).

However, Hofstede (1984), in his influential theoretical and empirical study, developed what is widely accepted as *the* decisive definition of culture (Mead, 1994; Trompenaars, 1993):

> "the collective programming of the mind that distinguishes the members of one human group from another. . . . Culture, in this sense, includes systems of values; and values are among the building blocks of culture" (Hofstede, *op cit* p.21)

Hofstede developed an approach to 'mapping' culture along a number of 'dimensions'. These are (Hofstede & Bond, 1988):

- Power Distance
- Individualism versus Collectivism
- Masculinity versus Femininity
- Tolerance of Uncertainty
- Long-termism versus Short-termism

These cultural dimensions allowed, for the first time, an objective analysis of the differences between one culture and another and provided a framework for the management of the relationships between different cultures in a working environment. This approach to management of cultural diversity, in a wide variety of circumstances, has been seen to have positive effects on the performance of companies operating internationally and, consequently, is recommended as a key element of any enterprise's business approach in such situations (*inter alia*: Mead, 1994; Jackson, 1993; Adler, 1991; Cox & Blake, 1991).

It is inappropriate to discuss Hofstede's full list of cultural indicators beyond this summary. However, it seems evident that a good understanding and appreciation of this type of analysis is essential in the development of a global business strategy.

Some Empirical Findings

Research undertaken by the Construction Industry Institute (CII) in the US, in collaboration with the American Society of Civil Engineers (ASCE) (Yates *et al*, 1991) would indicate that addressing issues such as these is a primary concern for the US international construction industry (Yates, 1994). Company executives from such organisations identified further exploitation of the global market as a major area of future growth and expansion in what is perceived as an increasingly stagnant and saturated market (a view supporting Bon's hypothesis). For this to succeed, however, would require changes in the way the industry functions, with greater emphasis on adjustment and adaptation to international market conditions and competition (Yates, *ibid*).

Such adjustment and adaptation would need to be in a broad range of areas, addressing the concerns of consultants and contractors operating in the international arena. These concerns pertain to political stability, education and training (Arango, 1991) and differing cultures (McCuen, 1991; Lewis, 1994). In addition, increasing incidences of partnerships, joint ventures (Barco, 1991) and internationalisation were cited as factors affecting construction industry productivity (Yates, 1991).

CONCLUSIONS

Analysis of the literature would lead one to conclude that cultural differences can have a profound effect on AEC enterprises operating internationally. Until recently, the industry was dominated by companies from the developed world who sought to work in the industrialising and developing world. Using their position of dominance, such organisations could impose

design and construction management techniques upon host countries with little regard for the cultural requirements and characteristics of those countries.

However, due to changes in the nature of global competition within the construction industry, AEC enterprises from developed countries of the world are encountering increased competition from companies originating from industrialising and developing regions of the world. Furthermore, these new globally operating organisations are competing for a share of the market for construction services of the developed world.

Consequently, all AEC enterprises will need to adopt a more strategic approach to the conduct of their overseas businesses if they wish to thrive in this dynamic global environment. The cultural dimension will be a key competitive feature of such a strategic approach and will have implications for all aspects of international construction procurement arrangements in the future. The wider implications of these issues are explored further elsewhere (Hall & Jaggar, 1997).

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ACCOMMODATING CULTURAL DIFFERENCES IN INTERNATIONAL CONSTRUCTION PROCUREMENT ARRANGEMENTS

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Abstract:

This paper seeks to illustrate some of the ways in which cultural differences can effect the procurement of international construction projects, before going on to examine the ways in which an organisation can respond to these cultural differences.

The paper draws, for its context, on the initial literature findings of an ongoing research project. This work is presented elsewhere (Hall & Jaggar, 1997).

The paper continues by discussing some of the potential strategies an AEC enterprise might adopt to allow for the impact of cultural diversity in their working environment, prior to concluding with a discussion of some of the broader procurement implications of the issues explored within the paper.

Keywords: ***International Construction Procurement; Cultural Diversity; International Construction Management***

INTRODUCTION

Some of the key dynamics that are effecting the business environment of the world's construction industries have already been illustrated (Hall & Jaggar, 1997). It is suggested that, in light of the recent liberalisation of international trading conditions, coupled with an ongoing trend towards globalisation generally, Architectural, Engineering and Construction (AEC) enterprises wishing to compete successfully in the future will have to adopt a more strategic approach to their business and, in particular, allow for the global dimension.

The theory, and current state of, international strategic management, as it applies to enterprises in the construction industry has been explored (*ibid*). However, the focus is on the importance of the cultural dimension to international business management. It is argued that attention to cultural differences is an essential aspect of the international business system and that a model, developed by Hofstede (1984), provides a useful framework for the construction industry in endeavouring to manage cultural differences when working internationally.

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The unique nature of construction activity (Abdul-Aziz, 1991) means that the advantages which companies in other industries have seen when applying cultural management techniques to their non-domestic business could be even more beneficial in a construction procurement situation.

A survey of key decision makers in the US construction industry (Yates, 1994) would suggest that one of the primary causes of their loss of international competitiveness in recent years (Arditi & Gutierrez, 1991) is a poor appreciation and understanding of cultural differences.

CONSTRUCTION PROCUREMENT IN A CULTURALLY DIVERSE ENVIRONMENT

There is an abundance of literature relating to the impact of cultural diversity on the management of construction activity in an international environment. Texts concerning the subject abound (*inter alia* Baden-Powell, 1993, Lucas, 1986; Stallworthy & Kharbanda, 1985) whilst the issue is often referred to in trade, professional and academic journals (*inter alia* Alisse, 1993, Palmer, 1995; Burritt, 1988)

However, this wealth of literature is lacking in a number of key areas:

- There is rarely an attempt to put the impact of culture into a theoretical context.
- There is little empirical support for the many observations made and, where empirical studies have been conducted (*inter alia* Enshassi & Burgess, 1991), their scope is very limited and tends to be specific to given circumstances or scenarios.
- The strategic implications are only superficially explored and there is little attempt to fit those strategic implications into a company's overall strategic framework.

Loraine (1992) and Baden-Powell (1993) give an indication of the range of construction activities that can be effected by cultural differences when working overseas. They effect every stage of the construction procurement process, from the initial decision to develop, through briefing, design, tendering and construction. A selection of examples can serve to demonstrate how pervasive cultural differences can be in an international construction situation.

Where a designer from one society (or culture) is designing a building or other architectural feature for a different society, a special understanding of the end users and the implications of their culture is required (Baden-Powell, 1993). Cultural differences can manifest themselves in any number of ways. For example, in Japan, the preferred floor planning grid is a 0.8 metre module. This is based on the traditional Japanese 'tatami' floor-mat dimensions. Similarly, the term 'tsubo', a uniquely Japanese unit of measurement (approximately equal to 48 square feet) is frequently utilised in lieu of square metres. Another dimensional difference is found in the varying floor-to-floor heights acceptable in Japan, which tend to be lower than in Europe and America and give rise to unexpected additional stories in high-rise construction. Meanwhile, in Germany material selection is strongly influenced by the requirement to meet stringent German fire safety criteria (Alisse, 1993).

In the construction industry, in particular, business is conducted on a person-to-person basis at all levels of the organisation hierarchy and at all stages of the procurement process. Adler's (1991) assertion that managers operating internationally spend up to 50 percent of their time in negotiation could well be an underestimate in the case of construction projects and enterprises. Styles of negotiation can vary markedly across cultures. People differ on such key aspects as:

- the amount of time and type of preparation for a negotiation
- the level of emphasis placed on the task at hand or on interpersonal relationships
- the use of general principles as opposed to specific details
- the number of people present and the extent of their influence.

Cultural diversity makes effective communication more difficult because foreigners perceive, interpret and evaluate the world differently. Communicating needs and interests in ways that will be understood becomes more difficult, as does fully understanding the others words and meanings. However, while communication becomes more difficult, creating mutually beneficial solutions can become easier. Differences rather than similarities form the basis of such solutions. The chance of substantial areas of difference and, therefore, substantial areas of mutual gain, generally increase in multicultural situations (Adler, 1991).

CULTURAL DIVERSITY: THE AEC ENTERPRISE'S RESPONSE

A survey conducted by Beamish and Calof (1989) shows company executives (from non-construction related industries) ranking communication skills as most important for managers in positions of international responsibility, followed by leadership skills, interpersonal skills and adaptability/flexibility. Functional and technical skills received a lower rating.

Within the construction industry, Kliem & Ludin (1992) suggest that cultural issues can be characterised as 'soft' issues - those about which people can learn but take considerable experience to master. Consequently, they receive less attention than 'hard' issues such as planning, structural design and so forth - issues that can be "mastered through learning alone".

This, then, provides the context within which the AEC organisations treat cultural differences when they are encountered and would indicate the expected response one might expect from such an organisation.

Possible Responses to Cultural Diversity

Adler (1983) outlined three approaches a firm could adopt when faced with a culturally diverse situation. These are outlined below and provide a useful working framework for describing a specific organisation's or individual's attitude when confronted with the dynamics of a culturally diverse scenario:

(1) The *Parochial* approach is the most common response to cultural diversity in which the members of the organisation do not recognise the diversity of their environment or its impact

on their organisation. In parochial organisations, members believe that "our way is the only way".

(2) The *Ethnocentric* approach is the second most common approach to diversity, wherein the members of the organisation recognise the diversity of their environment, but only as a source of problems. They believe that "our way is the best way".

(3) The *Synergistic* approach is the rarest response to a culturally diverse environment, occurring only where the organisation members explicitly recognise the concept of culture, seeing it as leading to both advantages and disadvantages. The members of a synergistic organisation believe that "our way and their way differ, but neither is inherently superior to the other". Combinations of both ways produce the best approaches.

The various perceptions and assumptions have different implications for companies' approaches to managing diversity. If organisations assume that the impact of culture is negligible, as with parochial organisations, the selected strategy is to ignore cultural diversity. This strategy precludes the effective management of diversity and, therefore, the possibility of minimising the negative aspects and enhancing the positive aspects.

If organisation members assume that the only impacts of culture are negative, as in the case of ethnocentric organisations, then their strategy is to minimise the sources of cultural diversity within and upon the organisation. This strategy can be implemented in a number of ways:

- by attempting to select a culturally homogenous workforce
- or by socialising all workers into the behaviour patterns of the dominant culture.

However, this means they preclude the opportunity of benefiting from the many cultural perspectives present.

If the members of an organisation see the impacts of cultural diversity as having both positive and negative effects within and upon the organisation, as in the case of synergistic organisations, then their strategy is to manage the impacts of cultural diversity rather than the diversity itself, thus minimising the problems and maximising the potential advantages. Synergistic organisations train their staff to recognise cultural differences and to use those differences to create competitive advantages for their organisation.

Benefits of a Strategic Approach to Cultural Diversity

As can be seen, it is inappropriate to prescribe a series of procedures to allow for cultural differences. Instead, what is required is a more holistic approach to training and education, encompassing the cultural dimension. This would provide managers at all levels with an awareness of the issues involved and a collection of cross-cultural management skills which could be developed with experience.

By employing Hofstede's (1984) framework, expatriate managers could initially be placed in regions of the world where the cultural differences tend to be minor. Progressive assignments

would move managers to regions of the world where cultural differences are more pronounced but where the individual managers would be in a position to more readily cope with the challenge those differences present. By implication, such an approach would entail the company adopting a strategic attitude to its overseas work.

Effective cross-cultural management means working with members of another culture, tolerating differences as far as possible and recognising their priorities when developing shared goals (Mead, 1994). According to Cox and Blake (1991), management of that diversity can bring many economic benefits. Among those benefits, a company's ability to attract, retain and motivate people from diverse cultural backgrounds gives that company competitive advantages in cost structures, creativity, problem solving and adapting to change.

Meanwhile, Yates (1991; 1994) identified a number of approaches to mitigate the problems revealed by the CII and ASCE research. These approaches can be divided into two broad strategies. The first is to synergise the efforts of all involved in the industry, entailing co-operation and strategic partnering between entities traditionally considered to be corporate adversaries. The second is to train and educate both college graduates and new expatriates in cross-cultural issues and how they can best be benefited from or mitigated.

CONCLUSIONS

New patterns of trade and competition in the global construction industry have meant that, while traditional areas of expertise are still important to a construction enterprise's competitiveness, they will have to increasingly focus upon other aspects of business strategy if they are to survive as a world force into the next millennium.

Among these other aspects of business strategy is a greater understanding and appreciation of different cultures. If this is integrated into their procurement arrangements, evidence from the literature would suggest that they will experience benefits throughout their organisations. However, if they fail to address this issue, they could find themselves increasingly marginalised and their markets becoming increasingly parochial.

An issue of procurement identified by the International Procurement Research Group (IPRG, based at Liverpool John Moores, Glamorgan and The Nottingham Trent Universities in the UK) is "strategic procurement management" (Hibberd *et al*, 1996). Based on the issues explored in this paper, it would seem that attention to cultural differences should be an essential element of strategic construction procurement management at an international level.

We envisage that international AEC enterprises would enjoy a number of benefits if they were to embrace cultural management techniques when operating outside their domestic environment. These include improved partnering and collaborative arrangements. This aspect of procurement is of great importance in an international context as projects tend to be beyond the means of individual construction companies due to those project's greater size and increased complexity.

Furthermore, major projects carried out on a Build-Operate-Transfer (BOT) basis for national government departments are increasingly popular in developing regions, where funds are limited. Because of their access to capital, such projects are often undertaken by well established international construction enterprises. Generally the constructor/developer will have direct contact with the government through its relevant departments and ministries for a prolonged period of time. An appreciation and management of cultural differences in such circumstances could prove vital for the successful outcome of these type of projects.

Another issue which is becoming more important is that of technology transfer. AEC enterprises wishing to operate internationally are finding themselves obliged by their contract conditions, and by their own ethical requirements, to provide transfer of management and technical expertise to the host nation. It is apparent that a successful cultural management programme would help to facilitate this transfer.

Further research will attempt to establish to what extent cultural differences effect the performance of construction enterprises working internationally. The research will seek to find if the hypothesis is borne out by the experience of those working in the industry and, in doing so, move towards filling the gaps in the literature previously highlighted. This research will entail an empirical approach in the form of surveys and case studies to gather data which will assess, among other things:

- The effect of cultural diversity on the management and business activities of construction enterprises operating internationally;
- The strategy which international AEC sector enterprises adopt in response to cultural diversity and;
- The level of training and education in cross-cultural issues provided to managers of AEC enterprises operating internationally.

A preliminary survey undertaken by the Construction Procurement Research Unit indicates that cultural differences are of concern to British international contractors and tends to support the findings of the CII/ASCE research discussed previously. The findings of this survey will be published in the near future.

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The Effects of Culture on Communication in Multi National Construction Organisations: An Australian-Thai Case Study

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Abstract

A case study was undertaken on a project being undertaken by an Australian - Thai joint venture organisation in Bangkok. The study identifies the methods, channels and patterns of communication utilised by project participants and examines the factors influencing the circumstances of that communication. Communication, Multi-National Organisations and National Culture provide the theoretical framework within which the study is made. It is concluded that national culture impacts on the methods, channels and patterns of communication and that these impacts influence the transfer and reception of information. Observations and discussions with participants over a three week site based investigation suggest that an appreciation of national culture and host country language is essential for the achievement of high performance in multinational construction organisations.

INTRODUCTION

Multi-national organisations (MNOs) have blossomed in recent years, and yet commentators continue to express disquiet over the paucity of concern shown by these firms in respect to the important role played by their human resources and in particular towards their expatriate managers (Dowling *et al* 1994; Hancock *et al* 1996).

For Hall (1995) the primary benefit to be had from the cultural differences that one finds in MNOs lies in the opportunities to learn from the differing modus operandi employed by those involved. Members of an organisation from different countries may have entirely different cultural backgrounds which provides the MNO with opportunities for both synergy and dissynergy in organisational operations. In order to achieve synergy and make the MNO an effective and high performing organisation, both effective and efficient communication is required (Wiseman and Shutter 1994). Communication has been recognised for many years as a critical factor for success within the construction industry. Communications breakdown, frequently, is the first sign of problems, notably in relationships between project participants, and can engender situations conducive to disputes, claims etc...

The formation of joint venture construction companies and projects has become commonplace between foreign and local organisations in developing countries. In these cases, those working on any given project will normally be drawn from, at least, the two nations represented by the companies involved and, possibly, more. Joint venture organisations may then be described as multi-national. A recent survey of expatriate construction managers working for Multinational firms (Hancock *et al*, 1996) showed that three quarters of those surveyed believed that their employers did not include language capabilities in their selection process. Neither it seems did those employers concern themselves with staff learning to speak the language of their host country as 90% of respondents claimed to have received neither pre-departure or post-arrival training of any kind. Given this apparent lack of importance attributed to the issue of

language by construction MNOs, a case study of a construction joint-venture project was conducted to identify problems arising as a result of communication difficulties, and the approaches used by participants, to overcome them. Some tentative conclusions concerning the relationship between national culture and the transfer and reception of information were then drawn.

COMMUNICATION

Communication (defined as being action that makes information and ideas common to many: Williams 1983) encompasses speech, systems of writing and drawing, signs, symbolic rites, polite formulas, military signals etc. which together we might term as "language". For communication to be effective, messages to be imparted must be encoded and subsequently decoded by the receiver. In order for this to happen, those party to any communication must all have a clear understanding of the language. As such, language, the basis for the act of communication, is a social institution and therefore central to the culture of those engaged in it.

Communication performs several functions. Firstly, it is used to exchange information. Without communication, nothing can be accomplished and so it is 'about getting things done'. Secondly, communication assists in the facilitation and maintainance of work group relationships and is therefore an aid to co-operation. Thirdly, it is widely used to influence people's attitudes and values whilst also acting as a means whereby individuals can express their inner feelings.

Because communication does not occur unless a message is received, understood and acknowledged (Ferguson & Ferguson, 1980), a person speaking a language unknown to the receiver is not communicating with him/her. In order to overcome this difficulty, people will choose from a variety of communication methods available to them in order to establish an area of mutual understanding. In the course of everyday interaction, these methods can be grouped under three general headings; verbal (the spoken word), non-verbal (facial expressions, body language, eye contact, office layout etc.) and written (memoranda, letters, notes etc.). Apart from the need to choose an appropriate means of communication, it is also necessary, for effective communication, that organisations allow both formal and informal communication channels to exist (Schermerhorn *et al*, 1994). Formal channels generally are those that follow the chain of command established by the hierarchy of the organisation and usually comprise written and drawn media (letters, memos, policy statements, reports, drawings, schedules etc.). Informal channels (often referred to as *the grapevine*), tend not to be planned, but arise from the natural social interaction between members of the organisation (Ferguson & Ferguson, 1980; Kreps, 1990).

Barriers to communication

Apart from dependance upon a common language, and appropriate choices of medium and channel, the achievment of effective communication is also subject to a number of variables referred to as Barriers. Jerry *et al* (1977) identified nine such disturbances:

- *Power Differences* (between managers and subordinates)
- *Differences in Language Backgrounds* (tendency to communicate only with those of a similar national and social background)
- *Style of Communication and Intonation Used* (the degree of autocracy imposed by managers and their communicating demeanour)
- *Choice of Communication Channels* (mistaken selection of channel may lead to conflict)
- *Physical Distortions* (distracting phone calls , unexpected visitors etc.)
- *Semantic Problems* (particularly mixed messages resulting from conflicting images portrayed by sender's words and body language)
- *Cultural Differences* (differing reactions to messages resulting from different national/ethnic perceptions and values)
- *Absence of Feedback* ("one-way" communication allowing no measure to be made of the success of transmission)
- *Status Effects* (bias in the up and downward flow of information due to organisational hierarchies)

MULTINATIONAL ORGANISATIONS AND NATIONAL CHARACTERISTICS

In recent years, multinational construction organisations have multiplied, particularly in the region of South East Asia. Most often, these organisations take the form of joint ventures between local and foreign companies with or without common activities. Such a composition occurs because of a range of mutual advantages and benefits:

- The local industrial investors can benefit from the "know-how" acquisition and high technologies obtained as well as from the input of qualified personnel from the host country,
- The host investors can promote and assist in establishing any potential market in the local country,
- The host can help in arranging and obtaining sources of international finance for the joint operations,
- It can provide confidence and competence to enter the local market and allow the organisation to stay and compete,
- The locals can assist in recruiting local qualified employees,
- The locals can assist the host country to familiarise itself with the local financial, accounting and taxation systems,

- Risk of the unknown local environment can be jointly shared among the local and the host, and greater availability of cash flow & local finance can be easily obtained.

By definition, members of MNOs come from several nations or different cultural backgrounds or consist of two or more nationalities or languages (Weinshall,1977; Foster,1980). As a result, people bring along their values, beliefs, perceptions etc. into an organisation where cultural diversity will be one of the most common issues (Larkey, 1996). This combination can create either synergy or dissynergy in and for the organisation. When members cannot get along with each other, they often hold the diversity of cultural differences as responsible for the collapse of relationships and intra-organisational conflict.

Following Larkey (1996), we consider diversity to be: (i) differences in worldviews or subjective culture, resulting in potential behavioural differences among cultural groups and (ii) differences in identity among group members in relation to other groups. Thus, for an organisation to be successful, people within the organisation have to share some common cultural characteristics and communication is inevitably influenced by cultural issues.

Hofstede (1980), in classifying the cultural dimensions of societies, proposed four categories:

Power Distance: the degree to which people accept a hierarchy or unequal distribution of power in organisations.

Individualism versus Collectivism: the extent to which people prefer working individually or as a group.

Uncertainty Avoidance: whether people are tolerant of risks and ambiguities or feel the need for organisational stability.

Masculinity versus Femininity: the extent to which the dominant societal values are assertive, acquiring of material and money, careless of others etc. (masculine) or emphasise relationships, concern for others and the quality of life etc (feminine).

Whilst Hofstede's work is widely accepted and serves as a basic model for international comparisons, there must be some question as to its sensitivity. The Thai national character derived from the empirical data of two nationwide samples by Komin (1991) show a total of 9 value clusters underlying Thai society. An understanding of these cultural values when determining an appropriate management style in Thailand, is then, important for inter-cultural management. These clusters (described below) serve to illustrate a greater subtlety in understanding of the Thai people than is possible from Hofstede's analysis.

Thai National Characteristics

Ego Orientation

Komin (1991:193), points out that " Thai people have a very big ego, a deep sense of independence, pride and dignity. They cannot tolerate any violation of the 'ego' self. Despite the cool and calm front, they can be easily provoked to strong emotional

reaction, if the 'self' or anybody close to the 'self' like one's father or mother, is insulted."

Generally, it is the matter of "face" and "dignity". To Thais, the "ego" represents the "face" (an extremely sensitive issue). The "ego" of the Thai is so important, it naturally follows that they have an avoidance mechanism to fend off unnecessary clashes. Additionally, this mechanism is delicately and keenly observed by all parties involved in an interaction. Vulgar phrases or expressions such as "damn it" will mistakenly be perceived as swearing at, or scolding of the Thai her/himself. In response, the Thai will demonstrate her/his dissatisfaction by silent boycott or passive non-cooperation.

The preservation of one another's ego is the basic rule of all Thai interactions. Attempts at forcing or demanding of them will not help to accomplish an activity in a society where individuals act because they want to and not because others expect them to, or the situation demands it..

Grateful Relationship Orientation

Komin (1991) comments that, reciprocity of kindness, particularly the value of being Grateful is a highly valued characteristic trait in Thai society. Most Thais have been rooted and socialised to value this Grateful quality in their daily life styles. Thais call this concept *Bunkhun,* meaning indebted goodness. They believe that it must be returned, often on a continuous basis and in a variety of ways, because *Bunkhun* should not and cannot be measured quantitatively in material terms.

Through this process, good connections and social relations are developed which generally help to explain the effectiveness and efficiency of the success of projects or completion of jobs. This is because the gratitude creating process is connected with the establishment of power through relationships. Through the power and relationship connections, many difficulties and wrong-doings can be easily overcome and/or eliminated. Therefore, establishing good relationships is important to the successful acheivement of objectives.

Smooth Interpersonal Relationship Orientation

A smooth interpersonal relationship orientation is characterised by the preference for a non-assertive, polite, relaxed and pleasant interaction which accounts for the smiling and friendly behaviour of Thai people. Thus, to be successful in Thai society requires a soft, calm and careful yet polite manner, presentation and approach in order to reduce tensions and maintain harmony.

Flexibility and Adjustment Orientation

Besides ego and smooth attitudes towards interpersonal relations, the Thais are "flexible and situation-oriented". When faced with a problem, they will always respond to it as "a small matter"; to them everything is adjustable and solvable. Thais are more concerned with "Relationship" and "Flexibility" values, and are not principle oriented; indeed they usually appear not to be strictly law-oriented. To them, laws may be prescribed on paper, but right or wrong depends on who the person is or whom the person knows. This is why the enforcement of law can be difficult in Thailand (Komin;1991).

Religio-Psychical Orientation

In Thailand, Buddhism is the religion practised by most nationals. As a result, Buddhist teaching has an influential effect on Thai society and cultural values. In general, Thais are relatively superstitious and fatalistic, believing that their lives are predetermined by the good or bad acts performed in their previous lives. This is the main reason why Thais take things easy and patiently in their daily encounters. It is also this approach which has given foreigners the inaccurate perception of Thais as lazy and lacking the urge to work and move ahead.

Because of the Buddhist concept of *karma,* Thais are not group-oriented. *Karma* stresses that individuals must work for their own merit and demerit, detachment, non-violence and permissiveness etc.

Education & Competence Orientation

Komin finds that Thai people give more importance to the "form" than "content" of education which means that education is perceived as a "means" of climbing up the social ladder and for career advancement. Such a value helps in understanding the low task-achievement value prevalent amongst Thais (Komin;1991).

Interdependence Orientation

Co-operation has been commonly practised amongst Thais over the centuries and this reinforces the sense of "neighbourliness". Such co-operation can be clearly seen in agricultural activities whereby all members of a neighbourhood willingly help one another. As a result, Thais can be said to place more emphasis on interdependence than on individualism for achievement.

Fun and Pleasure Orientation

The Thai people have a belief in *Samuk* (meaning, fun and having a good time). Thus, most Thai social interactions are pleasant, humorous, fun and lively in nature. Thais find repetitive activities boring and are thus seldom committed to routine activities.

Achievement Task Orientation

Komin's findings (1991) reveal task achievement is often influenced by social relationship values; without consideration of which, nothing will be accomplished. Amongst Thais, there is a preference for good relationships over the need to accomplish tasks. Therefore, good relationships and connections are necessary for the motivation of individuals and subsequent organisational success.

When categorised within the bounds of Hofstede's model, Komin's analysis of the Thai people aligns with Hofstede's findings that the Thais are characterised as high in uncertainty avoidance, power distance, and collectivism and as low in masculinity. What a comparison of Hofstede's and Komin's work demonstrates, is the need to appreciate that models are only an approximation of reality and may well be constructed in different ways and to varying degrees of complexity. A manager, following an oversimplified or overgeneralised model may well remain ignorant of small yet important aspects of the culture with which he/she is dealing.

Case Study

Data Collection

A case study was undertaken of a Joint Venture project between an Australian contracting firm and a Thai property developer during the summer of 1996. The firm,

which has ten projects throughout Thailand, was established in 1993 and is under the control of an Australian management team, with all departmental managers being Australian expatriates. Each project has its own organisational structure and at the project level, professional staff of both nationalities are employed. The management structure of the project site studied consisted of an Australian project manager, site manager and site superintendent and Thai project engineer, site engineer, two senior foremen and five headmen (the headmen having direct line responsibility for the local subcontracted and directly employed labour force). Approximately 350 people were employed on the site during the observed period.

The main aim of the field study was to note types and patterns of communication between project participants along with the identifciation of factors influencing the circumstances of each media's usage. The study was undertaken in two parts:

Observation Period:
A fourteen day (5-8 hours per day) observation period allowed a study to be made of the project environment, its participants and the communciation channels, methods and patterns utilised by them. This period also enabled the development of a conceptual base for later unstructured interviews. Activities analysed during this period included attendance at site meetings, observation of site inspections and the issuing of site instructions.

Interviews:
Six days (1-3 hours per day) of unstructured interviews followed the observation period. Interviewees consisted of those deemed by the researcher to be "important" project participants regardless of whether they held a formal title.

The observer is a native Thai speaker with 7 years experience of interacting with native English speakers. His background provided an advantage in describing and interpreting the results collected during the interview phase. During the observation period, information and data were translated and recorded in English at the point of collection in order to reduce the curiosity of the subjects and the possibility of conflict. Data from interviews were recorded separately.

CASE DISCUSSION & ANALYSIS

During the observation period, three main events were observed and analysed; site meetings, site inspections and site instructions. The unstructured interviews enabled explanation and subsequent analysis of the observations.

Event 1: Site Meetings
In general the organisation used meetings as a means of exchanging information, generating ideas, discussing problems and making decisions. Meetings can be classified as project and site meetings. Given that the research was focussed on the circumstances of internal communication, only site meetings were observed, because they excluded external consultants and sub-contractors.

Participants at site meetings were the Project Manager, Site Manager and Site Superintendent (all Australian and speaking only English); the Site Engineer, Foreman and five Headmen (all Thai and speaking only Thai) and the Project Engineer and two Senior Foremen (all Thai, but speaking both Thai and English).

Meetings were held twice a week on site and lasted approximately one hour each. None of the Australians spoke the local language, but three of the Thais were able to speak both languages. Given the obvious communciation difficulties, a combination of verbal, non-verbal and written methods were utilised to explain issues, discuss matters, problems and identify any information needed. Both Thai and English were used in the meetings and the Thai Project Engineer acted as a translator.

Observation and subsequent discussion showed that the forum of site meetings was disliked by the Thai participants who preferred to discuss matters privately: this might be expected given Komin's identification of the Thai characteristics of Smooth Interpersonal Relationship Orientation, Flexibility and Adjustment and a love of Fun and Pleasure. The Australian managers construed the general quietude of the Thais as signifying that they were not taking meetings seriously and neither manager was aware whether the locals had understood what they (the Australians) had said during meetings. The differences in language required that translation be provided, but by his own admission, the Project Engineer who undertook this work would not translate anything that he felt might upset another person. This meant that no criticism could be directly passed either way. This situation aligns with the lack of questioning on the part of the Thai personnel because of the need to ensure that others do not "lose face". Translations were also influenced by unfamiliar vocabulary, idioms and the sheer length of some of the messages to be translated. Although the Thai participants did not, generally, contribute during meetings, they would discuss matters and ask questions privately with the project engineer and senior foremen (those they respected) afterwards. Overall observation of Site Meetings suggested that communications are impacted by both technical (translation) and cultural factors.

Event 2: Site Inspections

Both project and site managers inspected construction work points on site for the purposes of quality and time management. The project manager normally inspected progress in the morning before returning to his desk, while the site manager spent most of his day inspecting aspects of the work. The two of them normally communicated with sub-contractors and their own directly employed labour at the work points during such inspections. Apart from the Project Engineer (a Thai national) only the two Senior Foremen had any previous experience of working with other nationals and these three were the only bilingual staff working on the project. As a result, most communication during inspections were of a non-verbal kind eg. body language, eye contact etc.

The local workforce revealed that they were enjoying working with foreigners even though they encountered difficulties of comprehension. This enjoyment was evidenced by a smiling and joking attitude towards the managers during inspections. Demands made by the expatriate managers were met with smiles and jokes, but not with any changes in practice. Where either mistakes or problems occurred, the workforce would hide it or try to fix it before the managers found out, because they did not want to offend them. If a mistake was serious, those responsible would be likely to resign their work and move to another employer in order to avoid criticism and face to face confrontation. This point is in line with Komin's ideas of "Ego Orientation" and "Grateful Relationship Orientation". However, they would not undertake work simply because it was demanded. The key to success in achieving the required standards of time and quality was through the appointment of headmen (promoted from within the

labour force) who were respected by the rest of the workforce. These headmen, however, were unable to inform the managers of problems which occurred on site due to their own sense of "Indebted Goodness" towards the workforce. The site manager socialised with one of the headmen in order to determine the existence of problems about which he was unaware. The above indicates that communication was impacted by the local culture.

Event 3: Site Instructions

The site manager issued work schedules to the senior foremen, foreman and headmen on a daily basis. Whilst the senior foremen were usually instructed verbally, the foreman and headmen received written instructions. The rationale for these chosen media is that the senior foremen were competent in English, but the foreman and headmen were not and therefore the written format allowed them more time to gain an understanding of the instructions and a time saving was made on the part of the site manager. A difficulty noted was that there was no way of knowing whether the headmen had understood any spoken instruction because they would politely smile and nod their heads (Ego Orientation and Smooth Interpersonal Orientation) giving the impression of understanding even when they did not. Additionally, it was observed that the headmen would attempt to follow instructions whose meaning was either unclear or incomprehensible to them; this led to frequent problems which had both cost and time implications for the project. Whilst the Senior Foremen could be instructed verbally, it was noted that such instructions were not effective when issued with a raised voice. Response to such an approach typically included a silent boycott or the taking of sick leave for a few days.

Conclusions & Recommendations

Although the study undertaken was only conducted on a single project and over a short time period, there were enough examples of the impact of national culture on the communication process for some tentative conclusions to be drawn and some practical recommendations to be made.

A range of communication methods and channels were adopted by project participants according to circumstance, but in many instances, effective and efficient communication was not possible owing to the intrusion of cultural and language differences. These differences can be said to impact upon opportunities for synergy within the MNC and, where such an impact is negative, high levels of performance are unlikely to be achieved and additional costs are likely to be incurred.

In the case studied, the cultural factors not only affected the transfer and reception of information, but also had a knock-on effect in respect of the management style adopted, possibilities for teambuilding and the decision making process.

For successful joint-venturing, effective and efficient communication is required. We would recommend that MNOs consider the following possible means of improving their chances.

- Provide local culture training courses to all expatriates prior to the taking up of an assignment. Courses should include an appreciation of the main factors of national culture and characteristics and some basic language acquisition.

- Provide post-arrival courses, including more advanced language training.

- Employ more local staff who have experience of working with expatriates. These staff may act as a connector between the differing cultures.

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GENERIC WORKING - THE DRIVER TO GOOD BUILDING PROCUREMENT

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Abstract

Generic working or multi - skilled work practices are now being used by organisations to gain competitive advantage. Organisations are redefining their strategies to adopt these new methods of working and these strategies should be reflected in the design of buildings to be used by these organisations, thereby enabling flexibility in the delivery of their core business activity. Working practices will have a direct bearing on the functional analysis and space requirements connected to the building procurement process.

Exemplars exist in commercial and public sector buildings of innovative designs linked to working practices. In the commercial sector, examples can be drawn from the trend towards multi-functional teams operating in specially designed buildings. Within the public sector, patient focused hospital design for example, aims at minimising the transportation of patients between physically distant departments. The necessary facilities are provided throughout the hospital building adjacent to the patient in a unit that is staffed by multi-skilled generic staff trained to deliver all of the services required.

The paper will explore generic working principles and how these link to building design. The authors believe that working practices to deliver the core business needs can (and should) be the driving force to decision making for good building procurement.

Introduction

Working practices in the modern post industrial society of the nineties has changed dramatically from the foundries and mills of the last century or the large factory units typical of the first 70 years of this century. Business has moved on from the days of Henry Ford and Frederick Taylor where people were seen as an extension of the production process, a mere cog in the production machine. Business process re-engineering looks at process and place and seeks to combine these in a way that brings competitive advantage. Hammer and Champney (1993) state that "the old ways don't apply and we must change every aspect of our business accordingly". This applies equally to the buildings we use as much as the processes we employ. Hammer and Champney chronicle the experience of Taco Bell who changed their system of work and were able to re-think their property strategy, whilst their competitors' answer to increasing turnover was to expand their real estate holding by extending the size of their units. By matching building design with the new work practices, Taco increased seating capacity by reducing their kitchen sizes, thus increasing turnover within their existing property holding.

The procurement activity should take account of both process and place within a framework of quality, value and risk to provide buildings that support the business activity and achieve

competitive advantage to the organisation. There is a need for re-appraisal of the physical settings for these new ways of working. Work is increasingly being organised around flexible models that include concepts such as generic working, multi-skilling, team working, learning structures etc., and it may be useful to examine some of these conceptual frameworks.

Generic Working

Generic working can be loosely defined as the provision of human resources trained to deliver a wide range of services in order to suit the needs of a particular customer group. The principle is now well established and requires a new set of skills to be centred on customer care and quality rather than our traditional skills. The wide range of tasks requires a multi-skilled approach and cuts across several functions.

Traditionally the service sector of industry has followed a model based upon the task to be carried out. This model has created a culture organised around the needs of particular skill categories and job definitions, and has defined areas of demarcation between one discipline and another. Today that 'task focused' model is obsolete as it inevitably leads to a degradation in the quality of service that can be delivered. Schelinger and Hasket (1991) describe this as "setting into motion a cycle of failure that is uniformly bad for customers, employees and shareholders. Amongst it symptoms are customer dissatisfaction, high employee turnover, waste of resource and high unit cost".

The modern service centred customer is better informed and more demanding. Their expectations are higher than in the past and they are less likely to accept the word of 'the expert'. Organisations now need to change their approach to become customer focused. This change in attitude must permeate through all levels of the organisation from top management to front line staff. It means that staff in its organisation must recognise who their particular customers are, what their needs are and must become more tuned to 'on the spot' problem solving. It is necessary to recognise the diverse range of tasks required to satisfy the needs of each customer and to ensure the organisation is structured to deliver the right combination at the right time.

Multi-skilling

'Multi-skilling' is a means of enhancing labour flexibility and may be defined as "the process of enhancing the skill repertoire of workers in such a way as to improve the ability of an employee to work in more than one narrowly defined occupational speciality" (Cordery, 1989). Whilst this is a good general definition, to gain maximum benefit from multi-skilling, it should be deep rooted rather than a skills extension programme.

Job Re-Definition

The adoption of generic working principles will require the re-arrangement of traditional work patterns and the opportunity should be taken to focus on those factors which lead to success.

The new working pattern should create, within the individual employee, an attitude which values the fulfilment of customers' needs. Rigid 'Taylorist' organisations which revolve around processes are inappropriate for the modern organisation. The reality is that customers now expect and demand a service more responsive to their needs. To achieve this, organisations should redesign their approach to service with their customers' expectations as the driving force and not the building or operating system with its associated constraints. Property portfolios must be designed or acquired to fit the business needs and working practices with the capability for change. Flexibility is the key.

Motivation

Job definition and workplace design is an important element in the motivation process. Traditionally, approaches to defining jobs and workplaces have, however, concentrated on the tasks to be performed and the consideration of the human element has been almost secondary. This is evident in traditional Scientific Management approaches where jobs are de-skilled and broken down into simple component parts that can be performed on a production line basis. Motivation in this case has been largely limited to straightforward incentive pay systems. The adoption of good integrated workplace design can improve staff motivation and enable the organisation to deliver its key objectives.

Learning Organisation

The 'learning organisation' requires and encourages learning and knowledge generation at all levels. It is being hailed by many of the modern day gurus as the answer to transformational change. It would appear to the authors, however, that an organisation could very well have in place all the attributes of a learning organisation but if these are superficial they will only address the visible part of an organisations' culture. The underlying sub-culture and most importantly, the perpetual set of all individuals who constitute the organisation, must also be captured.

The work of Argyris and Schon (1978) on single and double loop learning is particularly relevant in respect of the introduction of Generic Working. Single-loop learning is concerned with the efficiency of an organisation, whilst double-loop learning is concerned with the effectiveness of the organisation. This is a key reason for the introduction of generic working if organisations are seeking to gain competitive advantage.

Double-loop learning requires the traditional norms and values to be challenged, a concept which encapsulates the concept of generic working. It must be understood that to foster the evolution of a learning organisation and achieve double-loop learning, it is necessary to operate a 'no blame culture', a major challenge in its own right.

Culture

Culture describes the values and beliefs of an organisation and its employees, and also the way in which they interact both internally and externally. The behavioural norms will be shaped by the social and economic environment that the organisation operates within and also society's expectations. Therefore, external influences such as political, social and market requirements will impinge on the development of a corporate culture.

The procurement process should take full account of cultural issues.

Teamwork

Effective teams are a powerful force in the business environment by way of developing plans and effecting solutions to simple and complex problems. The strength of a team comes from the synergy that a team can generate. It is the individuals, however, that make up a team. First and foremost, it should be particularly noted in introducing generic working that it should focus on the development of the individual. Successful development of the individual will then facilitate Generic Team Working and should achieve a synergetic effect (2 + 2= 5) - a positive way to seek competitive advantage.

Empowerment of Employees

Empowerment of employees has evolved over recent years as a means to tap the tremendous potential that is held by an organisations' employees. The empowered workplace is characterised by:

- enhancing the content of the work
- expanding the skills and tasks that make up the job
- liberating creativity and innovation
- exercising greater control over decisions about work
- completing a whole task rather than merely portions of it
- achieving customer satisfaction
- developing a market place orientation

The empowered work place is characterised by an environment where employer and employee are perceived as partners.

Risk will be a factor for managers in the decision to delegate and empower or not. The important aspect for managers to remember is that if the front line workforce at the customer interface is not empowered, then the emerging service-sensitive customer (internal or external) will not be satisfied. Training qualifications and skill development of employees must be addressed in an empowered workforce if employees are to be capable of responding to the needs of customers. The approach required is one of developing a learning organisation by the development of the individual as well as the organisation.

Property

Property can no longer be viewed as a safe investment for Companies and must be judged by its contribution to the business process. It must be flexible and capable of change to provide the place for the processes that support the key business imperatives. Our attitudes to workplaces and those who work in them will influence our expectations, old traditional worker definitions are changing with the concepts of empowerment and knowledge working, Raymond and Cuncliffe (1996) have re-defined worker categories in terms of collar colours:-

Collar Colours	
Blue collar	traditional manual worker
White collar	traditional office worker
Ultra white	Top executives
Open collar	academics, writers
No collar	Virtual office worker
Gold collar	thinkers and creators - the ones who add real value

These changing work practices and attitudes require appropriate environments to ensure the necessary blend of "process and place".

That a radical rethink of the workplace is required demonstrated by the following two paradigms.

Public Sector Paradigm

Hospitals have traditionally been designed and built around centralised functional specialities. This has meant that as hospitals have got larger the departments have become dispersed and patients are travelling, either by foot or wheelchair, greater distances to suit the convenience of the institution rather than to progress their treatment. The latest UK Government white paper on the future of the National Health Service in Britain (NHS, 1996) outlines the notion of "a high quality service which is organised and run around the needs of individual patients, rather than the system or institution".

Hospitals have, in the past, run as fragmented organisations that thrive on specialisation, as a consequence we have seen the development of jobs such as phlebotomy which exist purely to draw, blood from a patient but not to analyse that blood, as well as many other narrowly defined 'specialist' laboratory tasks that require a minimum of training. Many other staff groups also exist which are all pigeon holed to a specific function although as individuals they are capable of performing a wide range of duties. This has led to an organisation compartmentalised by process complexity which constrains the ability of the organisation to deliver an appropriate level of service to fit the needs of the individual patient. The buildings which have emerged reflect these organisational constraints and have led to the podium and tower architecture which is a feature of many large hospital complexes today. Patients are housed in relatively narrow tower blocks with treatment, diagnostic, laboratory and operating departments concentrated in sprawling podiums. This can create a logistical nightmare for staff

and patients with each element of the care process having to be accurately scheduled and patients transported through long featureless corridors from ward to department and back to ward. This may happen several times during the average stay. At the same time that this is happening, vast quantities of patient samples (blood, urine etc.), medical records, meals and other commodities are being transported along these same corridors to centralised laboratories, filing stores, kitchens etc.

In the last two or three years there has been a shift towards a new paradigm of clustered services delivered by generic staff in patient care centres rather than nursing units. This involves creating new aggregations of patients as a means of improving performance. In order to design new ways of processing patient care and re-define the jobs involved, it is necessary to consider the grouping of patients, this is not to say that they all need to be of the same type (i.e., all cancer patients) but their needs must be similar so that appropriate processes and environments can be created.

Emerging from this analysis can be seen the case for integrating the style of care with the design of the buildings in which that care takes place. It is the combination of the processes and working practices that must lead the spatial modelling that precedes the design activity. Centralised specialist departments should only be included where this is unavoidable due to factors such as high cost of capital equipment or highly skilled specialist operating requirements. Services should generally be provided as part of the care centre and may include facilities such as:-

- laboratories
- X-ray and diagnostic units
- treatment units
- minor or day surgery space
- localised stock holding areas
- localised administration
- networked information services

Philip Lathrop (1993) has defined the goals to be achieved in this new service model as:-

- improve the continuity of professional relationships among care givers and doctors as they collaborate on behalf of the patient.
- minimise the movement of patients through the hospital
- increase the proportion of direct care activity when compared to infrastructure work
- tailor operating environments to the particular needs of related groups of patients
- empower staff members to plan and execute their work in ways that are most responsive to patient needs

There are clear pointers here to the success of the buildings' performance leading to criteria that must be reflected in the procurement process.

The integration of working practices and building design must also extend to the appropriate selection of equipment; for example, the equipment in a localised unit base laboratory must be simple to use even if it may be slower in process time. This would still give considerable improvement in the overall time to process a sample and reduce the need for special environmentally controlled spaces that would be required in a centralised laboratory with more complex equipment.

When designing hospitals of the future, buildings should be seen as enablers to the healthcare process. The design of spatial relationships and built environments must be preceded by questions of

- how is care organised
- who performs the tasks
- where are the tasks performed
- what are the patients needs

Commercial Sector Paradigm

The constant search for ways that enable organisations to achieve competitive advantage has required organisations to search for new ways of working. The Virtual Office (Greengard, 1994), is a model whereby leading edge technology and new concepts of working redefine work and job functions by enabling employees to work virtually anywhere.

Information technology has been a major enabler in developing the concept of the Virtual Office by the development of powerful desktop and laptop computers, modems, software and digital communications, enabling work to be carried out virtually anywhere in the world, hence the term "Virtual Office". This method of working has coined the phrase "Teleworking". A 1988 survey carried out in the United States of America established that some six million Americans work at home full time, and another 19 million do so on a part time basis (Cutler, 1990). The trend is following in the United Kingdom with British Telecom estimating that up to a million people already work away from the office (Whitfield, 1993). Professional disciplines working from home have also been shown to be diverse (Huws, 1993).

The emergence of the teleworker is creating a new paradigm and becoming a simple but classic example of generic working. Home based workers are empowered, and by the nature of their single location become generic workers carrying out such tasks as secretary and administrator with generally minimum support from the central support hub.

The emergence of generic teleworkers has started to have a dramatic effect on the corporate property portfolio. No longer is it necessary to have large corporate headquarters capable of accommodating all staff. Re-engineering of corporate functions and facilities leads to a requirement for telecentres, hot desking, touchdown desks and business/social meeting points.

The most dramatic effect of this is the reduction that can be achieved in occupied floor space having a dramatic and beneficial effect on organisations' financial viability.

Organisations must consider how and who will achieve the procurement of the buildings and facilities required of the new generic work environments.

PROCUREMENT

The procurement of buildings required to support the new methods of working will require development of the concept of the intelligent client. The role will need to be filled by a person or organisation that is capable of recognising the rapidly changing work environment, capable of identifying business requirements, and being able to deliver resources for the range and quality of services required at minimum risk exposure.

The resultant effect of this evolution may very well be the demise of many traditional building solutions as we currently understand them. The key issues for the future will be:-

- increasing adaptability to changing business needs
- providing a healthy workplace for creative people
- assimilating the potential of new technologies

ensuring full use of diminishing resources whilst minimising environmental impact.

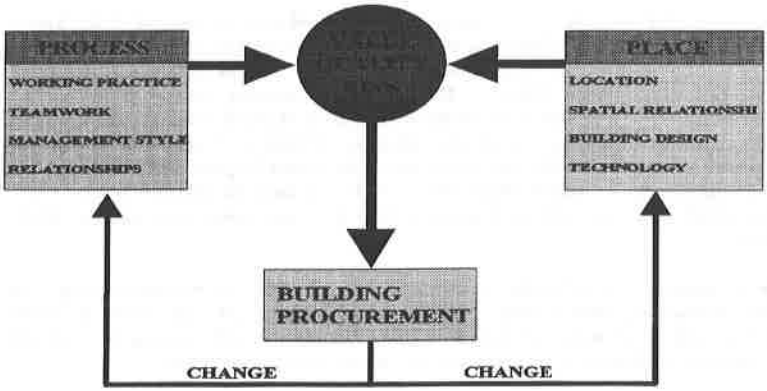

Figure 1 Building Procurement Model

It is proposed that to meet the requirements of figure 1, an intelligent client role will need to be filled by a new professional under the banner of Facilities Management. The Facilities

Manager will not remove the role of the traditional professional team but will be capable of understanding the business agenda and culture of the organisation, and be capable of articulating this in a brief for building procurement that recognises the strategic, tactical and operational requirements of the current and future business needs.

A comprehensive understanding of generic working, motivation, teamwork, empowerment and how property portfolios support the development of learning organisations will be required.

Traditionalists will find this emergent role controversial. It involves change and change is threatening but it is happening and will happen at a pace that is quickening as global competition speeds towards the millennium. Building procurement must face and resolve this challenge.

To survive, corporate organisations must become highly flexible and dynamically responsive to change, capable of not only operating nationally but globally 24 hours per day 365 days per year. This is requiring a significant mind shift and implies a deep cultural change. Traditional restrictive professional attitudes and practices that present barriers to change will need to be banished. The future, however, is not bleak for the traditional professional roles, since these professionals will have a important and complimentary role to play in the Team. In many cases they will emerge as the Facilities Manager. Professional development and the acquiring of new skills will be needed. Universities will play a important role in recognising the new emergent profession and the need to develop courses capable of meeting the mature candidates requirements for professional development.

Many may claim the new role is project management. Not so. Facilities management is a process by which an organization ensures that its buildings, systems and services support core operations and processes as well as contributing to achieving its strategic objectives in changing market conditions. A holistic approach to operational management, that will add value to the process of project management.

The facilities manager operating as the intelligent client representative will:-.

- Identify core business needs and user requirements.
- Develop facilities to meet business objectives.
- Recognise the value that buildings and facilities can add to the business agenda.
- Constantly monitor the property portfolio against the needs of the business agenda.
- Formulate and communicate policies.
- Holistically manage non core services.
- Create service partnerships.
- Constantly evaluate service and asset provision to ensure the core business agenda is being delivered.
- Negotiate service level agreements.
- Act as a single point of contact for non core functions, enabling the business to concentrate on its core objectives.

Organisations will need to evaluate how they will achieve an intelligent client capability. Most will initially adopt the concept of the in house appointment of a Facilities Manager or Facilities Management Department, depending on the size of the organisation. However some will develop the concept of the borderless organisation, and form strategic alliances and partnerships beyond the limits of their own organisation.

Facilities management is understood by many to mean outsourcing of services. This is a very limited view and an approach that will not sustain the development of market place competitive advantage, although short term gain can and is very often achieved by this approach. The more progressive organisations are recognising that the central thrust must be to ascertain how does this capability add value to the organisation in a competitive market place, where value is seen as a measure that takes into account the metrics of cost, quality and risk.

Organisations will therefore need to take into account the following:-

- Recognising the value that facilities add to the business.
- Developing property portfolios and facilities that are flexible to meet business objectives.
- Recognising that facilities do not always mean assets !

CONCLUSION

So what has Generic working to do with Intelligent Clients, Facility Managers and the Procurement of Buildings? It is a paradigm that shows the evolving - indeed radical - change that is developing whereby new work practices need to be recognised and developed into tangible concepts that can then be articulated to the traditional professional team to ensure that property portfolios match the requirements of the business agenda. Double loop learning must become the norm. Facilities managers with a holistic approach spanning management concepts and a sound understanding of building design and procurement will be the new changemasters of building procurement into the next millennium.

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CLIENTS' CRITERIA ON THE CHOICE OF PROCUREMENT SYSTEMS - A MALAYSIAN EXPERIENCE

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Abstract
The uncertainties in the construction industry are generated by some of the construction projects exceeding their time and cost budgets. At the time when the cost of building and of borrowing money are regarded as high, clients are less willing to tolerate such uncertainties. Although cost, time and quality are the three most important considerations, the business of building procurement invariably calls for some compromise or conscious balancing of these priorities. Clients who want to control the design and variations to a large extent in their project will follow the traditional procurement path. Clients who want a relatively fast method for their projects will take the design and build procurement path as the construction time is reduced because the design and building will proceed in parallel and there is also a guaranteed cost and completion date. Clients who want to modify or develop the design requirements during construction will take the management contracting procurement path because they can adjust the programme and costs for their projects.

Key Words: Guaranteed cost; certainty in time; functional quality; financial risk; clients' priorites

Introduction

The increasingly complex and varying demands placed upon its construction industry by the clients not only stem from the need to provide more sophisticated commercial and industrial working environments at minimum cost and maximum speed, but additionally from the fact that client organizations are also complex with different categories of customers requiring discrete solutions to their procurement needs.

It is therefore necessary for clients, particularly those that are not experienced in implementing construction projects, to be aware of the workings of the construction industry, its procedures and the characteristics of temporary management organizations. The client will have to create a project strategy for the successful implementation of the project.

Furthermore, the increasing complexity of buildings, the need for greater financial management, the need to reduce design and construction periods and the increasing burden of contract administration have put pressure on the clients to seek alternative approaches to the traditional methods of setting about obtaining the buildings they need. The clients are more conscious now of the need to change and they would certainly opt for whatever

alternatives are available and appropriate to the project in question. Thus, alternative procurement routes are being increasingly used due to the increasing awareness of most clients especially in terms of the project performance criteria of time, cost and quality.

Different types of clients determine their project success by different criteria or by different weightings of the basic criteria, and it is necessary for members of the construction industry to be aware of these various basic characteristics in order to assist them in the selection of the most appropriate procurement system for their particular project.

In order to ensure a successful choice of procurement system, the clients's brief must be clear and comprehensive and contain his or her primary and secondary objectives in terms of functionality, quality, time and cost. The client should establish a minimal acceptable level of functional performance and quality for his/her project at an early stage and ensure that the brief accurately reflects his/her needs and, if appropriate, any tolerances he/she is prepared to allow the designers. The criterion of value for money can be achieved if functionality and quality appear at the right price.

Clients' Criteria

Tan (1985) viewed the *traditional* method of project implementation in Malaysia as being too lengthy; it needs a radical overhaul and restructing to make the process faster and more efficient. This method, today, is taking a severe battering from all quarters and the most severe complaints are coming from the clients themselves. As projects become larger and more complex and also the requirements of the clients change, this method has come under increasing attack due to the cost and time overruns.

The *design and build* method offers an advantage to clients who want the total project cost to be kept to the minimum. The *design and build* clients must be able to accurately define their requirements at tender stage and are unlikely to wish to amend them during the development of the project. The length of pre-tender time in the design and build method will largely depend on the amount of details in the client's requirements. The flexibility in developing details or making substitutions is to the contractor's advantage in this method.

Kumarasivam (1985) stated that it is important to determine at an early stage who does what in the *management contracts*.. In design, this is fairly clear; the management contractor is an advisor only, the total responsibility for design rests with the designers.

On site, the management contractor usually has responsibility for ensuring that the works contractor carries out the work in accordance with drawings and specifications prepared by the design team. The aim of this method should be to have a partnership between clients, designers and contractors, and to balance the three aims of time, cost and quality; the aim is also to replace the usual " adverserial " contracts by one of trust between the parties, in order for this type of contract to be successful.

A survey was conducted on 45 projects, consisting of 28 projects procured by the *traditional* method, 11 projects procured by the *design and build* method and 6 projects procured by the *management contracting* method. The clients interviewed were divided into 2 types, that is, the public and private sector clients. The number of private sector clients was 26 and those from the public sector was 19.

The category of the respondents are tabulated in Table 1. The *traditional* clients consist of 54% (public sector) and 46% (private sector). The *design and build* clients consist of 27% (public sector) and 73% (private sector). All the *management contracting* clients belong to the private sector. These respondents are further divided into the the types of business that they are engaged in. The *traditional* clients comprised of developer (32%); owner-occupier (11%); government-owned bodies (54%) and others (3%). The *design and build* clients comprised of developer (36%); owner-occupier (27%); investors (9%) and government-owned bodies (28%). The *management contracting* clients comprised of developer (50%) and owner-occupier (50%).

TABLE 1 : CLIENT CHARACTERISTICS

PROCUREMENT METHOD	CLIENT CHARACTERISTICS						
	CATEGORY (%)		BUSINESS TYPE (%)				
	PUBLIC	PRIVATE	DEVELOPER	OWNER-OCCUPIER	INVESTOR	GOVT-OWNED	OTHERS
TRADITIONAL METHOD	54	46	32	11	-	54	3
DESIGN AND BUILD METHOD	27	73	36	27	9	28	-
MANAGEMENT CONTRACTING METHODS	-	100	50	50	-	-	-

In Section 3 of the questionnaire, the clients were asked to describe the level of importance of the criteria in assessing the performance of their projects. Table 2 shows the breakdown of these criteria and the client's assessment of their importance. Table 3 gives specific criteria and their ranking for project performance for the *traditional* clients, the *design and*

build clients and the *management contracting* clients. The figures show that there is a significant difference in emphasis in the ranking, ranging from 1(high) to 13 (low),between the three types of clients.
Traditional clients placed a great emphasis on the value for money, *design and build* clients placed a high ranking on the building with high aesthetic quality and the *management contracting* clients placed great emphasis on low maintenance cost. The criterion of value for money was given a low priority by the *management contracting* clients because these clients prefer to be given a reliable estimate for the contractor to be bound by, rather than be given a low price and ending up with an overrun on cost at the end of the project.

However, the *design and build* clients placed the criterion of minimum overall time of building in Rank 2. The reason stated by them was that the construction industry is very dynamic and fast investments are important for the country's economy. These clients also placed a high priority on the aesthetic quality and confidence in the design because the architects and designers were employed together with the other consultants.

For the *management contracting* clients, the quality of workmanship may suffer because the actual construction works are carried out by works or package contractors who are employed, coordinated and administered by the management contractor. The criterion of high quality in workmanship was placed in Rank 11 by the *management contracting* clients.

Under the argument of quality, Hillebrant (1985) stated that :-

> "clients are aware that by using a management contract, the architect may have less time to develop the design because he is under greater pressure from the contractor and sub-contractors. Thus, quality may suffer as a result."

On the other hand, the *traditional* clients placed a higher priority on value for money, obtaining the building which fits its purpose, and also attached importance to the main contractor's capabilities. Although under this procurement method, a single contractor becomes responsible to the client for completing the project in accordance with the contract, most of the actual construction work is performed by various sub-contractors. Thus, the main contractor's capabilities are very important to ensure that the construction work is

TABLE 2 : CLIENT'S CRITERIA

No.	Client's Criteria	Very Important		Important		Not Important	
		No. of clients	% of clients	No. of clients	% of clients	No. of clients	% of clients
1	Obtaining detailed planning permission	26	58%	10	22%	9	20%
2	Reliability of the estimated design time	14	31%	22	49%	9	20%
3	Reliability of the estimated construction time	18	40%	19	42%	8	18%
4	Reliability of the estimated construction cost	25	55%	16	36%	4	9%
5	Minimum overall time of building	17	38%	23	50%	5	12%
6	Minimum construction time of building	20	44%	20	44%	5	12%
7	Lowest cost	15	33%	21	47%	9	20%
8	Value for money	31	69%	10	22%	4	9%
9	Low maintenance cost	21	47%	14	31%	10	22%
10	Low operational cost	21	47%	14	31%	10	22%
11	High aesthetic quality in the design	13	29%	24	53%	8	18%
12	Obtaining the building which fits its purpose	29	64%	14	31%	2	5%
13	Confidence in the design	18	40%	23	51%	4	9%
14	Confidence in the main contractor's capability	27	60%	17	38%	1	2%

TABLE 3 : RANKING OF CLIENT'S CRITERIA

RANKING OF CLIENT'S CRITERIA FOR PROJECT PERFORMANCE			
CRITERIA	Traditional Client	Design and Build Clients	Management Contracting Clients
a) Minimum overall time of building	10	2	7
b) Minimum construction time	8	6	6
c) Lowest cost	11	5	4
d) Value for money	1	13	8
e) Low maintenance cost	7	10	1
f) Low operational cost	6	11	2
g) High aesthetic quality	13	1	5
h) High quality in workmanship	5	7	11
i) Obtaining building which fits its purpose	2	12	12
j) Confidence in design	9	3	10
k) Main contractors capabilities	3	8	13
l) Actual design time	12	4	3
m) Actual construction cost	4	9	9

carried out according to the specification as stated in the Bills of Quantities which form part of the Contract Documents.

Reasons For Procurement Choice

The clients interviewed were asked for the reasons as to why they have chosen the type of procurement method for their projects. Table 4 shows the breakdown of the respondents in each category. There were 11 *traditional* clients (32%); 4 *design and build* clients (36%) and 2

management contracting clients (34%) who have chosen the procurement method because of advice from their consultants. There were 15 *traditional* clients (64%); 6 *design and build*

clients (55%) and 4 *management contracting* clients (66%) who have chosen the procurement method because of previous experience. There were 2 *traditional* clients (4%) and 1 *design and build* client (9%) who were instructed to take the procurement method because of Government procedures.

TABLE 4 : CHOICE OF METHODS

REASONS FOR CHOICE OF PROCUREMENT METHODS	NUMBER OF CLIENTS			PERCENTAGE OF CLIENTS		
	Trad.	D&B	M.C.	Trad.	D&B	M.C.
Advice from consultants	11	4	2	32%	36%	34%
Previous experience	15	6	4	64%	55%	66%
Others e.g. Government procedures	2	1	-	4%	9%	-

Table 5 shows the breakdown of the reasons for the procurement choice. From the analysis of the data, 26% of the *traditional* clients; 27% of the *design and build* clients and 33% of the *management contracting* clients said that they were familiar with the procurement method chosen for their projects. Another 12% of the *traditional* clients said that this method is flexible, as they are able to control design and variations to a large extent. With regard to flexibility, 33% of the *management contracting* clients said that this method enable them to modify or develop the design requirements even during the construction stage.

TABLE 5 : REASONS FOR PROCUREMENT CHOICE

REASONS FOR CHOICE OF PROCUREMENT METHODS	NUMBER OF CLIENTS			PERCENTAGE OF CLIENTS		
	Trad.	D&B	M.C.	Trad.	D&B	M.C.
Familiar with this method	7	3	2	26%	26%	33%
Method was flexible	3	-	2	10%	-	33%
Enable projects to be completed early	9	4	2	31%	37%	33%
Government projects	9	4	-	31%	37%	-

About 31% of the *traditional* clients said that this method enable the projects to be completed on time. One of the reason cited by them is that the design will be fully developed before tenders are invited, and the contractor will be wholly responsible for the contruction stage. Another reason is because of the existence of the priced bill of quantities, which will enable interim valuations to be assessed easily and variations to be quickly and accurately valued by the presence of pre-agreed rates.

There were 37% of the *design and build* clients who said that this method enable the projects to be completed early. The main reason is that the construction time is reduced because design and building will proceed in parallel if this method is used. For the *management contracting* clients, 33% of them said that this method enable early completion. This is because an early start on site is possible, long before tenders have even been invited for some of the works packages.

From the analysis, 31% of the *traditional* clients and 37% of the *design and build* clients chose the method because these are Government projects, and they have to abide by the Malayasian Government instructions. All the *management contracting* clients interviewed belong to the private sector.

Clients' Satisfaction

a) **Regarding Time**

There were 18 *traditional* clients (54%) that were satisfied with the completion time for their projects. The levels of satisfaction on the completion time of the *design and build* client and *management contracting* clients were 82% and 83% respectively. From the analysis of the data, the *management contracting* clients were in the developer and owner-occupier category. The criterion of early completion of their project is obviously an advantage to them because they want quick return on their investment, especially for commercial projects. Most of the *traditional* and *design and build* projects were publicly owned and as such, the stipulated overall time could be controlled. This is because all the operations are subject to considerable scrutiny and governed by fairly strict procedures, from the in-house project managers in the government funded development agencies.

With regards to time, both the public and private clients would want to reduce the project duration, that is, the period from commencement to completion, to a

minimum in order to ensure a rapid return on the monetary and other resources that they have expanded, or to reduce onerous carrying charges. These clients are also keen to shorten the construction period so as to minimize disruption to their existing operating facilities.

The public sector clients would want to commence the construction of the project as quickly as possible in order to satisfy political pressure and to facilitate the needs of their expenditure programme. Thus, these clients will choose to carry out the design and construction of the project in such a way as to enable a specific construction completion date to be met.

b) Regarding Cost

Different categories of clients may have differing subgoals within the overall cost objectives. Based on the 28 clients interviewed, 64 % showed that the traditional clients are highly satisfied with the final cost of the project. The levels of satisfaction on cost of the design and build clients and the management contracting clients were 73% and 83% respectively.

The public clients, and those whose financial regulations demand it, will often require the tenders for the project to be the lowest received on a fixed priced lump sum basis and to be subject to minimal changes during the life of the project. The private sector clients on the other hand, will be prepared to accept an indicative cost at the beginning of the construction period, provided that they are kept informed of the likely final cost, by means of accurate forecasts at regular intervals during the duration of the works.

The *management contracting* clients placed great emphasis on the reliability of project cost rather than on the lowest cost. In contrast, *traditional* clients placed lowest cost and value for money as very important. However, for the *design and build* clients, the overall construction cost was very important as this system allow guaranteed cost and completion date.

Both the public and private clients will want value for money but some may be prepared to authorize additional expenditure during the construction period in order to achieve changes in the design which will enable them to enchance the performance of the new building and operate it more efficiently.

c) **Regarding Quality**

Achieving adequate functional performance and the right level of quality is usually the dominant or primary objective in most construction projects. Unless the completed building is suitable for its purpose and intended use, the clients' needs will not have been satisfied and value for money will not have been achieved.

Quality in this context has been described as aesthetic quality and functional quality. From the analysis of the data, 93% of the *traditional* clients were satisfied by the aesthetic quality of their projects. All the *design and build* clients and *management contracting* clients were highly satisfied with their projects' aesthetic quality. With regard to the functional quality, 96% of the *traditional* clients were satisfied with their projects; 91% of the *design and build* client and 83% of the *management contracting* client stated that they were highly satisfied with the functional quality of their projects.

The *management contracting* clients interviewed stated that this system was chosen because they want speedy projects and a building which fits its purpose. All the clients interviewed were of the opinion that they must establish a minimal acceptable level of functional performance and quality for their projects. The reason cited by them was to ensure that the brief will accurately reflect their needs and, if appropriate, will describe any tolerances they are prepared to allow for the designers.

Conclusion

In Malaysia, the *traditional* method of building procurement will undoubtedly continue to be used for a substantial percentage of all types of building projects. It has been suggested that in times of recession, the level of use will stabilize and might even increase. The *design and build* method is currently forecast to continue to grow within the forseeable future, at a comparable rate to the growth that it has achieved over the past 10 years. This method has been accepted as being appropriate for use on most types of projects. The *management contracting* method is more difficult to forecast ; a large portion of the difficulties that have undoubtedly been experienced, relate to the contractual and financial relationships between the management contractor and his works contractors.

Whatever method of procurement is used, the client ought to make clear to the tendering contractors what the objectives of the project are, and how they relate to one another. Client's objectives are always a combination of the objectives for performance of the

completed scheme, for achieving this performance within a named cost or budgetary limit and for getting the project into use by a target date.

Clamp and Cox (1990) conclude that the *traditional* clients will benefit in terms of cost and quality but at the expense of time ; the *design and build* clients will benefit in terms of cost and time but at the expense of quality ; the *management contracting* clients will benefit in terms of time and quality but at the expense of cost.

The procurement method chosen is not the only factor that will affect project performance. Masterman (1992) states that the fragmented nature of the building industry, particularly the separation of design and construction, the uniqueness of construction projects and the resulting ephemeral nature of the project organization, places great dependence on the project team in setting up the building process and bringing the project to a successful conclusion.

The Building Economic Development Committee's report, *Faster Building for Commerce* which was published in 1988 established that client's priorities are determined by their need to minimize the commercial risks associated with property development and that their main concern was with the functionality of their buildings. Fast and punctual construction periods were demanded because of their impact on cost, and quality standards were high and often very demanding.

The Centre for Strategic Studies in Construction at Reading University produced a report in 1988 which argued that, although the modern client is more sophisticated than in the past, he/she did not want any surprises during the implementation of his/her projects and he requires certainty of performance regarding the three criteria of time, cost and quality.

The primary conclusion to be drawn from this research is that procurement method is not a good predictor of performance. Other variables that will affect performance will be the building designer's experience, the contractor's capabilities, the client's characteristics and also the project characteristics.

The selection of the three procurement methods are associated by the different requirements of the clients to project performance. The *management contracting* clients are concerned with minimizing time of operation, facilitate variations and provide extra control especially for large and complex projects. In contrast, the *traditional* clients are more concerned in

achieving value for money because they will have to satisfy public accountability. The *design and build* clients are concerned with the minimum overall time of building because they want quick return on their investment.

From the analysis of the data surveyed, the *traditional* clients are in favour of projects, where competitive bids are required in order to ensure financial accountability and minimize tender cost. This is prevalent especially in government funded projects. In contrast, clients who are involved in constructing complex and prestigious projects would follow the *management contracting* route because the design needs to be under their direct control. These clients are prepared to accept the time and cost implications of any changes to the design during the construction stage. The clients will choose the *design and build* route if time is an essence and the project require experienced or specialised contractors. Moreover, the client will only reimburse the contractor on completion of the project.

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CAN VALUE FOR MONEY BE REALISED BY USING PRIVATE SECTOR FINANCE FOR THE PROCUREMENT OF PUBLIC SERVICE INFRASTRUCTURE?

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Abstract

Keywords: Construction, Procurement, Infrastructure, Private Finance Initiative, Value.

In 1992 the UK government introduced a new reform, the Private Finance Initiative. The aim was to improve public services and infrastructure through the stimulation of increased capital investment and the harnessing of private sector skills. There was however, and still is much criticism as to whether the PFI offers value for money. An article in Chartered Surveyor Monthly, in March 1996 entitled 'The Opportunities and Pitfalls of the Private Finance Initiative' again reiterated the concerns. It questioned how PFI would be able to offer value for money by transferring public sector service provision to the private sector, when considering the rate of return required by the private sector.

To date there has been much speculation, but little if any research done in relation to this issue. The UK National Audit Office announced in November 1995 that they were to begin the conduction of value for money audits into projects procured under the Private Finance Initiative. However, in doing so, they were not attempting to study or consider the value for money implications of the government policy, but to look at individual projects in terms of their provision of value for money.

This paper is based on an assessment of the value for money implications of the Private Finance Initiative, as a government policy. It was based on qualitative data collected through the conduction of a number of interviews and a thorough and comprehensive literature search. The analysis took the form of an assessment of the economy, efficiency and effectiveness of the Private Finance Initiative.

The results indicated that PFI is economic and efficient but is not yet operating effectively. It was found to have more potential than was currently being realised, as some of the aspects introduced with PFI will take time to develop fully. The effectiveness of PFI, therefore, is thought likely to improve with time.
The overall conclusion reached in the paper is that the Private Finance Initiative, as a government reform, is able to offer better value for money in the provision of public services, than any available alternatives.

Introduction

In the 18th and 19th centuries the great works of the United Kingdom and the Colonies, particularly the canals and railways which provided us with much economic growth and prosperity, were promoted and funded by private initiative. Since then and until recently, government grew apace, assuming more functions and even responsibility for the provision, operation and maintenance of transport infrastructure. Since 1979, however, we have seen private sector enterprise and disciplines being brought into an ever wider area of the economy. Privatisation in the 1980's liberated large sections of the British economy from the hand of the public sector. It is claimed to have resulted in improved efficiency and services, which have led to substantial increases in investment.

The Private Finance Initiative ("PFI"), launched in November 1992 is the next step on from privatisation. It aims to secure the best possible value for money for the taxpayer through the involvement of the private sector in the delivery of services to, or on behalf of, the public sector, where the delivery of these services involves a significant capital expenditure. It differs from privatisation in that the public sector retains overall control in the PFI projects, either as the main purchaser of the services required or as an essential enabler of the project.

Aims and Objectives

The main aim of this research is to assess the likely value for money consequences of the introduction and implementation of the Private Finance Initiative in the procurement of public sector capital projects.

In order to meet the above overall aim the following objectives were set.

1. Consider the nature of the Private Finance Initiative.
2. Establish the meaning of the phrase 'Value for Money'.
3. Consider the nature of the Private Finance Initiative in terms of its ability to achieve economy, efficiency and effectiveness as criteria for the provision of Value For Money.

Methodology

The literature search involved searching libraries and making enquiries for information with various individuals, professional bodies, companies and numerous government departments. Ten interviews were arranged with a cross section of people who had strong connections with the initiative. Half of the interviews were conducted face to face with the remainder conducted by taped telephone. A questionnaire was produced which was broad by design and focused on areas where different views or more detailed information was required or where there were apparent gaps in the literature search. In all cases the interviews were structured with

questions sent in advance. This method produced a lot of information but few specific examples because much of the information concerned work in progress that was still of a highly sensitive nature.

Value for Money

A thorough description of value for money is given by P.C. Jones and J.G. Bates in their book Public Sector Auditing (Bates and Jones, 1990). It says the following:

> "Value for money is achieved when a public body carries out its duties to high standards at low cost. This can be by saying that a good job is being done. Slightly more technically, value for money is achieved when administration and service provision is 'economic, efficient and effective'. These three concepts are interrelated. Economy and efficiency are similar: both relate to saving resources. Economy ensures that input costs are minimised. Efficiency ensures that maximum output is achieved at the minimum level of input cost sufficient to be effective. Efficiency, therefore, subsumes economy. A body cannot be efficient and uneconomic, but it can be both economic (i.e. cheap) and inefficient. Effectiveness is a far more positive idea. Effectiveness means that a service provided properly caters for a real need".

Jones and Bates (1990) refer in their definition specifically to administration and the provision of services in the public sector but the definition is as equally applicable to the provision of public sector capital projects, and therefore, 'economy', 'efficiency' and 'effectiveness' are the parameters used to assess and evaluate the ability of PFI to offer value for money.

The Principles of PFI

Numerous examples of waste and inefficiency exist in the public sector. Construction of capital projects and the management of public services are no exception. The UK Government White Paper, 'Setting New Standards : a Strategy for Government Procurement' found that on average construction costs overrun by 13%.

The Ministry of Defences 10 year £1.9 bn Trident Works programme in Faslane and Coulport finished in July 1993, 72% over budget and a year behind schedule. The National Audit Office report showed that the main problem was a familiar one on large Government projects. There was no single point of authority for project definition and design which led to inadequately controlled project design changes. London's new British Library is another example. Originally estimated at £115m the costs have now risen by more than 300% and currently

stand at £496m. The reason for this cost overrun has been blamed by various parties on an unclear chain of command.(Barrie, 1995)

The Private Finance Initiative was designed to offer some solutions with the majority of benefits arriving through the involvement of the private sector. The Treasury's guidance (H.M.Treasury, 1995) states that the principles were :-

- a better allocation of risk;
- better incentives to perform;
- close integration of service needs with design and construction;
- a clearer focus on the respective responsibilities;
- a continuing commercial incentive; and more potential for efficiencies.

There is nothing revolutionary about the principles underlying PFI. What is new is the change of emphasis, particularly in central government attitude, where there is no longer a general presumption that PFI can only work in certain limited areas of procurement.

Economy

Economy as defined by Jones and Bates(1990) is the minimising of input costs. As the provision of economy is a key concern in today's society, numerous other definitions have been given by authors including the government in the document Benchmarking IS/IT, (HMSO, 1995) where economy is defined as:

> "Achieving lower prices and higher productivity on the part of the service provider."

It has also been described as 'obtaining the same goods or services more cheaply' and is usually expressed in terms of savings.

For the purpose of this research, economy is taken to be an accumulation of these definitions and is expressed simply as 'offering more for less.' (Collins, 1982). We can test for economy by considering:

- Cost of private money
- Risk

- Bidding strategy and
- Management

All of the above are important but within the constraints of this paper we shall compare the cost of private money versus public money. Private money unarguably is more expensive than public money.(Geiss, personal communication). Traditionally and for this very reason the UK Treasury has opposed using private sector finance for things that could be financed by the government more cheaply. This was formerly emphasised in 1981 by Sir William Ryrie (NEDO, 1981) in a report commissioned by the Treasury to examine Government policy on this issue. The conclusions of the report, known as the "Ryrie Rules", were that the use of private funding for public projects should be governed by two basic principles:

Privately funded solutions must be tested against publicly funded alternatives and shown to be more cost effective; unless Ministers decided otherwise in particular cases, privately funded projects should not be additional to public expenditure provision, i.e. provision for public expenditure would be reduced by the amount of private funding obtained. Capital projects are typically financed mainly by debt, whether publicly or privately funded. (Durrant, 1995). The reason why Government is able to obtain debt more cheaply than the private sector is due to the financial markets perceiving them to be a good debtor. The transactions costs of government financing are also low and the market in government debt is liquid and efficient with the result that Governments are able to borrow on very attractive terms.(H.M.Treasury, 1991).

However, a simple comparison considering only the interest levied on the money does not compare like with like.(Ratzer, personal communication). Public financing costs do not reflect the risks of individual projects. Where private finance is used, the funding structure is arranged on a project specific basis and the cost of the finance is strongly related to the risks being assumed by that project. This is not to say that individual publicly financed projects are less risky, but that the financial markets have no deep concern over the Government's ability to repay. Governments are effectively self insured in that they assume the willingness of the taxpayer to insure the risks.

Another consideration is the length of time over which interest is going to roll up. The private sector concessionaires will look to foreshorten the period in which they are exposed to the roll up of interest prior to receiving any income.(Freeman, personal communication). Also with the construction period being the period subject to the highest risk the concessionaire will be looking for a timely completion to enable the project to be refinanced with lower rates of interest, due to the decreased level of risk.(Geiss, personal communication). Money borrowed from the Treasury however, although borrowed at a relatively low rate of interest, may be subject to capital charges that last for up to 80 years.(Contracts Journal, 1994).

The only area where PFI is not believed to be improving the provision of economy is the pre contract bidding costs which are currently very high. This however, may be a temporary

phenomena and the situation could improve with time. PFI is generally therefore considered to be making vast improvements to the economy of public sector service provision. Economy however, does not automatically subsume efficiency and therefore the following section considers efficiency within the provision of public services under PFI.

Efficiency and Effectiveness

Efficiency is in many ways similar to economy, but where economy ensures that input costs are minimised, efficiency ensures maximum output is achieved at the minimum level of input cost sufficient to be effective.(Bates, 1993).

Within the context of the aims and objectives the areas of interest evolve from whether the PFI improves the efficiency of the public procurement of capital projects i.e. whether the outputs are sufficient to warrant the level of inputs and how the outputs compare with other more conventional procurement methods.

There are two main areas in conventional procurements where inefficiencies are apparent. Firstly inefficiencies due to the interfaces which exist in taking a project through from conception, to design, construction, operation, maintenance and where applicable replacement. This means that in the initial procurement stage there may be examples of:

- over engineering
- poor utility
- long design lives but poor warranty protection

During the operation stage further inefficiencies may exist, for example:

- inappropriate maintenance
- under exploited dual for dual use
- little active management of alternative use

The second area where inefficiencies occur is in respect of the constraints placed on public sector funding. This means that the level of capital expenditure allocated to the construction, operation or maintenance of a capital project may bear no relation to how much is required to achieve the best overall long term result. The efficiency of services is influenced not just by

what is provided, but how it is provided. Service delivery encompasses reliability and accuracy, and delivery on time.(HMSO 1995).

The involvement of the private sector allows greater investment optimisation by not applying the constraints on funding as is done in the public sector. This allows greater and more effective implementation of the whole life costing exercise done at the design development stage. The private sector as a commercial enterprise will optimise their spending regime to maximise the utility of an asset over its life.(Private Finance Panel, 1995). Unlike the public sector the private sector will spend what they have to spend in order to maximise efficiency because they are contractually committed to do it.(Clarke, Personal communication).

Through whole life asset management and the employment of a more effective spending regime, the inefficiencies apparent from other more conventional methods of procurement disappear in PFI projects.

The design of a PFI project is driven by the user's requirements rather than any predetermined standards. It is a private sector decision to formulate and decide on tolerances in design; however, they must ensure that the users' or public sectors requirements are also met to their satisfaction. Long term fitness for purpose is also taken into account by the private sector by considering design and construction efficiencies. The desire to win work, with the risk that another competitor may take that opportunity away, clearly focuses the mind of the private sector to reduce cost wherever possible whilst maintaining the same quality standard.(Private Finance Panel, 1995).

A number of performance measures are set for each PFI project. Payment for the services provided are based on the attainment of the specified performance standards. Where performance falls below a set level it can result in fee reductions being made. The aim of the public sector in introducing the Private Finance Initiative, was to improve the country's services and infrastructure.(H.M.Treasury, 1993).

Their objectives in terms of how they were going to achieve this, were:

- to stimulate increased capital investment.
- to harness the private sectors enterprise, efficiency and management expertise.

These are the primary objectives. The secondary objectives are to stimulate diversity and totality of application.(H.M.Treasury and Private Finance Panel, 1995). The primary and secondary objectives examined so far, have each been considered in isolation. In reality the whole PFI process has progressed as a composite unit. It is therefore necessary to consider whether the main aim of PFI has been achieved, i.e. has the introduction and implementation

of PFI improved services and infrastructure. In consideration of this there is currently one overriding factor, namely that the whole PFI process is too slow and it is taking too long for projects to reach a financial close.(Geiss, personal communication). This was described by Geiss as a 'lack of deal flow'. The reason why it is slow is due to the Government's 'deals not rules' policy. Although this is essential to the success of PFI, it has caused numerous log jams as bidders and government departments 'test the water'. In theory this problem should be temporary and with time it should ease as the parties involved gain experience.

In terms of whether PFI is effective as it stands now, the answer must be 'no'. Confidence is the factor that may affect this potential. Already one major bank has pulled out of PFI project financing completely and until such time as the deal flow improves, the effectiveness of PFI will be restricted.

Conclusions

It has been established that value for money is to be of increasing importance in today's society due to the reallocation of funding required to cope with the ageing population pattern and the productivity divide.

A project procured under the private finance initiative involves a number if not all of the following functions: design, build, finance, operate and maintain. A PFI project is therefore not easily comparable to public sector projects procured under more conventional routes. This development of a wider scope placed in a single integrated contract has produced a streamlined procurement process which has resulted in the reduction of many of the previous inefficiencies.

A simple comparison of public money and private money does not compare like with like. Although more expensive on face value, private money is related to a more realistic cost. This is because it includes costs for risks which the public sector has generally ignored on the basis that it is self insured.

The Private Finance Initiative has facilitated the introduction of the use of private sector management into the procurement of public services and infrastructure. In this respect PFI has enabled these skills to be used to the benefit of the public sector for the provision of better value for money.

The structure of PFI contracts has provided greater opportunity for the utilisation of whole-life costing techniques to produce greater levels of economy over the whole project.

A greater level of investment optimisation has resulted from the removal of public funding constraints and the involvement of the private sector in the funding of projects.

PFI has also produced efficiencies in terms of the delivery of projects. This is a result of the payment structure being based on the attainment of a number of certain performance criteria.

The effectiveness of the implementation of PFI is currently being limited by the fact that it is based on a 'deals not rules' policy. This, although a temporary situation, has created a huge learning process through which the private and public sector alike are having to pass.

The overriding conclusion drawn from this research is that the introduction and implementation of the Private Finance Initiative has the potential to offer better value for public money. However, the slow rate at which it is being implemented and at which projects are reaching financial close is detracting from its potential at this point in time. The research shows that the problems are not perceived to be of a permanent nature and should be resolved as the people involved gain more experience.

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Which Services, Provided By Consultant Project Managers, Are Essential?

Humphries D. C. [1] and Walker D. H.T. [2]

Abstract

There are many professionals, from a wide variety of backgrounds, offering project management services in the construction industry in Australia. In terms of marketing their services, project managers may be tempted to persuade clients that particular services they are capable of providing are in some way essential. Obviously, if this marketing strategy is successful, then such professionals have expanded their opportunities to earn revenue from expanded service to be offered. These services may overlap, or replace, services offered by other professionals in the construction industry.

Recent research that addressed the problem of defining what range of services are required to be provided by consultant project managers for major building and infrastructure projects by classifying them into 'Fundamental', 'Significant' and 'Not Essential' services is discussed. The advantage of having such a classification is that clients can decide more readily which services should be provided independently by the project manager, and which may be provided by others.

The paper should be of interest to client who are faced with deciding which project management services should be handled either in-house or by a consultant project manager, and which services could be better provided by other specialist consultants.

Key words: Project Management Services, Project Teams, Ranking

INTRODUCTION

Morris (1994), recognised the need to define "*the set of project management services a competent owner should mobilise, whether totally in-house or with external assistance.*" This paper begins by defining the terms 'project' and 'project manager', briefly describes the research methodology, and then proceeds to report on the findings and conclusions of Humphries' (1996) work.

Many projects are highly complex and may require the project manager's undivided attention while others may benefit from an integrated project management service including specialist advise which can be offered by other specialist consultants.

Humphries (1996) developed a classification system of project management services through undertaking:-

1. A comprehensive literature search to adequately define:-

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- a project;
- types of project manager; and
- what services are provided by project managers.

2. A case study of actual consultant project management functions and responsibilities by examination of project management contracts.
3. An industry survey of consultant project managers and users of consultant project managers to discover the services they actually provide.

A pilot questionnaire drafted from the findings of the literature review and case study details was tested on selected knowledgeable sources. This questionnaire was then further refined and developed to reflect the comments of those used to test the pilot questionnaire. A schedule of background information was incorporated into the survey instrument to establish context, in terms of project size, client knowledge and the use of project management services. Care was taken to collect balanced expert opinion on issues raised by the survey instrument.

DEFINITION OF TERMS - WHAT IS A PROJECT? WHAT IS A PROJECT MANAGER?

Wideman (1986) defines a project as "*Any undertaking with a defined starting point and defined objective by which completion is identified*". Strukenbruck (1981) and Stretton (1987), added more parameters to this simple definition and combined it with concepts of uniqueness, complexity, dynamism and the need to cut across organisational and functional lines and the use of varied skills and resources. In the context of this paper, a project is assumed to include the inception, design and construction of a major building project.

There are many definitions of 'Project Management' and many different people describing themselves as project managers. The Chartered Institute of Building's definition of a project manager, is "*a person or group who works on behalf of the client and ensures that a building project is coordinated correctly in order that the time, cost and quality objectives of the client are met*". (CIOB 1988).

It is proposed that the role of Project Manager be separated from that of designer. In the RAIA (1987) definitions, the ideal role proposed is that of primary consultant where an independent person is appointed to manage the design, procurement, construction and completion of a building project on a fee basis where no design functions are undertaken.

SERVICES THAT A PROJECT MANAGER CAN PROVIDE

If individuals were to project manage their own projects for their own benefit, then the range of responsibilities and duties would be 100% of the total enterprise. Similarly, employee project managers would be expected to do everything necessary to manage the project that was within their capabilities.

On small projects, the duties of the consultant project manager may also include most of the management work necessary to complete the project. These duties may include functions

such as **costing** and **estimating, programming** and **design management.** Large projects are generally more complex and may employ a greater number of specialist consultants. This requires a greater level of attention and a more sophisticated approach from a consultant project manager. The project manager's work may be divided among specialist programming consultants, quantity surveying consultants and others on larger projects because of the complexity and the scale of the tasks that confront the team.

The extent of the project manager's obligations would be governed by the definition of services in the project management contract and should also be reflected in the quantum of the fee being paid. A distinction has to be made between clients expectations or desires, which may be the total service provided by an employee project manager, and what services are actually contracted for.

The Institute of Project Management (1987) provides the Project Management Body Of Knowledge (PMBOK) as a framework for the duties and tasks that project managers are required to perform. It defines the work of project managers as the process of the management of human resources, cost, time, communication, scope, quality and risk. This is also viewed as a very broad and generic description that could not be used in a contract for project management services without further definition.

Expanding on the PMBOK definition, Roman (1986) lists nine activities of project managers in combination with some of the general managerial processes referred to earlier:-

1. Planning project activities, tasks, and end results, including work breakdown, scheduling and budgeting.
2. Organising, selecting, and placing the project team; coordinating tasks and allocating resources.
3. Interfacing with constituencies, negotiating with and integrating functional managers, contractors, consultants, users and top management.
4. Effectively using the project team and user personnel.
5. Monitoring project status.
6. Identifying technical and functional problems.
7. Solving problems directly or knowing where to find help.
8. Dealing with crises and resolving conflicts.
9. Recommending termination or redirecting efforts when objectives cannot be achieved.

Walker (1987) identified a range of skills required to meet the project manager's responsibilities and obligations. These are: entrepreneurial flair, administrative skill, ability to investigate funding options requiring analytical skills, team building skills, and budgeting skills. He also described other more specific construction industry skills, such as project management control skills (with knowledge of building technology and planning), people management skills to control the team, and co-ordination skills to draw on the team expertise within their own areas of responsibility. Walker (1987) identified a further skill, namely: lobbyist and manager of public relations.

In this research, the following unranked list of specific services under consideration for project managers to be required to perform includes:

1. Provide liaison between architects, builder and consultants (LIAISING).
2. Provide direction and counselling (LEADING).
3. Manage and oversee the management coordination of the project (CO-ORDINATING).
4. Prepare tender documents, call tenders, analyse tenders and make recommendations, furnish and administer all management systems, advise on and organise insurances (CONTRACT ADMINISTRATION).
5. Review contract documents and drawings, evaluate planning and operational options (REVIEWING).
6. Provide time programmes (PROGRAMMING).
7. Prepare estimates, budgets and/or cash flow projections, and cost control (COSTING/QUANTITY SURVEYING).
8. Arrange and/or chair meetings, manage communications, and supply information on the definition of the project title and site restrictions (COMMUNICATIONS).
9. Advise and make recommendations on the appointment of consultants (ADVISING).
10. Ensure compliance with authority requirements and codes of practice (COMPLIANCE).
11. Reporting to the client representative by provide monthly reports detailing the status of the project in terms of cost, time and quality (REPORTING).
12. Monitor progress, workmanship materials and equipment, monitor contractors, effect decisions of the client (MONITORING).
13. Act as sole representative and agent in respect of the project, in the context of the project management contract (REPRESENTING).
14. Relay instructions and give directions on the client's behalf (PROJECT AUTHORITY).
15. Advise and make recommendations on pre-construction matters including buildability (BUILDABILITY).
16. Enter into agreements on behalf of the client with the builder in order to administer variations, claims and all matters relating to the timely completion of the project (SUPERINTENDENT).
17. Take responsibility for the preparation and coordination of the consultants design briefs and all other services (BRIEF WRITING).
18. Co-ordinate the preparation of the consultants quality control documentation (QUALITY ASSURANCE).
19. Take responsibility for the sub-consultants work nominated in the contract; supervise, control and coordinate all consultants (DESIGN MANAGEMENT).
20. Manage the control of persons entering the site (CONTROL OF PREMISES).
21. Negotiate the contract price with the builder, negotiate with adjoining landowners and occupiers (NEGOTIATING).
22. Prepare a feasibility study for the project (FEASIBILITY PREPARATION).
23. Investigate a preferred method of procuring the construction contract (RISK MANAGEMENT).
24. Assist the builder with any difficulty that would prevent the timely completion of the project (PROBLEM SOLVING).
25 Taking responsibility for the construction of the facility (CONSTRUCTION MANAGEMENT).

26 Assisting the client, beyond advising, in the formulation of policy on behalf of the client (FORMULATING POLICY).
27 Acting as intermediary to the project design in implementing major changes or reviews of the design (CHANGE AGENT AND COMPROMISE AGENT).
28 Mediating between project teams (MEDIATING).
29 Assisting in the resolution of disputes between teams (CONFLICT RESOLUTION).
30 Motivating project teams through formal or informal methods (MOTIVATING).

It is, therefore, the project manager's job to co-ordinate and bring together the relevant experts to resolve these issues by discussion, exchange of ideas and information. These informal mechanisms, though, are seen to be essential to achieving good outcomes for projects. Such facets of the management of projects may not be readily apparent, especially to clients who do not have previous experience in construction projects. It is inexperienced clients who will most likely use the services of the consultant project manager, as they do not have access to an in-house project manager.

If clients are able to distinguish between Fundamental and Not Essential project management services, then a clearer picture of the more essential nature of some of the services in relation to others may be drawn. The more Essential or Fundamental services may then be matched to the project manager's qualities to assess his ability to perform the services contracted for in an efficient manner. In seeking to engage good project managers, emphasis should be placed upon the abilities of the project manager to match the Fundamental category of services that are proffered by the consultant firm. The nature of Fundamental services will be defined later in this investigation.

RESEARCH FINDINGS

It became evident to Humphries (1996), that there exists a hierarchy of services that clients require of the project manager. With experience gained from a pilot study, advice of expert project managers, and evidence from a review of the literature, a questionnaire was developed to survey project managers for them to rank the importance of each identified distinct service. This entailed personally interviewing a selected number of people (10 in number) who were known as consultant project managers, or users of consultant project management services. These people were decision makers, and therefore can be considered as expert senior executives, with significant responsibilities.

Users and project managers were consulted through the questionnaire to gain the perspective of both sides of the contractual equation. Large construction projects were targeted, as the use of project managers is more prevalent, and greater division of tasks is likely to occur. Some careful screening of potential interviewees took place to ensure that the projects used as a reference by respondents fitted the thesis criteria.

The actual questionnaire (based upon the list of services given above) required opinions to be given on whether services are 'Fundamental', 'Significant' or 'Not Essential'.

RANKING	SERVICE	SCORE	BAND
1	REPORTING	20	
2	LIAISON	20	
3	MONITOR	19	
4	ADVISE	19	
5	NEGOTIATE	19	
6	PROBLEM SOLVING	19	BAND 1
7	CO-ORDINATION	19	
8	REVIEW	19	
9	FEASIBILITY PREPARATION	18	
10	MOTIVATING	18	
11	LEADERSHIP	18	
12	CONTRACT ADMINISTRATION	16	
13	FORMULATING POLICY	16	
14	BRIEF WRITING	16	
15	COMMUNICATIONS	16	
16	REPRESENTATION	16	
17	RISK MANAGEMENT	16	
18	CONFLICT RESOLUTION	16	
19	CHANGE AGENT AND COMPROMISE AGENT	15	
20	MEDIATOR	15	
21	DESIGN MANAGEMENT	14	
22	PROJECT AUTHORITY	14	
23	PROGRAMMING	13	
24	COMPLIANCE	13	
25	CONTROL OF PREMISES	10	
26	SUPERINTENDENT, ACT AS	9	
27	COSTING/QUANTITY SURVEYING	8	
28	BUILDABILITY	8	BAND 3
29	QUALITY ASSURANCE	6	
30	CONSTRUCTION MANAGEMENT	4	

BAND 1 - represents services with a score of between 18 and 20 out of a maximum of 20 points. (90%-100%)

BAND 2 - represents services with a score of between 16 and 10 out of a maximum of 20 points. (50%-80%)

BAND 3 - represents services with a score of less than 50% of the maximum points scorable.

Table 1. Table Of Services With Scores And Bands

The answers to the questionnaire from each of the ten respondents have been aggregated for each category of service. A hierarchy of the services was developed from the survey results by applying a score of two to each respondent that classified a service as Fundamental, one

for Significant services and zero for Not Essential services. The scores are added together across each service category. Three bands of services have been indicated to approximate general groupings of the classification of services. These results are shown in Table 1.

CONCLUSIONS

All services listed in the questionnaire and detailed in Table 1 are considered to be services that are generally provided by consultant project managers. Evidence presented in this paper strongly suggests that both Fundamental and Significant services will feature in consultant project management agreements as some optional services are likely to be taken up by clients who recognise the need for more than basic project management.

It is significant to note that services which may be carried out as separate disciplines feature at the lower end of the schedule. These include Programming, Compliance, Superintendent, Costing/Quantity Surveying, Buildability, and Construction Management. This position in the schedule supports the view that these are not Fundamental services to be provided by project managers.

Table 1 may also provide a useful indication of the ranking of types of services that should be offered to potential clients of consultant project managers. It may also be used to set the major focus of a project manager's work at the outset of a project, or as check list of activities to be used as a reminder during the course of a project.

Benchmarking performance has attracted much interest as clients attempt to achieve better value for money invested in project management services. The classification of services presented in Table 1 indicates the relative importance ranking of services. This may be used in conjunction with performance measures to benchmark project management services.

The Humphries (1996) investigation, while limited in scope, provided a good indication of the preferences of users and providers of consultant project manager services. The context of the industry survey was restricted to consultant project managers working on large building or infrastructure projects. Further research may be able to refine and confirm the conclusions of this study by expanding the scope of the investigation.

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Procurement Design Strategy of Building Energy Management Systems (BEMS) in multi-building sites in Australia

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Abstract

The Building Energy Management System (BEMS) has been a growing area in the last few years, yet there has been very little research on the operational problems and the evaluation of the procurement decision design. Over five hundred Australian organisations with BEMS including hospitals, tertiary institutions, commercial sites, and technical colleges and further education were surveyed as part of a research study focusing on the BEMS sytems configuration, current performance, selection criteria, operational problems and the acceptance of a strategic approach and partnering concept for procurement decision design.

This study uses the frequency distribution technique to analyse the research results. It indicates the acceptance level of field, automation and management nets for various types of multi-building sites; it also indicates the future research directions needed to improve existing BEMS to meet the expectations of the end-users. While most of the participants prefer to purchase packages than develop these in-house, minimum cost being the common selection criterion. Problems of overdesign still exist in some organisations. In the majority of Australian organisations, the respondents do not accept risk sharing or partnering. The proposed action research is designed to test the proposition of a strategic approach and partnering concept for procurement decision design, applied to total system performance based specification in order to reduce the problem of overdesign experimentally. Based on empirical analysis, future research should improve existing BEMS to meet the expectations of the end-users.

INTRODUCTION

The Building Energy Management System (BEMS) is defined by Scheepers (1991) as the system comprising the creation of such an environment for the process taking place within the building that provides optimal functionality and integration of the process concerned. It takes into account the responses to changes at the local levels, for instance, changes in operating temperatures and equipment operation routine. This has been achieved by the generation of environments which provide peak performance criteria and integrity for building operation. Ford (1989) pointed out that system designs and specifications were very general in nature. The owner was partly to blame for not properly documenting the operation and management philosophy in the form of a brief. However the consultants often presented a 'standard specification' , made a few minor changes and addded a points list during the design phase. The specifications are largely equipment performance-based and there is always conflict due

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to different interpretations. The problem is further compounded because consultants do not thoroughly research the clients' needs, only specifying what is required in the BEMS project. Mason (1993) identified that the BEMS rarely meets anyone's expectation, and he proposed solution to this problem by enlisting systems engineering ideas according to the intention aand recommendations of Building Services Research and Technology Association (BSRIA)'s AN1/90 specification method. According to Working Group, BSRIA BEMS Bracknell Centre (England), BEMS can be classified as the Level 1 for Field Net, Level 2 for Automation Net and Level 3 for Management Net (Chapman, 1993). The format of the specification 'system' includes BEMS preliminaries, the standard National Engineering Specification and the particular specification in a modular basis containing controls program, specification schematic, specifcation schedule, specifcation flow chart and quality assurance. His proposed solution requires a degree of proactivity which does not come easily to the construction industry. Essentially, the vehicle used to solve the problem is the specification. The disadvantage of this method is that it is too detailed that the conventional consultant fee scales can not apply for the work. BEMS has been a growing area in the last few years, yet there has been very little research into the operational problems associated with, and the evaluation of, the accompanying procurement decision design. Multi-building sites were chosen on the basis of popular provision and were a key ingredient in maintenance of organisational effectiveness from the point of view of the need for manpower savings, remote control and communication for operational efficiency.

As technology increased its strategic role, many organisations are making the evaluation of technology investment opportunities look more like the organisational strategic planning process. Managers base strategic planning on the application of a number of different approaches and paradigms, but very few building owners have documented the application of a strategic approach and partnering concept for procurement decision design.

Precedents

Mansfield (1994) suggested a "partnering" contract arrangement whereby the fortunes of both Contractor and Client are shared and the Contractor must demonstrate an overall reduction in costs to the Client in order to maximise his profit. The definition of 'partnering' is basically a voluntary relationship set up to achieve the project objectives and business objectives of each party involved. It is not a legal term, but rather a management term (Hellard, 1995). Mansfield's philosophy for contracting today is based on optimizing resources to meet changing client needs. He claimed that this was not a totally new concept, there were as many failures as successes and there was a constant search for the right contractual mechanisms that would drive both parties to a common goal. This stands for the demand side of partnering. Peterson (1994) expressed his view about partnering from the supplier/contractor point of view and willingly takes the responsibility of risk sharing. With both sides of demand and supply, it is deduced that partnering may be the future direction of BEMS contract tendering.

The orgin of this idea also comes from strategy based maintenance for facilities management. This is a parallel approach to solve the problem of being over-designed for BEMS procurement decision design. The proposed action research is to designed to test the

proposition of a strategic approach and partnering concept, applied to total performance based specification to reduce the BEMS problems on the basis of the knowledge of the writers.

This survey and its findings are aimed at:

- determining a 'norm' in the adoption of BEMS technology because of its strategic role in maintenance of organisational effectiveness in multi-building sites;
- identifying ways in which BEMS systems are selected by end-users of multi-building sites;
- highlighting major areas of operational 'need' by system managers for multi-building sites as a basis for future upgrading of their system requirements;
- gathering information about the attitudes and behaviour of the system end-users for regarding the strategic approach and partnering concept for procurement decision design, applied to total system performance based specification in order to reduce the problem of overdesign.

The purpose of this survey and its findings is proposed to broadly examine BEMS system configuration, current performance, selection criteria, operational problems and the acceptance of a strategic approach and partnering concept for procurement decision design. This information is a useful feedback for procurement decison makers to achieve BEMS systems which are more efficient and better meet the expectations of the end-users. The next section of this paper outlines the research methods used to gather and analyze the necessary data. The third section presents the results. The final section lists out the concluding comments.

METHODOLOGY

Hypotheses

The hypotheses to be tested in this paper may be stated as follows:

H1: BEMS can meet the industry expectations which are primarily based on cost of operation and installation as against the expected system performance in Australia.

H2: If a strategic approach and partnering concept for procurement decision design is adopted, the exact scope of work will be determined by the suppliers including design, manufacture and installation. A total performance-based specification may enable innovations to reduce the problems of overdesign.

Research Design Method

A two-stage survey research process provided the primary data for this study. First, industrial representatives were contacted and interviewed on the basis of networking. These interviews had the specific targets of obtaining information about the interviewees and their understanding of markets and trends. End-users' responses were sought because the focus of this research is the general understanding of the acceptance of a strategic approach and partnering concept for procurement decision design. In the second stage of the research project, the study requested information, through written questionnaires, concerning the

system configuration, current performance, selection criteria, problems and the acceptance of a strategic approach and partnering concept for procurement decision design. The method adopted in the research was a survey questionnaire, and the frequency distribution was used to describe the sample.

The study was undertaken in July 1995, questionnaires were mailed to over five hundred organisations including tertiary institutions, hospitals and commercial properties, addressed by name to the Head of the Maintenance Department or the engineers responsible for BEMS operation. The population for the survey questionnaire was chosen so as to get a broad based industry response. The survey was carried out with the support of the Secretary of the Institution of Hospital Engineers, Australia, who circulated it to their members.

RESULTS

Response Rate

The survey questionnaire was sent to five hundred and sixty-four organisations Australia-wide, from which there were 83 respondents.

Category of respondents

From the responses to the questions in the title of the organisation, it was possible to break down the respondents into four categories:

- University - 29 respondents from 46 Australian universities (68%)
- Victorian TAFE College - 10 respondents from 12 invited Victorian TAFE Colleges (83%)
- Hospital - 37 respondents from 500 members of the Institution of Hospital Engineers, Australia (8%)
- Commercial building - 6 respondents from 6 referred multi-building sites (100%)

Major Results

Table 1 shows the distribution by State. The State of Victoria (VIC) has the largest percentage of respondents, with 42 (52%), followed by New South Wales with (NSW) 10 (12.6%), followed by Western Australia (WA) with 9 (11.4%), followed by South Australia (SA) with 6 (7.6%) and Queensland with 5 (6.3%), followed by Northern Territories with 3 (4%), followed by Tasmania (TAS) and lastly Australia Capital Territories (ACT) with 1 (0.8%). A response rate of 68% from universities was achieved which is very high for a mailed survey questionnaire. Such support means that the findings of the survey are more likely to be representative of Australian universities and Victorian TAFE Colleges and thus more useful as indicators of concerns and trends.

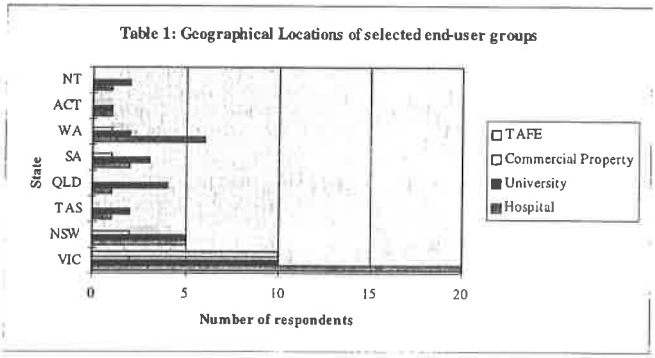


Table 2 below shows that 45% hospital respondents have a management net, this indicates that these respondents are large hospitals. There are only about 42% university respondents which have a management net and no Victorian TAFE College has a management net.

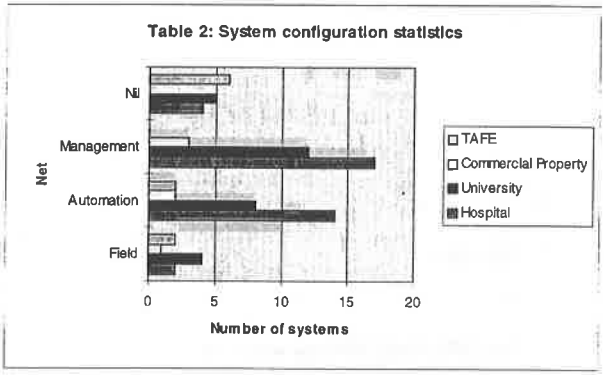
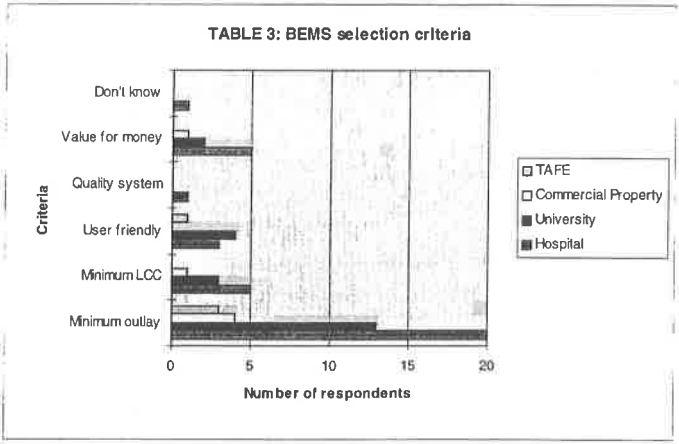
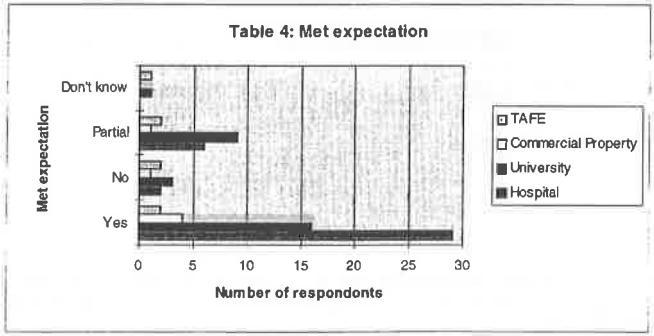


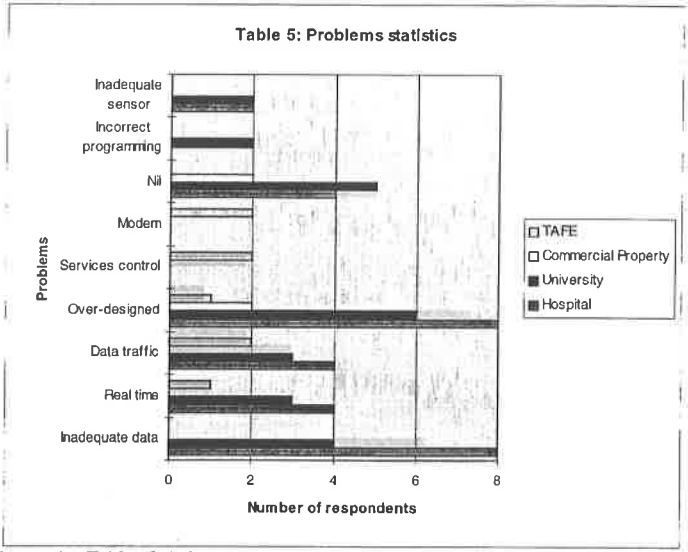
Table 3 shows that minimum capital outlay is the most common selection criteria. More than 13% hospital respondents and more than 11% university respondents are concerned about the minimum life cycle cost.



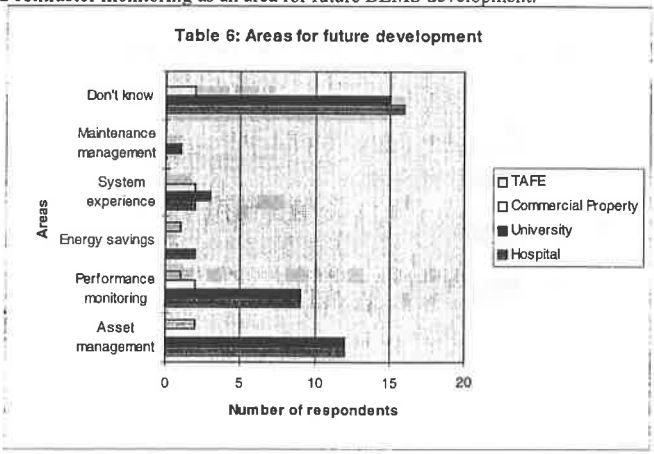
The Table 4 below indicates BEMS has not fully met the expectation of the Australian organisations. However, more than 76% hospital respondents, 55% university respondents , 66% commercial property respondents and 50% TAFE college respondents met their expectation.



Overdesigned systems are still a common problem for Australian organisations as indicated in Table 5: More than 21% hospital respondents, 21% university respondents, 20% commercial property respondents and 50% of TAFE college respondents have this problem.

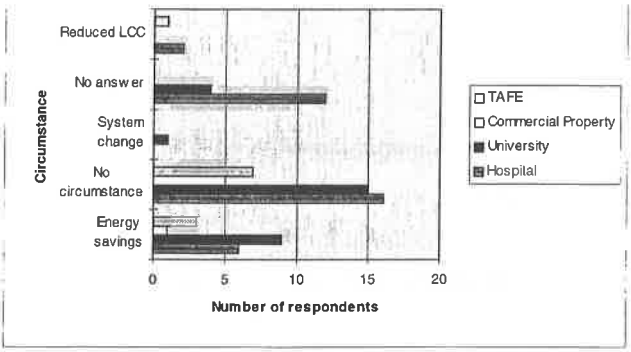


As shown in Table 6 below more than 30% hospital respondents, 40% university respondents and 20% TAFE college respondents are aware of asset management as an area for future development. Also, more than 25% hospital respondents, 30% university respondents , 33% commercial property respondents and 25% TAFE college respondents realised contractor monitoring as an area for future BEMS development.



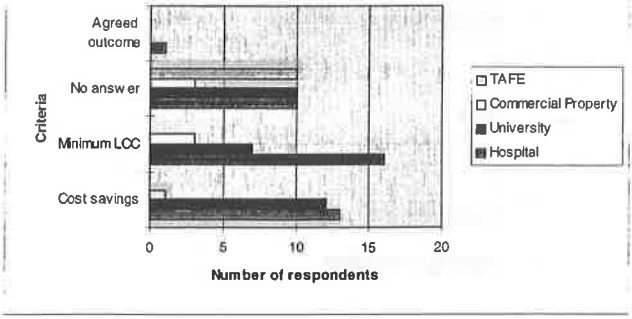
More than 21% hospital respondents, 35% university respondents, 17% commercial property respondents and 30% TAFE college respondents accepted some value of partnering as shown in Table 7.

Table 7: Circumstance to accept partnering



From Table 8 below, more than 41% university respondents selected cost savings as a total system performance criterion for partnering whereas 42% hospital respondents and 50% commercial property respondents selected minium life cycle costing as the performance criterion.

Table 8: Total system performance criteria for partnering



Other Comments

The following comments are extracted from the survey questionnaires:

"To eliminate the proliferation of different systems for each facility on a spread out campus we are locked into using BEMS system on all new developments. This inherently places the respondents at "the mercy of the vendor". However, if a partnering environment then this form of problem diminishes. The original selection is therefore critical."
"It is envisaged that a "fully blown " BEMS system will be established within the next few years. This system will not incorporate fire services and security."
"My experience with BEMS system suppliers is their knowledge of energy management strategies of building services and in particular chillers is limited. Furthermore, there is little incentive for the suppliers to make their systems perform unless profit sharing is employed."
"Public works use minimum cost and whole of life costs for consideration of plant and equipment. This does not give consideration to the end user."
"Partnering is interpreted that the customer and supplier work together to achieve an installation for the best price. Nothing is hidden in contract that could trap either partner into supplying something that does not meet customer needs."
"After sales service and technical backup are the weakness with a considerable number of BEMS suppliers, consequently, this should be carefully considered in any selection of a system."
"Minimum expenditure and multi-skilled have been effected in building and services by H&CS (Health and Community Services) policy, in spite of tightening maintenance."

CONCLUDING COMMENTS

The survey highlights the implication of the first hypothesis that BEMS has not fully met the expectation of the Australian organisations. The findings of the survey, however, go against the second hypothesis. It would appear that the majority of Australian organisations do not accept the risk sharing involved in a strategic approach and partnering concept for procurement decision design concept at both a philosophical and practical level. Only one respondent felt that the strategic approach and partnering concept could improve on the present mechanism for selection of BEMS systems. The literature reviewed and empirical results provided in this paper, show the acceptance level of BEMS system in Australian organisations, the ways in which BEMS systems are selected by the end-users, and the major areas of operational 'need' expressed by system managers for multi-building sites. It is concluded that most of the participants prefer to purchase system management packages than develop their own 'in-house'and minimum cost being the common selection criteria This information is a useful feedback for building owners to achieve BEMS systems which are more efficient and which better more effectively meet the expectations of the end-users. The expectations of the end-users are primarily based on cost of operation and installation against the expected system performance. The proposed research is designed to test the proposition of a strategic approach and partnering concept for procurement decision design, applied to total system performance based specification in order to reduce BEMS problems experimentally.

The major limitation of this research study is that most of the respondents are in Victoria. One possible conclusion is that empirical research on BEMS in Australia is very much in an embryonic stage of development and there is scope for more analysis and research. Use of a strategic approach and partnering concept for procurement decision design highlights the need for research in the application and evaluation of BEMS performance.

Future research is needed in the area of using a strategic approach and partnering concept for procurement decision design.

ACKNOWLEDGMENTS

The help of Mr Jeremy Bowley, secretary of the Institution of Hospital Engineers, Australia, in circulating survey questionnaires to their members is acknowledged.

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APPENDIX I: ABBREVIATIONS

TAFE	Technical And Further Education
LCC	Lift Cycle Cost

UNDERSTANDING MARKET RISK FOR COMMERCIAL PROPERTY INVESTMENT.

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Abstract:

The literature on investment performance and portfolio theory has implied that the capital asset pricing model (CAPM), with suitable modifications, is directly applicable to the analysis of property investment. Most of these studies have been undertaken in the American context and there is a lack of research in this area in Australia. Thus the central feature of the research is to analyze the relationship between risk and rates of return on property investment using CAPM framework in the Australian context.

In Australia, institutions and banks as owners are likely to be the major players in the next property boom. This research aims to provide a framework for the analysis of market risk with use of the market risk boundary layer (MRBL) model. A novel feature of this research is to utilize the contemporary practices and techniques used by financial and stock management sector in the analysis of market risk for commercial property investment. The paper highlights the recent advances in property portfolio investment analysis including introduction to the concept of the MRBL model. This paper is first in the series of papers to be published by the authors as a part of a doctoral research undertaken by the principal author.

Keywords:

Market risk, Capital asset pricing model, Commercial property investment, Market risk boundary layer, Portfolio analysis.

INTRODUCTION

The application of portfolio theory and the capital asset pricing model (CAPM) framework to the evaluation of market risk for property investment is a fairly recent phenomenon. Most of the work in this area has been done in the last ten or fifteen years. Significant portion of this work has been done in the American context and generally there is a lack of structured research in this area in Australia. However, the robust economic growth, increased credit availability, favorable interest rate movements and high levels of foreign investment have brought about exceptional increases in the quantum of property investment over the past few years. The statutory funds, with continued soaring sales of life insurance and other products, are expected to devote at least $1 billion a year to property investment. As for superannuation funds, the likely investment boom is expected to contribute substantial funds to the real estate sector (JLW Research, April, 1990).

The institutions and banks as owners are likely to be the major players in the next property boom in Australia (Dickinson, 1995). The institutional investors in particular, are subjected to portfolio risk as they have property investment diversified across a range of properties. The boom and bust phenomenon of the 1970s and 1980s in the Australian property market has pushed many property investors and building owners into bankruptcy and to a point of no return. Future property investors and building owners need to understand the factors that contribute to such a condition and develop risk strategies to combat the uncertainty in rates of return. The paper seeks to find some rational and effective ways to document and learn from the contemporary industry practices and techniques used by the financial and stock management sector for the analysis of the investment in property portfolio.

LITERATURE REVIEW AND CURRENT TRENDS

The literature on investment performance and portfolio analysis in the theory of finance is considerable and contains many important studies including those undertaken by Markowitz (1952), Sharpe (1964), Friedman (1970), Findlay et al (1979), and others. Most of these studies have focused almost exclusively on financial assets and generally have not included real estate investments. Market risk for financial assets like equities, bonds, etc. has been analysed very extensively. A literature search on the market risk for property investments indicates that most of the papers in this area have been written in last fifteen to twenty years. Some of the important works undertaken in this area have been carried out by Findlay et al (1979), Jaffee & Sirmans (1984), Geltner (1990), Liu et al (1990), Hassan (1990), and Hargitay & Yu (1993). JLW Research (1992) and JLW Research (1990) have contributed to the advancement of property portfolio and investment management in Australia. These works have implied that the CAPM framework is an extremely important analytical tool in both financial management and investment analysis. Many researchers have tried to extend the CAPM framework to the analysis of the relationship between risk and rates of return on property investments.

Portfolio risk and the CAPM framework

A portfolio is a collection of investment assets. The portfolio logic is: An asset held as part of a portfolio is less risky than the same asset held in isolation. From an investor's standpoint the fact that returns from a particular asset goes up or down is not very important; what is important is the return on his or her portfolio and the portfolio's risk. The basic portfolio model, developed by Markowitz (1952), derived the expected rate of return for a portfolio of assets and an expected risk measure.

Portfolio return

The expected return on a portfolio of assets is simply the weighed average of the expected rates of return for the individual assets in the portfolio, with weights being the fraction of the total portfolio invested in each asset (Markowitz, 1952).

$$E(R_{port}) = \sum_{i=1}^{n} w_i R_i$$

Here the w_i's are the weights, and the R_i's are the expected returns on the individual assets. There are n assets in the portfolio. Note (1) that w_i is the proportion of the portfolio's dollar value invested in asset i, and (2) that the w_i's must sum to 1.0.

Portfolio risk

The riskiness of a portfolio is determined by the standard deviation (σ_{port}) of returns from the expected return. Unlike the expected return on a portfolio, the riskiness of a portfolio is not simply a weighted average of the standard deviations of the individual assets in the portfolio; the portfolio risk is a function of the weighted average of the individual σ_i's , plus two times the weighted covariance between all assets in the portfolio (Markowitz, 1952).

$$\sigma_{port} = \sqrt{\sum_{i=1}^{n} w_i^2 \sigma_i^2 + 2\sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j Cov_{ij}}$$

Here the Cov_{ij} is the covariance between the returns for assets i and j, σ_i is the standard deviation of asset i. In a portfolio with a large number of assets, this formula can be stated as the summation of weighted covariance. This means that the important factor to consider when adding an asset to a portfolio is not the individual asset's variance, but its average covariance with all other assets in the portfolio.

CAPM framework

Although investment performance measurement and analysis have attracted considerable attention, most of the activity and development has so far been limited to the performance measurement of investment portfolios containing stock market securities (Hassan, 1990). Information concerning the stock market has been freely available and a sophisticated information industry has evolved around these markets. Most investors (institutional or individual) possess investment portfolios which are a mixture of financial and real assets and therefore there is a need for a considerable amount of information in a quantitative form for real estate.

Relatively recent developments in the theory of finance have caused a major shift in the perceptions about real estate investment risk. The realization that the total investment risk can be partitioned into two main components initiated a completely new approach to the analysis and treatment of risk. An asset's risk consists of two components, market (systematic) risk and company-specific (unsystematic) risk (Sharpe, 1964). Company-specific risk is that part of an asset's risk associated with random events that are unique to a particular asset and can be eliminated by proper diversification. Market risk on the other hand, is caused by general movements in the market and which reflects the fact that all assets are systematically affected by certain overall economic events. Market risk is the only relevant risk to a rational,

diversified investor, because he or she should have already eliminated company-specific risk. A popular measurement of systematic risk used by the proponents of the CAPM is beta (β). CAPM assumes that in an efficient market, all assets will be priced with the lowest risk asset attracting the lowest return and vice versa. Beta is a measure of an investment's sensitivity to the market.

A number of studies have been undertaken in recent times to analyse the CAPM framework and its applications in property investments. Liu et al (1990) conducted a study with the use of the CAPM framework to investigate what consequences arise from recognising real estate imperfections on the pricing of real estate and other financial assets and on the composition of optimal investor portfolio. Liu et al (1990) recognise three separate asset classes in their study: financial assets, income-producing property, and owner-occupied houses. They have relaxed the standard CAPM assumptions in order to arrive at a separate pricing paradigm for financial assets, income-producing property, and owner-occupied houses respectively. The standard assumptions of the CAPM were relaxed to recognise non-liquidity, a mildly segmented market structure and the consumption and investment attributes of owner-occupied housing.

Liu et al (1990) pricing paradigm for real estate proceeds using prior modifications to the CAPM by Errunza and Losq (1985) and Bosch (1986). The Errunza and Losq version of CAPM does not recognise that some assets such as owner-occupied houses are not only an investment but also provide housing services that an owner can consume and that affects the pricing of all assets. Bosch version of CAPM recognises not only the potential of durable assets for delivering services but also the existence of a rental market where these services can be traded. However, Bosch (1990) had assumed in his study that the rental costs are stochastic, while, Liu et al(1990) assume that rental costs are deterministic for the sake of simplicity. Several future avenues of research have been suggested by Liu et al (1990). These include extending their model to account for holding period clienteles, taxes, or leverage in either a single period or multi-period context and assessing the impact of these imperfections on the non-liquidity of the real estate investments.

Geltner (1990) investigated the market risk of unsecuritized investment grade commercial real estate. Geltner researched the market risk defined with respect to US national consumption and compared it to market risk defined with respect to US stock market. The conclusion of his study was that the market risk of the FRC (Frank Russell Company) and PRISA (Prudential Realty Investment Separate Account) indices of institutional real estate holdings appear to be virtually zero with respect to the stock market even after correcting for smoothing, but substantially positive with respect to the US national consumption. Liu et al (1990) model complements that of Geltner who offers an alternative paradigm for pricing income-producing real estate but not owner-occupied housing within a CAPM framework.

Property investment in the theory of finance

Hassan (1990) has investigated the literature of modern finance theory applied to real estate investments. Hassan found that most of the studies dealt with stocks and bonds and generally have not included real estate investments (REI) because there is no centralised market for real

estate where continuous information on real estate markets is provided. However, the introduction of Commingled Funds (CF) and Real Estate Investment Trust (REIT) securities in the American real estate financing is providing more data on which important studies have been performed by Miles and Rice (1978) and Miles and McCue (1984). These studies have found that :-

1. Real estate generally out performed stocks and bonds.
2. Real estate offered very good portfolio diversification potential by reducing risk and increasing returns.
3. Real estate provided a good hedge against inflation.

Hassan (1990) felt that real estate market do not approximate the conditions assumed in the traditional CAPM. Non-risk characteristics such as taxes, marketability and information costs, he feels, may be more important than risks in pricing general real estate investments. Ibbotson and Siegel (1984) have incorporated these non-risk factors into pricing mechanism in the New Equilibrium Theory (NET). They perceive investors as pursuing returns net of all investor costs, where each investor translates all risks, taxes, the burdens of non-marketability and obtaining information, and other factors into his own hetrogeneously determined costs for which he demands compensation.

Hassan's study concludes that the issue of using appropriate CAPM in real estate valuations is not yet resolved and further study is essential to establish the validity of CAPM framework in real estate investments. However, the emergence of real estate indices like FRC or PRISA partially fulfill the need to use a more appropriate market index in real estate asset pricing model. The study further concludes that the literature concerning market efficiency test of real estate is almost non-existent. Only Gau (1984), Gau (1985), and Gunterman (1987) have done some work in this area..

Property investment and market risk

Hargitay and Yu (1993) in their work have laid down the theoretical foundations of investment decision making, incorporating the techniques and procedures of modern management science, so that particular decisions regarding property investment can be made efficiently and rationally. Hargitay and Yu (1993) admit that unlike financial assets (shares, bonds, securities, etc.), tremendous strides have not been made in the development of the evaluation of market risk for real estate assets.

The investment characteristics of property are significantly different from the characteristics of assets in other investment media (Liu et al, 1990). Hargitay and Yu (1993) feel that this is the main reason why property is so useful and attractive for the purpose of portfolio diversification. The examination of the theory and methodology which have evolved in other investment media, they feel, can be used or adopted for property investment and portfolio work. Most of the researchers have expressed their anxiety at obtaining a realistic estimation of the beta coefficient for property portfolio.

RESEARCH METHODOLOGY

The research methodology proposed for the evaluation of market risk for real estate investment is the one which is associated with portfolio theory. The essence of this methodology is the realization that the real estate investment risk can be reduced by creating a portfolio of investment assets. The risk structure of the portfolio investment depends on the degree of correlation between the returns produced by the component assets of the portfolio and the differences between the risk characteristics of the individual assets. The proposed methodology is designed to demonstrate the validity of the use of the variance as an appropriate quantitative measure of risk, and volatility expressed by the beta coefficient as an indicator of the market risk.

Data collection

Reliable data are required for the measurement of the rate of return and the risk dimension for a real estate investment portfolio. From an institutional investor's point of view, whether a property is reversionary freehold or a long-term leasehold can be likened to an investment with growth potential or with a fixed income. This in principle allows the analysis to be compared with equities, in respect to the capital market, and taking into the account the state of the economy. One point is clear from the various perceptions of the data needs; the scope of the data required ranges from broad macroeconomics indicators to the microeconomics aspects of the real estate market. As pointed out by Hargitay and Yu (1993), real estate, because of its individualistic features requires even more data than other investment media. The various data items are broadly classified into: data on the national economy, data on the real estate market and data on the individual portfolio and property.

Property market data

Evaluation of the market risk require pertinent information about the state and mood of the market. The stock market and the capital market are described as 'efficient' because information is reflected instantaneously in the prices of shares. The same, however, cannot be said of the real estate since there is no central market for transactions and for generating information. A real estate investment analyst therefore has to rely on the gathering of up-to-date market data from all available sources.

Economic data

Macroeconomics data usually comes in the form of statistics published by official bodies such as the Australian Bureau of Statistics (ABS). The importance of such a quantitative data does not need further emphasis since real estate investment must be seen in the context of the economy. The economic environment determines such fundamental factors as interest rates, economic growth, level of economic activity, consumption and investment. This data and its interpretation will provide a valuable insight into the present state of the national economy, as well as being an indicator of future prospects, based on past trends. The most commonly used measure of economic activity is the Gross Domestic Product (GDP).

Individual property data

Information pertaining to planning, land use and development control can be found in plans with the local government authorities and their planning reports. These data are important for the evaluation of real estate investment risk of properties which are subject to changes in land use zoning of properties seeking planning changes. Local information, such as traffic and pedestrian counts, new amenities in the area, market surveys, and so on, may be essential data for market risk analysis.

Survey questionnaire

The value of the economic and property market data, however, has to be set off against some shortcomings. One of these is that the statistics produced are almost totally national or regional aggregates. Statistics at the local level, which may be of greater significance, are often not available. As a result, local variations and spatial differences may distort the application of the data in evaluating the investment risk of any local market. A survey questionnaire will be circulated amongst the prominent real estate portfolio investors to obtain their subjective judgment on various factors influencing market risk. The questionnaire will be designed so as to enable its analysis using a computerised statistical analysis package.

Data analysis

The data obtained shall be organised either on the time-series approach or the cross-sectional approach. The time-series approach traces the history of a fixed group of properties or portfolios and bear a closer representation of the behavior of actual assets and portfolios in the long run. The cross-sectional approach uses selected locations instead of a fixed group of properties or portfolios and represent the institutional investment activity in the short run (Hargitay and Yu, 1993). It is proposed to carry out a computerised *stepwise multiple regression* since this will allow to handle a great many variables. Such an analysis will provide at each step the various multiple and partial correlation coefficients of determination. In addition, it may provide simple correlation for all variable pairs. The data will be analysed to depict the historical beta coefficient and establish it as a measure of real estate investment portfolio's volatility relative to that of an average real estate investment portfolio. Statistical analysis will be carried out to analyse the risk and rates of return on a real estate investment in terms of how that investment affects the risk and return of the portfolio in which it is a part.

Market risk boundary layer (MRBL)

The market risk of the real estate investment portfolio is the aggregate of the risk of its components i.e. the risk of the individual property and the risk of the portfolio. A property portfolio may appear to be producing a satisfactory overall return but some of the individual components may be poor performers, whilst the other components may be doing exceptionally good. It is important therefore that the strengths and weaknesses of the portfolio be identified. The evaluation of the real estate investment portfolio is proposed to be done in number of stages commencing with the evaluation of individual properties and

proceeding towards the evaluation of the portfolio itself through the evaluation of the various sectors of the portfolio. Figure 1. shows the 'Hierarchical Market Risk Evaluation Model (HMREM)'.

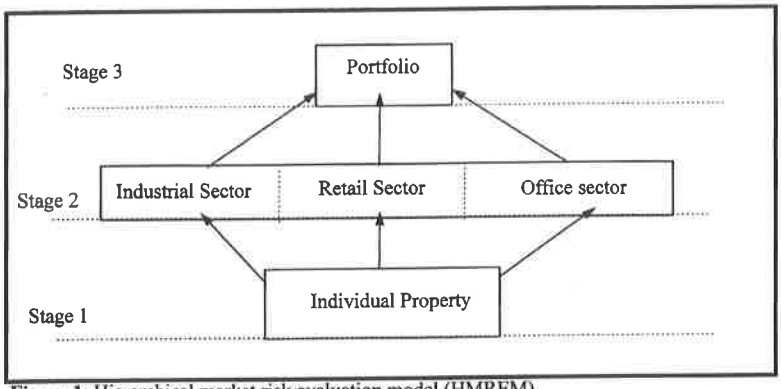

Figure 1: Hierarchical market risk evaluation model (HMREM)

The historical evaluation will include: rate of return measures, growth rate indictors, risk indicators, portfolio balance, portfolio beta factor, etc. The two concepts of efficient portfolio and beta are fundamental to the establishment of the generic model. An efficient real estate investment portfolio is the one in which the market risk is minimised for a particular level of return; such a portfolio is optimal in the sense that no further diversification or risk reduction can be achieved without some reduction in the return level. There will be efficient minimum risk portfolios at each return level and the relationship between their returns and market risk is proposed to be called as the 'Market Risk Boundary Layer (MRBL)'.

The MRBL is that set of portfolios that has the maximum return for every given level of risk, or the minimum risk for every level of return. The set of portfolios on the MRBL dominates all the portfolios beneath the frontier. Specifically, every portfolio on the MRBL has either higher return for equal risk or lower risk for equal return than some portfolio beneath the frontier. The research project will derive a mathematical equation of the MRBL and determine its geometric form. Figure 2. illustrates the concept of MRBL. Sub-optimal or non-efficient portfolios plot to right of the MRBL because they have more than the minimum risk achievable at their particular return level. The MRBL is the upper boundary of the set of all available risky investment portfolios.

SUMMARY

The application of portfolio theory and the CAPM framework in the evaluation of market risk for real estate investment is a fairly recent phenomenon. Most of the work in this area has

been done in the past ten or fifteen years. Significant portion of this research has been done in the American context and generally there is a lack of a structured research in Australia (JLW Research, June 1990 and JLW Research, April 1992).

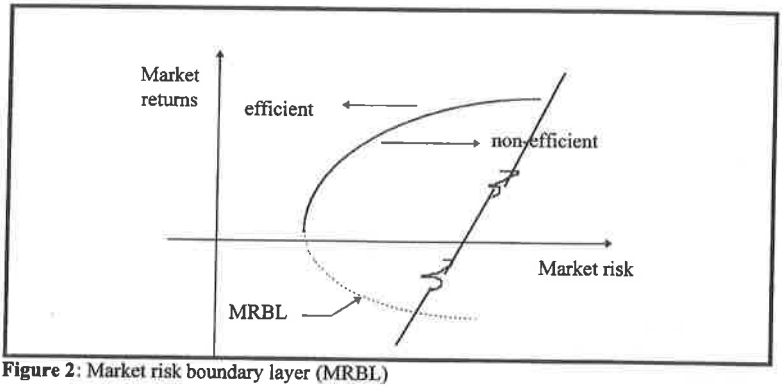

Figure 2: Market risk boundary layer (MRBL)

The research program proposes to evaluate the market risk for real estate investment portfolio in the Australian context. The institutional investors and banks are likely to be the major players in the next property boom. These investors in particular, are subjected to portfolio risk as they have real estate investment diversified across a range of properties. These future real estate investors need to understand the factors that contribute to the presence of market risk. The research seeks to find some rational and effective ways of documenting and learning from the experience of professionals involved in this sector of the economy. It is proposed to utilise the contemporary industry practices and techniques used by financial and stock management sector for the analysis of the investment in the real estate investment portfolio.

The validity of the popular CAPM framework is proposed to be established in context of the institutional real estate investors in Australia and suitable adjustments recommended. The establishment of the MRBL model will determine whether the portfolio held is sub-optimal, optimal or super-optimal.

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NETWORKS AND THE LEARNING ORGANIZATION

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Abstract

Building procurement is a strategic activity that establishes the organizational structure of the temporary multi-organization which is ultimately entrusted with the design and construction of a building. Therefore, trends in organization design and current business practices are essential in formulating appropriate and effective procurement strategies.

The emergence of the 'network organization' in management literature in the last several years is indicative of the importance of this organizational form in a business environment characterized by rapid change and turbulence. An examination of the building industry reveals that while the structure of this industry is a network archetype, the adversarial nature of relationships that have long prevailed in the industry act as an impediment to the full development of the advantages that are intrinsic in the network organization.

The learning organization is one which is continually expanding its capacity to create its future by improving the quality of thinking, expanding the capacity for reflection and team learning, as well as the ability to develop shared vision and shared understanding of complex business issues.

The concept of the learning organization is examined in order to exploit the full potential of the network organization.

Procurement; Network organization; Learning organization; Building industry.

INTRODUCTION

Procurement – the set of initial strategic decisions in the building acquisition process – is perhaps the single most important determinant of the outcome of this process. It is at this stage that the design of the organization [sometimes called a 'temporary multi-organization' (Davidson, 1988)] is formulated. The organizational structure that ensues ultimately determines not only the performance of the project but also its own performance.

Under traditional methods of procurement the 'formulas' for organizational design have been limited. However, as project complexity and market dynamics have made it necessary for owners to seek alternative methods of procurement, the complexity of organizational design leading to the creation of appropriate structures, has proportionately increased to such an extent that models and solutions must now often be sought outside the bounds of the building industry. One such novel organizational structure is the *network organization*. What makes this structure interesting from the perspective of procurement in the building industry is that, as it will be

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shown later on, the building industry has always operated in a network organization mode albeit unbeknownst to its participants.

A significant characteristic of the relationships that have long prevailed in the building industry is their adversarial nature; indeed, this adversarial spirit emanates from the language of the contracts that bind the parties that form the temporary multi-organizations we have just mentioned. The evolution of the network structure as it is applied in contemporary business situations tends to adopt a spirit of complementarity and cooperation. Thus the question: How can the building industry - the archetypical network organization - transcend its tradition of adversarial relationships and adopt the spirit of cooperation which is required so that a network organization may attain the benefits ascribed to this type of structure? While solutions may be found in a variety of approaches, we have elected to explore the virtues that can be derived from the concept of the *learning organization:* an organization that is continually expanding its capacity to create its future.

NETWORK ORGANIZATIONS

Network organizations are clusters of firms interconnected together by contractual or informal communication and exchange links; the firms work jointly toward common external objectives, such as the production or delivery of products or services, within an explicitly defined scope, budget and time-frame. Once the life cycle of such endeavor comes to an end, the particular network organization is disbanded, while its former constituent firms are likely to pursue new alliances and join other networks in moves that are consistent with each firm's own internal objectives.

In this description of network organizations, *external objectives* refer to the shared objectives towards which all firms in a network operate. Such objectives are project-specific, and a firm espouses these as a result of its commitment to the network's collective reputation and well-being. The *internal objectives,* on the other hand, are the firm's own long term objectives expressed in performance measures, such as return on investment, stability in the market place, etc.

In the current business environment of network organizations, where boundaries are thin and transparent (Bahrami, 1992), a congruence of internal and external objectives not only becomes imperative, but it is often dictated by the very operation of the network and the nature of the transactions that the technology and the market support. (Snow et al., 1992; Eccles and Crane, 1987).

The emergence of network organizations has been linked to the state of the environment in recent decades. 'Turbulent,' 'unstable,' 'in flux,' 'kaleidoscopic,' are some of the words used to describe this environment. The consensus is that there is rapid and dramatic change in the environment that inevitably impacts on any organization's ability to operate effectively and efficiently. Under these circumstances the traditional hierarchical organizational structures have come under scrutiny: are they able to continually adapt to the rapid succession of dramatic changes experienced by many firms, not only in selected industries but uniformly across industry boundaries?

Current technological advances and the rapid accumulation of knowledge appear to have pushed many organizations beyond the limits of what they consider to be bounded rationality. Intrinsic complexity in products and processes have attained such high levels that the expertise

required to deal with it cannot reasonably be found within the bounds of hierarchically integrated organizations. Strategies that worked in the past have become obsolete, and alternative strategies often prove fruitless for attaining objectives that often resemble 'moving targets.' For hierarchical organizations it is no longer possible to satisfy the requirements of economies of scale and other market constraints within the present market fragmentation.

Yet amidst the required structural flexibility and agility (Bahrami, 1992), which are essential for organizations within this environment, another apparently contradictory element is required: stability. This stability can be found in the network organization. Indeed, stability is essential for the network organization to attain its external objectives, i.e., the successful delivery of products and services. It is also equally important for the survival and well-being of the individual firms within the network.

At the same time, shifts in business paradigms, as manifested in practices such as 'partnering,' 'business process re-engineering' and 'information technology' are impacting on firms and leading them to look outside their boundaries (Katsanis and Davidson, 1996); they are also likely to accelerate the adoption of the network organization form, and make positive contributions to understanding how they operate.

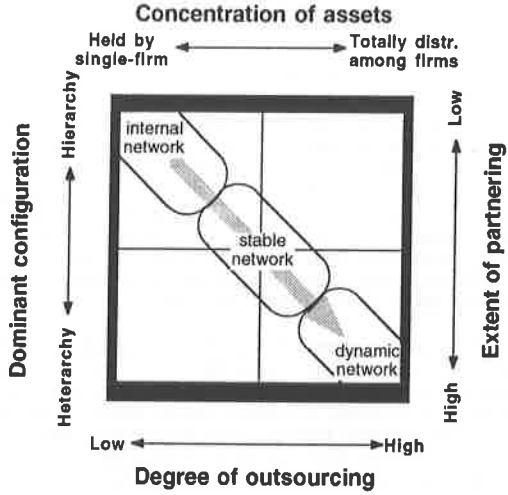

Figure 1. A Proposed Four-Dimensional Typology of Network Organizations

In recognition of these trends, the network organization has become a rather frequent theme in management literature for nearly two decades. Snow et al., (1992) have identified three types of network organizations, based on their configural arrangements and the ensuing degree of stability. Based on descriptions and examples, we present a new conceptual typology to organize these three types of networks, using four dimensions of structural attributes that each type exhibits. Figure 1 shows this typology in which the three types of networks correspond

consistently to distinctly different regions with respect to form, relations, asset ownership and outsourcing.

It appears that both the internal and the stable networks (Figure 1) are subject to considerable influences, in terms of operations and structure, that are usually associated with hierarchical organizations. In contrast, the dynamic networks tend to fit closer the profile of agile, flexible and lean organizations that emerge as the hallmark of heterarchies.

THE BUILDING INDUSTRY: AN ARCHETYPICAL NETWORK ORGANIZATION

In order to understand networks in the context of the building industry, it is important to examine certain key aspects of its operation and how they give rise to the end products of the industry – the buildings.

Each building is unique, usually in its configuration and function, and always in its location. To put a building in place, three broad sectors of activity are involved: the design and engineering sector, dominated by architects, engineers and related professionals; the construction sector, dominated by general contractors and sub-contractors; and the supply and manufacture sector, dominated by building product distributors, suppliers and manufacturers.

Each sector constitutes an industry in itself; yet, their collective activities constitute the building industry. It is, therefore, not surprising that the building industry is characterized as a multi-industry (Davidson, 1988). Indeed, it is this multi-industry attribute that makes the building industry difficult to classify in management terms in a comprehensive fashion that affords meaningful comparisons for analysis and study. For some time now, researchers and institutions have attempted to study the building industry as a whole under the misleading paradigm of the manufacturing model, much to the detriment of understanding the industry's problems and potential solutions (Groák, 1994). A reversal of this approach is currently observable, mainly because of the acknowledged demise of the hierarchical organization as a universal prototype (Peters, 1992) with its ties to manufacturing, and the concurrent emergence of networks as an organizational form that merits attention and study.

Each sector of the building industry: design and engineering, construction, and supply and manufacture, operates independently of the other in terms of institutional norms, regulatory procedures, and market mechanisms. Yet, they are interdependent in that the work of one, with regard to the final product (the building), can only be realized through the intervention of the others. Furthermore, each of them holds knowledge and information the others do not or need not possess and it is well known that mutual advantages ensue from such a situation for the subcontracting parties involved in the building process (Eccles, 1981).

For example, in the design and engineering sector, the set of professional services that a prospective building owner is likely to require for a given project are so project-specific that they are not usually found as in-house expertise in any single organization. Given the nature of the work and the fragmentation of the market, the economies of scale do not support the concentration of such a diverse set of services within an integrated organization. While there are several avenues available to a future building owner for procuring such services, under a common method of procurement known in the industry as the 'traditional approach,' the work is awarded to a prime consultant. This is often an architect, who becomes responsible for producing the design, which is, of course, one of the essential interim products. By virtue of this

mandate, the architect, though he may not realize it, assumes the role of the network designer and undertakes to assemble an appropriate team consisting of in-house architects and outside consultants such as structural, electrical and mechanical engineers, and other specialists appropriate to the scope of the particular building. In other words, constituting this team results in bringing together expertise found in a variety of organizations that have consented to an interchange of services for the optimum delivery of the final product. The team is, in fact, a network organization, predictably of short duration.

An explicit contractual link usually exists between the building owner and the architect by virtue of a contract document. The contractual relationship between the prime consultant and its subconsultants may be explicit or implicit. (Implicit relationships usually arise from statutes that govern professional obligations and civil liability assumed by virtue of professional advice or documents prepared by architects and engineers). The design team produces a design to meet the owner's requirements and prepares drawings and specifications upon which a general contractor is subsequently awarded a contract for the implementation of the design. The award is usually made following some form of competitive bidding solicited either from a small pool of selected general contractors or by means of public advertising. Alternative methods to competitive bidding usually involve extensive negotiations.

In a similar fashion, the general contractor assembles the construction team from a pool of subcontractors and suppliers. While traditionally competitive bidding has been a major determinant in the choice of subcontractors and suppliers, a variety of other criteria such as dependability and ability to deflect or absorb risk, have come to play a paramount role in the selection process. To carry out the construction of a project, the general contractor assembles the construction team, which consists of some in-house expertise and a large number of specialty contractors acting as subcontractors to the general contractor. Contractual links tie the general contractor with each of the subcontractors. Thus, the contractor has, in fact, configured a network organization, overlapping with, but different from, the design network established earlier.

The third sector – manufacture and supply – has traditionally been brought into the project by contractual links that emanate from the general contractor or from the subcontractors. A consequence of this arrangement is that in spite of the important role they play in the building process, manufacturers and suppliers have been viewed as occupying a subsidiary role in the process and not been principal team members (Glover, 1974). However, a variety of factors, including market forces and technology have already initiated a change in the dynamics of the relations by providing product information links to architects, engineers and technical managers (EDMAR, 1995). As a result, additional links are being established between the design networks, the construction networks, and the manufacturers and suppliers who also have network-like relations between them.

THE BUILDING INDUSTRY'S ENVIRONMENT: THE NEED FOR NETWORKS

It is acknowledged that in general the emergence of networks is in direct response to environmental turbulence. Some of the factors that can be ascribed to this turbulence are: market fragmentation, short project life cycles, and project complexity and uniqueness. These factors are found in a variety of industries and have become particularly acute in recent years. However, in the building industry these factors are, and have always been, intrinsic both to the product and to the process required for its delivery; as a result, the network organization has become a natu-

ral choice, though, as we have suggested above, the networks are, at present, of short duration, corresponding (in most instances) to the required organization of individual projects.

Fragmentation

Fragmentation is the hallmark of the building industry. Firstly, as stated earlier, the building industry is a grouping of three sectors. This situation results in expertise fragmentation. Secondly, the end product categories are so numerous and diverse, e.g., residential, commercial, industrial, institutional buildings, that a certain degree of specialization is required, which results in additional fragmentation. The third factor affecting fragmentation is the immovable nature of the end product which results in fixed geographic markets with limited ability to command and absorb the entire spectrum of expertise required.

Short Project Life Cycles

In the building industry, the process from product inception to production, has a relatively short life cycle. When this cycle is considered in terms of the interim products (designing, constructing, manufacturing/supplying) it becomes even shorter. As buildings are usually custom designed to meet the owner's needs, and as most owner are not likely to need another building for a considerable time, the completion of a project brings with it a discontinuity for the design and construction teams that worked on it. If a conventional integrated organization had been responsible for this process, it would be required either to line up a steady stream of commissions (which might have resulted in the clients having to wait for their turn), or it would be required to implement an extensive human resources program, with frequent lay-offs and massive hirings. Obviously such a mode of operation is not suited for building projects; indeed, at the heart of the need for subcontracting found in the building industry is the requirement for flexibility, found typically in what is known now as a dynamic network.

Complexity and Project Uniqueness

The requirement for flexibility is inextricably tied to the inherent complexity of projects and to the prevailing environmental uncertainty. The complexity of the projects confronting the building industry arises from their very nature. A building requires the cooperation and coordination of an inordinate number of professional disciplines and trades for its construction. Indeed, a typical medium-size building of moderate complexity requires nearly a dozen professional disciplines, such as architecture, civil, structural, mechanical and electrical engineering, as well as other specialties, and at least forty to sixty different trades supported by an even larger number of suppliers of materials and equipment providing a wide range of products, the number of which is counted in thousands. Added to these is the fact that most buildings are unique; as a consequence, the product is a prototype, assembled under conditions involving two major risk factors: unpredictable climatic conditions, and unforeseen ground conditions. It can be seen, therefore, that the complexity of the building project is absolutely enormous, way beyond the rational bounds of a single organization, particularly with regard to risk distribution, assumption of responsibilities, and warranties.

NETWORK ORGANIZATIONS AND LEARNING ORGANIZATIONS

The building industry has employed the concept of dynamic network organizations for some time. Even though the organizational configuration in the building industry has not been previously called a network organization, it has, as we have shown, all the attributes ascribed to the

network organizations in current management studies. Furthermore, the genesis of the network configuration in building follows from the complexity and discontinuity of operations at the project level that are associated with the environment of the industry and from the ensuing need for rapid response and adaptability.

Socio-economic and technological changes over several decades have played a significant role as a catalyst in the shaping of this configuration. The technology now available to managers appears to play a dual role: its adoption necessitates change and at the same time it also facilitates it. As the post World-War II projects became more complex, the technology that became available facilitated the management of such complex projects and brought them within the realm of reality. As a result, the disciplines of project and construction management were focused on the systematic management of building projects, forcing building team members to streamline their processes and rethink the division of tasks and responsibilities. It is significant that project and construction management as applied to the building industry have *implicitly* dealt with the management of projects undertaken by network organizations; as a consequence, they have built up an impressive body of knowledge that is now available for the study and operation of network organizations in other industries.

However the success of the network organizations lies beyond their structural configurations. Indeed their power appears to derive not singularly from their structure but also from their unique underlying philosophy. This philosophy – one of cooperation, complementarity and reciprocity – is antithetical to the adversarial spirit which, through its contractual entrenchment, has shaped the relationships of the actors of the building industry. A program of voluntary mindshifts is required that will enable the participants to reformulate their worldview to reap the benefits of the prevailing winds of change. This philosophy is embodied in the concept of the learning organization; its major tenets are discussed in the following section.

THE LEARNING ORGANIZATION CONCEPT

There is a relatively new concept in the world of organizational science called the 'Learning Organization.' Although there is no good parsimonious, general definition of the learning organization, Watkins and Marsick (1993:xii) give five statements about what a learning organization is and is not:

1. It is not just a collection of individuals who are learning.
2. It demonstrates organizational capacity for change.
3. It accelerates individual learning capacity but also redefines organizational structure, culture, job design, and assumptions about the way things are.
4. It involves widespread participation of employees – and often client – in decision making and information sharing.
5. It promotes systemic thinking and building of organizational memory.

Notice how 'fuzzy' this list is; many results of organizational learning are not quantifiable. However, this does not mean that they are unknowable. Organizational learning, unlike quality management, is not engineer driven; systems thinking may be a scientific discipline, but it does not insist that everything worth knowing be quantified or even be quantifiable. And organizational learning has probably become the critical competency of the 1990's (Dixon, 1992).

We would add to this list that the learning organization understands both its culture and the impact that being a learning organization has upon this culture (and the reciprocal impact that the

culture has upon the firm's ability to learn). Culture, as socially-constructed realities, is important to the organization [using the plural of reality implies that culture is an evolving process based on a changing definition of reality (Thompson and Luthans, 1990)]. Thompson and Luthans (328-337) further state several properties that emerge when relating behavioral and learning principles to organizational culture:

1. Culture is a generic term.
2. Culture is learned.
3. Culture is transmitted through a pattern of behavioral interactions.
4. In an organizational setting, there are multiple reinforcements and reinforcing agents.
5. Each individual carries predispositions that shape his or her interpretation of the organizational culture.
6. A symbiotic relationship exists between the reinforcing agent and target.
7. Changing an established culture is difficult.

Senge (1990) lists several 'learning disabilities' that are ingrained in all organizations; these learning disabilities will get in the way of any attempt to change an existing organization into a learning organization:

1. 'I am my position' – the manager or employee who places loyalty to the job before loyalty to the firm, what Tobin (1993) calls 'functional myopia.'
2. 'The enemy is out there' – the true enemy is almost invariably 'in here.'
3. The illusion of taking charge – proactivity is 'reactiveness in disguise.'
4. The fixation on events rather than processes.
5. The delusion of learning from experience – but the fact remains that we rarely directly suffer the consequences of many of our decisions because of the temporal separation of decision and consequence.
6. The myth of the management 'team.'

An appropriate antidote to this could be a shared spirit of adaptability, shared culture and vision across all organizations particularly if they participate in a temporary multi-organization. Emphasis on the ability to affect organizational change as well as to maintain high performance in the midst of change is paramount in an environment where networks have a very short life cycle. Ability to redefine organizational structure, culture, job design and fundamental assumptions in a setting characterized by turbulence are basic requirements for organizations whose existence depends on the cycles imposed by the market, e.g., by the building procurement process.

The concept of the learning organization when applied to network organizations facilitates the mindshift required to make the transition from: contractual rights to complementary strengths; from haggling and resort to courts to norms of reciprocity and reputational considerations; from independent firms to interdependent organisms; from bilateral contracts to multiple partnerships (Powell, 1990).

Senge's work is crucial in any understanding of learning organizations, if for no other reason than its focus on the role of structure on behavior, a role that is often overlooked or ignored in modern studies in many fields and the fact that every subsequent book on the subject cites it. In a later work Senge and coworkers (1994:18), have changed the definition of the essence of the learning organization to the development – not just of new capacities, but of fundamental shifts of individual and collective minds.

We are now coming to understand that there are four groups of concepts which need attending to in order to build an organizational foundation for the learning organization: Philosophy (in which vision, values, and purpose are important), Attitudes and Beliefs (in which there is genuine caring, a communality of purpose, and the willingness to admit lack of knowledge), Skills and Capabilities (in which systems thinking is developed, along with a shared commitment), and Tools (in which the systems devices Senge developed are used throughout the organization (Senge, 1990; Senge et al., 1994)). Developing this foundation and the new organizational skills and capabilities which need to flow from them may be the "highest-leverage area for creating lasting change" (Senge, 1993:21).

Senge (1990) further focuses tightly on the necessity of having a shared vision throughout the organization. In fact he flatly states (p. 209) that one "cannot have a learning organization without shared vision. Without a pull toward some goal which people truly want to achieve, the forces in support of the status quo can be overwhelming." Further, shared vision provides the focus and energy for learning. "It's not what the vision is, it's what the vision does" that is important (Senge, 1990:154) – an example of his focus on the process rather than the product. The vision pulls the entire organization together. A concrete application of the concept of a learning organization lies in the planning process.

And herein lies a crucial part of Senge's argument and of his focus on process rather than product. Planning is a process; the plan is a product. *Planning* is important – planning must be a learning exercise, valuable in and of itself. The plan then becomes secondary, a statement of the result of what the planners have learned about themselves and the organization. Who is on the planning team thus becomes less important than the fact that there is a team planning and presenting the thoughts and assumptions behind the planning to the organization as a whole. This is planning that does not produce a multi-volume plan to bind in a black notebook at the end of the year that will be allowed to gather dust – or, worse, be used to control individuals in the organization in the coming year – but rather a living document that can breathe life into the organization's future efforts (Cahill, 1996).

CONCLUSION

We have shown that the building industry is an archetypical network organization, in fact a dynamic one. However, the very attributes that give rise to this particular structure in the building industry also act as impediments to the full exploitation of the functional potential of the network. The fragmentation intrinsic in the building process promotes the formation of networks and yet the complexity that arises from the sheer variety of the participating firms is often countered by means that are not compatible with the underlying philosophies of the network organization.

Why all of this emphasis on 'learning organizations' in a conference about procurement? Simply put, we believe that the metamorphosis of the archetypical network of the building industry into a set of dynamic long term networks can be greatly enhanced and expedited by the application of the concepts of the learning organization on an ongoing basis. This, in our view, is a necessary step in capitalizing on the existing industry structure while learning from experience gained in other fields.

"Learning in organizations means the continuous testing of experience, and the transformation of that experience into knowledge – accessible to the whole organization, and relevant to its

core purpose" (Senge et al., 1994:49). Notice the words "continuous testing of experience"; to a great extent, this is the crux of the whole argument. Not only must experience be continuously tested (for a purpose, not just to test), but the relevant knowledge that is produced must be shared with everyone in the organization.

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SHOULD WE STRIVE FOR INNOVATION OR JUST RUN OUR PROJECTS WELL ?

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Abstract

The most important type of innovation from the procurement point of view is process improvement. This is due to the huge potential for improvement in the building process and the resulting organizational environment which stimulates innovation. These claims are conceptually examined and, moreover, substantiated by means of a case study. An office building process was followed and the data was used as a means to study the potential for building process improvement through various calculations. Finally, conclusions are drawn and recommendations are given to the client to take into consideration when organizing a building project.

INTRODUCTION

It is obvious that the procurement and the organizational methods used influence innovation and improvement in the construction industry. Innovation is conventionally divided into product innovation and process innovation. In this paper, the term *process innovation* refers to the "hard" innovation concerning technological processes, whereas the term *process improvement* refers to the "soft" innovation[1] concerning the flow of material, information and work processes. Process improvement is thus related to initiatives with varied titles, like continuous improvement, business process re-engineering, total quality management, concurrent engineering, lean production. (see e.g. Rummler and Brache, 1995).

It is argued that the most important type of innovation from the procurement point of view is process improvement. The reason is twofold:

- It gives possibilities for increased efficiency in the short term by improving the "existing" and known processes; it requires minor investments and is also likely to succeed.
- It sets the preconditions for "hard" innovations by creating an organizational environment which stimulates innovation and in which it becomes possible to take advantage of it.

These claims are conceptually examined in the paper and, moreover, substantiated by means of a case study which illustrates the existing improvement potential. In this case study, a fast

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[1] Some authors, like Davenport (1993) use the term process innovation instead of process improvement. This is confusing, due to the established meaning of process innovation in innovation literature: the term process innovation refers to technological conversion process innovation rather than to flow process innovation.

track office building project was monitored and documented, and the information gathered was analyzed from different perspectives. Finally, conclusions are drawn which can be taken into account in construction process improvement and in making decisions on procurement strategies.

WHAT IS PERFORMING CONSTRUCTION ?

The problem

The performance of construction has been criticized by many: construction productivity lags behind that of manufacturing, the costs of construction and buildings are high, customer-orientation is insufficient as is the quality of construction, etc. By and large, two explanations have been put forward for this situation:

- The first one claims that the innovation rate in construction is too low. The cure is thus to eliminate the barriers of innovation in construction.
- The other one argues that construction projects and, more or less, the whole industry, are inefficiently managed, thus creating a major gap between current and the achievable performance. The basic cure is to diffuse "the best practice" across the industry.

Next we examine these two views in more detail, especially their organizational implications.

Preconditions for innovations

The dominant view on technological advancement has seen product and process innovation as the prime movers of change. Characteristic to both product and process innovation is that the innovative features are embodied in a product or in production equipment. Most often, innovation is stimulated by external technological development or market demand. Innovation is often seen as a breakthrough leap, though incremental refinement is also accepted as a form of innovation.

When the literature concerning the preconditions for innovation in construction is summarized from the project-organization viewpoint, a few questions stand out:

- The low degree of **integration between design and production** functions in today's fragmented construction industry appears to be a major factor limiting the size and rate of innovation (Nam and Tatum, 1992; Nicholson, 1991; Slaughter, 1993). The early involvement of construction representatives in the design process and the allocation of time to evaluate alternatives are vital parts of a supportive context for innovation (Tatum, 1989).
- Specialty segmentation of the construction industry may limit any willingness to take the risks associated with new construction technologies (Tatum, 1986), while **the scopes of liability of the various teams** are generally based on professions and are a barrier to development. There is no accumulation of knowledge or any motivation for trying one's best. A special emphasis has to be put on minimizing interdependencies. (Lahdenperä, 1995)
- **Planning to consider multiple alternatives**, to ensure technical feasibility and to increase construction flexibility, is critical from the viewpoint of innovation. Placing a

> high priority on planning means assigning the time and resources to analyze construction methods and evaluate innovations. However, the bidding cycle often does not allow adequate time for this. (Tatum, 1989)

Problems of the process innovation view

However, both construction-specific and general problems have been seen in the approach emphasizing innovation. Many factors work against traditional R&D in the construction industry. Construction is a project-based business, but the objective of each project is to provide a facility that meets the owner's needs at the lowest possible cost and within the shortest schedule. This contrasts with the objective of generic development and makes it more difficult to focus attention on innovation. (Tatum, 1989)

On the other hand, it has been argued that innovation in the construction industry occurs to much greater extent than is usually recognized, and the sources of these innovations are more likely to be the people working on-site than manufacturers or research laboratories. The present problem is, however, the utilization and commercialization of innovations due to organizational constraints. Overall optimization of the various products requires the integration of design, manufacture and site assembly. (Slaughter, 1993)

These facts justify focusing on the project in question at the time and, especially, on the practical site process, instead of on innovation theories. Moreover, Tatum (1989) emphasizes the importance of being convinced that there is an opportunity to improve anything, including those operations for which the firm's technology and performance is at least as good as the competition, where there is no obvious need for change.

Moreover, innovation-oriented performance improvement is seen as an ongoing series of decisions as to whether the probable gain from each proposed improvement activity, considered independently, will exceed the expenditure to implement it (Hall et al., 1991). Organizationally, innovation-oriented performance improvement is strictly separated from production control and indeed does not address problems of control. Thus, in practice the innovation activities remain limited in their scope.

Process improvement

The process-oriented performance improvement is focused on the design, control and improvement of material, information and work flow processes. The issues related to the design of processes have recently been widely dealt with in the framework of business process redesign, re-engineering, etc. While we acknowledge the major potential related to the design-of-processes aspect, we have chosen to address here the improvement side in more detail. The primary reason is that initiating improvement is much easier than creating a new process design. Continuous improvement stimulates development; the results are tangible and create an inspiring atmosphere yielding positive repercussions.

Continuous improvement

Imai (1986) argues that the conceptual framework of innovation has prevented the understanding of the significance of "continuous improvement", characterized by incremental steps, wide internal involvement and organization-embodied innovation. Here, it is useful to analyze and compare it with innovation (Table 1), which has been the primary framework of analysis until now[2].

Table 1. Comparison of innovation and continuous improvement; modified from Imai (1986). (Koskela, 1992)

	Innovation	Continuous improvement
Focus	Efficiency of conversions	Efficiency of flow processes
Goal	Leaps in efficiency	Small steps, details, fine-tuning
Involvement	Company and outside specialists, champions	Everybody in the company
Time frame	Intermittent and non-incremental	Continuous and incremental
Technology relied upon	Outside technological breakthroughs, new inventions, new theories	Internal know-how, best practice
Incentive	New superior technology or need for capacity extension	Overcomes constraints in variability reduction or cycle time compression
Practical requirements	Requires large investment, but little effort to maintain it	Requires little investment, but great effort to maintain it
Mode of action	Scrap and rebuild	Maintenance and improvement
Transferability	Transferable: embodied in individual equipment and related operating skill	Primarily idiosyncratic: embodied in system of equipment, skills, procedures and organization
Effort orientation	Technology	People

To some extent, continuous improvement parallels the traditional view on innovation: they both incorporate incremental product and conversion process improvements. However, continuous improvement is more geared towards development of the flow process than its conversion (Figure 1). On the other hand, in some cases an innovation may enhance the efficiency of the flow process.

Concerning their relation, poor flow efficiency is a barrier to innovation, because the benefits of an innovation become invisible in the confused environment and, on the other hand, poor flow efficiency does not motivate the parties to the building process to try their best. Implementation is also difficult when there are many intervening disturbances (Hayes et al., 1988; Chew et al., 1991). This is related to the argument that **there is a preferred sequence**

[2] Innovation forms also the conceptual framework set by the organizer of this symposium.

of improvement and innovation: improvement should precede innovation. Also Tatum (1986) remarks that emphasis on process, meaning strong emphasis on process flow rather than hardware, limits the barriers to innovation.

The focus of continuous improvement

The focus of continuous improvement is typically on:

- eliminating bottlenecks
- variability reduction
- cycle time reduction
- elimination of non value-adding steps from the flow
- ongoing consideration of customer requirements for each activity
- fine-tuning different parts of the process for better synchronization
- maintenance for better reliability, and
- incremental development of equipment.

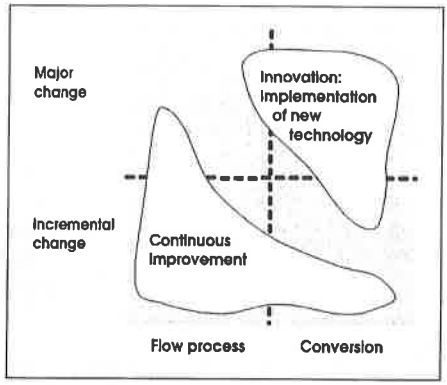

Figure 1. Continuous improvement and innovation: focus and aimed change (Koskela, 1992).

Thus, the following case study traces the potential of building process improvement; it is aimed at encouraging an acknowledgment of "step-wise innovation". It stresses improvement directed at the present constraints in the production flow and uses the above methods.

THE CASE STUDY PROJECT

General

A project was monitored by a researcher, who first collected all relevant documents of the project, and observed and documented ongoing tasks during both design and construction. Secondly, the information gathered was completed and checked by interviewing designers and construction parties. The results of the collection of empirical data were synthesized, and organized in a model of the construction process (Tanhuanpää and Lahdenperä, 1996), which consists of over 1000 design and building tasks and their duration, about 850 tasks dependencies and 450 key information flows between actors, etc.

The information collected is analyzed from different perspectives:

- what was the impact of the improvement methods utilized (Koskela et al., 1996)
- which factors troubled the project and how much waste was there (Koskela et al., 1996)
- what would have been the potential for further improving the performance and
- how could it have been realized?

The examination addresses changes in project duration and costs. The emphasis was especially on the acceleration of the project that can save a lot of time-related costs; acceleration was also seen as a means to improve the performance of the process.[3] Speed is obviously also increasing its significance as a means of competition (cf. Koskela et al., 1995).

The project

The office building in question (Figure 2) was realized in the design-build mode[4], where the briefing phase was started first in 1991 but interrupted due to the recession, and re-started in December 1994. The design of the 7 100 m^2 and 25 700 m^3 building, comprising five floors, was started in the beginning of January 1995 and the construction at the end of the same month. Subsequently, a floor was handed over monthly, starting from the fourth floor at the end of July. All the floors had been finished and handed over by the mid-November 1995.

Figure 2. The completed fast track office building project.

The design time of the building was 9 months, which is quite a standard design time for this kind of building. The construction time was slightly under 10 months and due to the overlapping of design and construction the whole project was thus realized in 11 months.

Many players in the construction project had already worked together in the same area, so they had some feeling about the expected quality level and mode of action. The tenant of the building was a growing multi-national company having a clear company vision and recent experience in specifying their office concept. Still, the growth of the organization made the definition of requirements more complicated.

Generalizability of the project

The justification for selecting the project as a basis for comparisons for the suggested improvements can be evaluated from the viewpoint of the time and costs considered. Firstly, the procurement costs did not exceed the budgeting guidelines given by Haahtela et al. (1995). This document gives a method and updated reference data to estimate project costs

[3] This was deemed appropriate since it makes the results tangible while respecting the agreement with the parties of the project not make public the actual and contracted cost data in detail.

[4] The case project was selected because it was as representative as possible regarding the properties of innovative organization in the framework of the prevailing practice (cf. previous chapter of this paper).

on the basis of space types and area, quality level, production technology, etc. and is the most used method by clients for budgeting and cost control in Finland.

Secondly, from the viewpoint of lapsed time, or project duration, a benchmark is given by Poikonen and Kiiras (1989) and it is, again, a planning method based on extensive empirical data. It gives a duration of 15 months for the case project. Another set of empirical data is presented in Figure 3. The data incorporates more than one hundred building projects that are similar to the case project. According to statistical analysis, the monitored project was implemented at least 25 % faster than is the average construction time for a building of that size and construction method (prefabricated concrete frame and facades). This leads us to conclude that the project in question is most challenging to be improved further.

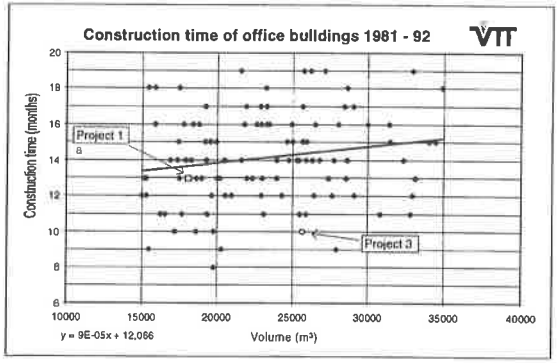

Figure 3. The building times of office projects with similar type of production technology (Anon., 1996b). Durations, from the launch of the site to take-over, are presented with regard to volumes of buildings and a corresponding regression line is drawn as well. So far, there have been 3 projects by the parties from which Project 3 is drawn as the case project. The second project was considerably smaller and falls outside the interval examined.

IMPROVEMENT POTENTIAL

Improvement opportunities

What is the potential of process improvement in construction? The data from this case study allows us to make a rough estimate of the potential in regard to time and cost. For this purpose, improvement ideas were surveyed, the theoretical basis of relevant methods were ascertained, and possible pilot cases and experiences studied. Then, the process was redesigned, respecting the new ideas. The original activity network and duration data etc. offered a test bench while the realized task- and time-related costs were also used in calculations. Alternatives, for which data from this case were not available, were assessed according to the market prices and reference projects. Great care was taken in making the improvements as realistic as possible.

Next, the improvement potential is discussed per project stage by way of examples. The presentation summarizes a number of lengthy calculations, along with their assumptions. The results of calculations are presented in Table 2. The focus is on improvements that can be realized in the short term; they could thus have been realized on this project, if the necessary action had been implemented.

Design and design management. Improvement of the client decision making process is the major single opportunity (see Table 2, method 1), that would shorten the design phase by two months. It does not shorten the total project time, but reduces disturbances in subsequent phases. Change over from distribution of paper drawings to computer integrated design (where drawings are sent electronically) would shorten the design by additional 1½ months; this does not have any direct impact on total time either. However, the site construction could have been started 1½ weeks earlier, if foundation plans (drawings) had been made this way (meth. 2).

Production planning and control. As is typical in construction, the time and effort directed to production planning was not at an optimal level. Calculations deal with the construction of the frame of the 5th floor, its infilling with light weight aggregate (meth. 3), and floor screeding on the 4th floor (meth. 4). Moreover, a reverse order in internal works (compared to the top down approach that was adopted), along with stepwise handover (floor by floor), turned out to be beneficial (meth. 5).

Procurement. Utilization of a prefabricated inner wall system (and corresponding scope of liability) turned out to be beneficial cost- and time-wise, even if its construction costs are somewhat higher than the costs of the in situ gypsum walls selected in the project (meth. 6).

Production. A major concern in production is the minimization of non-value-adding work (meth. 7). On the basis of wide empirical studies (Anon., 1996a), the share of various disruptions is 10 - 20 % of the total working time, even if only disruptions longer than one hour are included. Further, Josephson (1994) has found that the additional time caused by errors is around 10 % of working time. In the calculation, it has been assumed, even by exercising great caution, that the work input can be shortened by 5 % through reduction of disruptions and errors, although also focused site observations in the project actually gave a bigger share for major disruptions than this 5 % used. On the other hand, reports from industrial implementation studies indicate that the reduction of disruptions is indeed possible even through project-wise measures (Bengtson, 1994); in the reported case, the share of non-productive time decreased roughly from 20 % to 10 %.

Total improvement potential

What is the joint effect of these and some other methods studied? Some of the methods need each other to be successful, while there are several methods, the impact of which is not dependent on the use of any other methods. The total improvement potential has been assessed through constructing a network, where all analyzed methods and their interactions are taken into account. In all, it is estimated that the construction time could have been shortened by 2½ months and its costs could have been reduced by 1 million mark. This is

Table 2. The time and cost savings of some methods of acceleration when simulated with empirical data from an office building project in Finland (intermediate version).

Methods VTT	Benefits [working days]			Cost savings and incomes [FIM] [8]			
	Labor [1] input	Phase [2] duration	Overall [3] duration	Time [4] costs	Direct [5] costs	Earlier [6] incomes	Method total [7]
1. Management of client requirements and computer-integrated design [9]	13 / 0	72 / 0	— [9]	—	50 000 [10]	—	50 000
2. Computer-integrated design of foundation plans [11]	—	8/0	8 [11]	30 000	0	100 000	130 000
3. Enhanced production planning and constructibility	0 / 69	0 / 2 (18) [12]	2	20 000	120 000	20 000	160 000
4. Use of rapid-hardening floor-screeding material on all floors	0 / 0	0 / 8	8 (3) [13]	90 000	-160000	70 000	0 [13] (10000)
5. Reverse order in internal works and stepwise handover	0 / 0	0 / 15 (22) [14]	15	160 000	0	190 000	350 000
6. Product development in internal works: non-load bearing partition	0 / 286	0 / 17	17	190 000	-310000	200 000	80 000
7. Minimization of disruptions in site works	0 / 169	0 / 12	12	130 000	160 000	110 000	400 000
TOTAL [15]	13 / 506	80 / 52	60	600 000	-160000	680 000	**1120000**

[1] The figure describes the decrease in labor input in design offices and on site (design / site).
[2] This figure describes the shortening of the design and site-construction periods (design / site).
[3] This figure describes the shortening of the overall construction period (incl. both design and construction); the figure may differ from that of "phase duration" depending on the critical path of the project.
[4] This accounts for the saving in use of site facilities and equipment, management and supervision etc.
[5] This is a sum for changes in material, equipment and labor-related costs.
[6] The figure summarizes the net rent income from the period between accelerated and actual completion.
[7] The figure summarizes the other cost items per method (time and direct costs and earlier incomes).
[8] The abbreviation refers to Finnish mark; one FIM is equal to CAD 0.29, USD 0.22 and XEU 0.17 (about).
[9] The method covers only the part of design which is done after launching the site (cf. method 2); it does not shorten the overall duration of the project but is prerequisite for the implementation of some other methods.
[10] The figures consists of, for instance, partial savings in copying costs of drawings (half) while the costs of information technology are not taken into consideration here.
[11] The examination covers only the part of design which is prior to launching the site (cf. method 1).
[12] Acceleration is 18 days if the risk (of starting interior work before the shell was water-tight) is accepted as was done on site; by not accepting that risk, the saving is 2 days at minimum.
[13] The figures would change if the method were applied to the 4th floor only (the figures in parenthesis).
[14] The first three floors to handover were even 22 working days ahead the actual schedule.
[15] The figures are not arithmetical sums due to the overlapping effects of method 7 and methods 3 and 6 which have been taken into account, and also due to mathematical rounding up.

equal to 3 % of the total costs calculated on the basis of publicly available cost information (Haahtela et al., 1995).

The cost reduction has to be related to the value added on site, which was just over 10 million mark. Thus, **the cost reduction would be about 10 %**. In consideration to the average (site) construction time of 14.4 months, **the calculated time (7.2 months) is 50 % shorter**.

The conclusion can be drawn, that there is a major further potential for speeding up the building process and making it significantly more efficient. On the other hand, these **calculations do not cover all the improvement potential incorporated in design and construction but are only illustrations of measures that can be taken to start with.** In addition, the possibilities of improvements in the whole supply chain can be taken into full consideration. Thus, it must also be realized that in the longer term, the potential is considerably greater.

Concluding remarks

A review of the improvement means used denotes that the principles which were presented as conditions for innovation, also yielded process improvements. Better integration of design and construction, i.e. both in the meaning of constructibility as well as production planning conditions, and the scopes of liability chosen to minimize interdependencies, seem to be beneficial in every way. This concerns not only the project as an entity but also the subcontracts. Due to the absence of the need for big investments and corresponding risks and due to the preferred sequence of improvement and innovation described above, the superiority of the "improvement approach" becomes clear.

Admittedly, it can be argued that the method of cost reduction calculation is artificial, at least from the client's point of view; the cost reductions mainly benefit the contractor or subcontractors. However, when these improvements are used for competitive advantage, more and more of the firms are forced to implement similar measures, and over time the price level will reduce to reflect the true costs.

CONCLUSIONS

On the basis of the discussion above, we are inclined to draw the conclusion that **in an ordinary construction project, innovation is not, and should not be a concern for the client**. Instead, the crucial issue is to define the project so that it is efficient from the operations management point of view: achieving the realization of the facility with minimal waste and maximal value. The organizational solutions selected from this point of view are simultaneously conducive for innovation in the longer term.

The statement is not, however, unambiguous. The client's definite position as a primary actor creating the conditions to have (or not to have) success is recognized. Neither is the pursuit of innovation belittled. The key message is, however, that **the mechanism for innovation goes through setting the advantageous circumstances for an efficient process**. This way the benefit is available straight away since the organizational framework is similar.

There are a number of basic principles to be taken into account when a project is defined by the client:

- Organize the project so that there are no barriers to minimizing waste and value generation. Enough leeway has to be given for the main contractor (and suppliers) on technical solutions; also their early involvement to the process is most recommendable. Scopes of liability should conform to functional and production entities of the building instead of on labor based contracts (if the separate contracts system is used).
- Ensure that the parties selected for the project are capable and have waste-free processes. Should the implementers have more power over the design, etc., more consideration should be paid to their prequalification. Correspondingly, it is not enough to select parties based on price alone but the technological solutions offered together with other possible aspects of competition should be evaluated as well.
- Institute improvement in critical tasks of the project, if they are costly and take long enough. This can be done on a project-wise basis and especially in the case of repeated project developments. Then, it is worthwhile to aim at entering into partnering relationships which make it possible to improve the performance from project to project in a win-win situation.

Naturally, the project should be controlled by means of appropriate control strategies and tools. Besides, there is one more critical requirement for the client:

- Pay direct attention to your operations and consequent needs and requirements. Whether based on performance specifications or effective decision making, communicating the needs for the parties clearly and early enough is one of the key preconditions for efficient and effective implementation. In addition to requirements, a few desires — for which there is no known solution — work as stimuli for development and, moreover, lead to better serving facilities.

Of course the situation is different if there is a requirement in the project that cannot be fulfilled by means of existing technology. In that case, provisions must be made for organizing innovation (see, for example Westling, 1991).

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SELECTION OF PROCUREMENT PATHS FOR HIGHLY SERVICED HOSPITAL BUILDINGS

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Abstract

The procurement of complex and highly serviced hospital buildings is always fraught with expensive and complex problems of inadequate coordination of building services and hospital engineering services. These problems are detrimental to the success of hospital projects, and must be resolved by rational and professional project management from design to construction. "Complete" design is of paramount importance but cannot completely solve poor coordination problems. Issues relating to the client's brief, conditions of engagement of designers and contractors, division of design responsibilities, allocation of risks and early incorporation of specialist services contractors must all be considered in conjunction with the selection of an appropriate procurement route and form of contract. Research results from our case studies have indicated that there is no standard solution, or best buy amongst various building procurement paths. However, the use of an appropriate procurement strategy has a direct bearing on the success of a highly serviced project, and making this selection is difficult.

Introduction

This paper stems from research at Loughborough University, into effects of different procurement paths on coordination of building services for highly serviced buildings. This paper examines the complexity of services in hospitals and the need for their coordination. The paper also explains the development of coordination and procurement models and gives case studies and detailed analyses.

Hong Kong's rapid population and economic growth in the last 30 years have put strains on public services, including health and hospital care. Health care buildings must therefore be brought on stream quickly and with tight time scales and closely defined budgets to high quality standards. In addition, particularly for publicly funded projects, it is important that value for money is seen to be obtained. Furthermore, health care facilities must be designed so that they are suitable for future developments in medical technology and different modes of health care during their useful lives.

With the exception of the small clinics, most hospitals are large and complex buildings. In order to maintain the proper functioning of these special buildings, it is not uncommon to find more than 50 separate and distinct mechanical and electrical services and sophisticated hospital engineering services in these so called highly serviced buildings.

From our research, it has been identified that:

- hospital projects are costly and difficult to design and construct
- the problems and conflicts associated with the integration of building services are still more common than any other problems as found during the course of a project, and

though recognized for what they are, the coordination problems continue to persist in the design and construction processes.

- effective management of coordination of building services is a key to project success
- the procurement path selected for a project has a direct bearing on the success of coordinating building services but selection of an appropriate procurement path for highly serviced hospital building is not an easy task.
- selection of the design and construction teams can affect the success of a project.

The results of inadequately designed and coordinated building services can cause project overrun in time and cost, major monetary claims, unsightly services, lower quality and potentially difficult maintenance. Clients are therefore not entirely satisfied and all the blame falls upon the construction professionals. Therefore, there is a great need to study the impacts of procurement paths on the management of building services.

Most existing research is largely incomplete and does not fully investigate and address the missing element of the influences and knock-on effects of the procurement paths under particular circumstances. This vacuum area is of great interest to the authors and a research study has therefore been developed at Loughborough University since 1995.

Complexity of highly serviced building

Penn (1992) states that hospital projects by their very nature are complex in terms of multiple end-users, owing to the desire to incorporate the most up-to-date medical technology and modern hospital engineering services requirements. This complexity has resulted in a great deal of criticism of the inordinate time it has taken to design and construct hospitals and of the cost increase in the delivery of new hospitals. He seems to prefer the traditional procurement method to the design and build system, and he also cites the importance of strong project management in order to overcome these problems.

Wilkins and Smith (1995) have contended that the successful delivery of complex hospital building projects is closely related to the appropriate choice of building procurement methodology and they also suggest that a dedicated procurement management structure is required for each specific project.

Complex specialist building services now account for a greater percentage of the costs involved then ever before for modern hospitals. Nelson (1990) states that on average the cost for building services can be as high as 40-50% of construction cost. Despite the importance of the services elements, traditional practices from the drawing board to the construction site still fail to fully recognize the importance of integration and coordination of building services, and the importance of the use of an appropriate procurement path. Hence, it is commonplace for conflicts between services and other components of a building to emerge during construction. This is unfortunate, as the result is often an unnecessary waste of time and money. Coordination problems are well known in the building industry, yet they have not been fully resolved. As hospital buildings grow in size and complexity, these problems have become particularly acute. Obviously, to benefit clients and society, there is an urgent need to provide better management of design and construction processes while using the most suitable procurement strategy for the particular circumstances.

Background information on hospital building design and construction

Before exploring the selection of procurement paths, it is necessary to fully appreciate: (1) the complex issues of coordination of building services, (2) the choice of appropriate procurement methodologies, and (3) the characteristics of a hospital project. A large district hospital is no longer a simple building, but rather functions as a small town. A hospital must be suitable for the caring of the sick, hence the design of this type of building requires extraordinary considerations of special functions, medical techniques being employed, and the social and economic conditions prevailing at the time, as cited by Wong (1983). Most importantly, a hospital design must take into account its potential development in the foreseeable future.

Wong (1983) also highlights that services will affect the building structure and both the interior and exterior spaces, and that the analysis of the services requirements should be made as precise as possible. Also, architectural and structural design implications that arise from engineering decisions should be exhaustively examined as early as possible. By their very nature, services are complex and must be fully integrated and coordinated to ensure efficient operation and maintenance. As life lines, they must also be protected and kept in running order and be given sufficient reserves to cope with changes in demand, future developments in medical technology and modes of health care. It is, therefore, an essential requirement for project success that services are properly integrated and coordinated at both design and installation stages.

Another important aspect in hospital design is the interface management between hospital equipment/facilities and the various architectural elements, structural elements and building services elements. Kwok (1988), Gibb (1995) and Lam (1996) have all voiced the opinion that successful management of this task is of great importance, and there is a need for joint efforts from client, all designers and contractors.

To complicate the management of the coordination of building services for hospital projects, there are also other factors which must also be taken into consideration; the principal factors are:

- Wilkins and Smith(1994) have stressed that the problem of the multi-headed client (In a hospital project where the users are highly functionally differentiated and play a dominant role in the briefing process. Each of these users therefore has a narrow, specialist view, but demands an equal voice in the design of a hospital) must be recognized and managed from the very beginning of the project. Longer briefing process and design period are usually needed as design information from a multi-headed client is difficult to obtain during the early stage of the project. Also, this type of client can make changes to their area even during construction in order to cope with advances of medical technology, thus causing delays, disruption and additional costs. But changes are deemed to be necessary if the client's interests is the priority.
- Comprehensive briefing for hospital development is not usually available. Loosemore and Davies (1994) and Lam (1996) have all identified that a good briefing process is very important for the ultimate success of a project, as the greater the detail in the brief, the more accurately the designer will interpret the client's need and "complete" designs can be developed for smooth coordination of services, and adequate flexibility can be built in the design to facilitate changes, etc. in future.

- Technologically, hospitals are highly complex and require complete integration of diverse and intricate building services. Functionally they are equally complex, having to satisfy the disparate demands of the general public and the highly trained staff that operate the facility. The functional performance requirements are such that the quality of construction has to be exceptionally high. For a perfect hospital, building services must satisfy the hospital's functional requirements. These, however, follow developments in clinical practice and changes in medical technology and this means that the target is constantly moving. Hence, hospital design should be flexible, but making a completely flexible design is difficult and expensive.
- Hospital design and construction demand many participants, experts and others, and they have to be managed and controlled effectively. Project success can only be enhanced by engendering a team spirit; and a high degree of cooperation between project participants is essential.
- Designers and contractors should have "hands-on" experience of hospital projects. Previous experience and feedback information significantly improve the coordination of building services, hence employment of competent professionals is highly desirable.
- The significance of project accountability and the need to procure buildings within tight timescales and closely defined budgets to high quality standards for publicly funded hospitals will have a profound influence upon the selection of designers and contractors, and coordination of services at both design and installation stages. However, most hospital projects are still based on a traditional procurement path which still does not fully meet clients' needs.
- Last but not least, the allocation of design responsibilities for building engineering services must be fully recognized as Parsloe (1994) contends that the successful completion of a project is only possible when there is a resolve on both sides to work together to produce the best possible solution, i.e. coordination of services design and installation. He also concludes that ambiguity over design responsibilities can become the cause of serious conflicts resulting in project delays, increased contractual claims and increased litigation. Also, problems on complex hospital projects tend to concentrate around the interfaces and therefore interface management is extremely important (Gibb, 1995).

The term of procurement path

This paper refers generally to procurement path, rather than procurement method or procurement system as 'Procurement' is the act of obtaining/acquiring or securing. For this research, procurement is defined as the framework within which construction is brought about, acquired, or obtained. It can also be seen as an organizational structure adopted by the client for the management of the design and construction of a building project.

Need for coordination of building services

Engineering services systems are the life lines of a health care building as the proper functioning of a hospital depends on the proper and efficient operation and maintenance of all these services. For this reason, hospital engineering services should be properly planned, designed, integrated, coordinated, installed and commissioned. Hospital buildings

never rest placing a high dependence upon engineering services and hence a heavy premium on their proper design, installation and maintenance.

For the building services to be successfully and adequately incorporated into a building project, the choice of the correct procurement system is of paramount importance. The choice of building procurement paths available is now so wide that the need to carry out the selection process in a disciplined and objective manner should be self-evident.

Coordination model

To assist the evaluation and selection of a particular procurement path, the authors have evaluated many of the coordination problems and requirements for project success, and developed a simple model based on our previous research into the coordination of building services for highly serviced projects.

A conceptual model is considered to be a useful tool which promotes better understanding of the interrelationships among all coordination issues or variables in relation to the management of coordination of building services. This model (as shown in Fig. 1) is capable of illustrating the dynamic nature of the coordination process and the essential integration of all technical; social; organisation/structure and managerial components as well as their interactions with the environments.

The model sets out to illustrate that;

- effective coordination of building services demands maximum inputs from the clients, design teams and all contractors;
- it is essential to have 'teamworking' in design and construction;
- it is essential to have a complete design which is fully integrated and coordinated and all interface problems must be organized and managed;
- adequate time and resources, knowledge and hands-on experience for management of design and construction;
- effective project management of design and construction must be advocated by all parties;
- all parties are working towards the same goal, i.e. a successful project;
- appropriate contract terms are chosen which are fair and clear to all parties concerned.

Though simple, this model is considered to be detailed enough to assist evaluation and selection of an appropriate procurement path for a particular project. It is, however, not advisable to make a final selection of a procurement path based on this coordination model alone, as the characteristics of each procurement path will affect the coordination of services differently. It should be understood that, while on the majority of projects the use of one procurement path will normally ensure that the client's needs are satisfied, on larger and more complex projects it may be necessary for several of the methods to be used in combination. Therefore, a framework is, needed to assist a systematic evaluation of procurement path.

Procurement of building services and building construction

For the specialist building services to be successfully and adequately incorporated into a building project, it is necessary to give special attention to project management from design to construction, i.e. the procurement path.

Our research reveals that selection of procurement paths for any but the simplest project is difficult owing to many variables and the range of options available. To make an appropriate choice, criteria affecting decision making must be fully established and evaluated.

Despite considerable research into the choice of procurement methodologies for construction projects, most focus on strategic issues and neglect the implication of building services elements. Other research has ignored building procurement and concentrated on either services design or management of construction. It is rare to find a detailed analysis of procurement paths on the vital aspect of coordination of building services.

From our preliminary research results, it has been identified that selection of the best procurement path for a highly serviced building is in each case largely a function of the following functional factors which include; client, design, construction, contract, project characteristics and project management.

The functional approach is therefore based on all common factors to all construction projects. That is; (1) the main functions and the responsibilities of those involved in a building project; (2) the project characteristics; (3) the management of design and construction; (4) the contract form selected; the allocation of responsibilities for design and construction; (5) the integration of designers and contractors; (6) the project environment (external factors); and (7) time and resources provided for design and management. This functional approach is considered to be an useful tool which can be used in studying different forms of procurement.

At least 10 major functional factors have been identified which include:

Functional factors	Requirements
• Client	experience, briefing, decision making, funding
• Project characteristics	nature and complexity, cost, time, design, quality, change of needs
• Appointment of designers	completeness of services design and project information
• Design team	change from multi-organisations to single organisation, excellence in design, integration and supervision
• Construction team	change from mult-organisations to single organisation, excellence in planning construction and coordination
• Management	professional project management
• Contract/risk	fairness, clear responsibilities and balanced allocation of risks.
• Teamworking	without adversarial attitude and working in harmony
• Project environment	an influential factor from outside, design and construction must cope with this as best as they can

- Time and resources sufficient and appropriate

Having established the requirements of these functions, it is logical to view the building procurement as a system based on "System Thinking" and devise an objective Coordination-Procurement System Model as detailed below:

Sub-system	Characteristics
• Client	comprehensive brief, be decisive, and have efficient communication
• Project characteristics	complexity of building and building services, uncertainties in construction activities, and changes are needed to satisfy customers
• Appointment of designers	full design information and site supervision
• Design team	experienced and knowledgeable in integrated design and coordination of services, Total Quality Management (TQM) is important
• Construction team	experienced and knowledgeable in construction and coordination of specialist contractors, TQM is important.
• Management	professional project management, good interfacing, coordination and effective resolution of conflicts, TOM is important.
• Contract/risk	unambiguous design and construction responsibilities, obligations and rights/fair sharing of risks
• Teamworking	coherent and interdependent organisations with effective integration, mutual trust and cooperation
• Project environment	gradual change and gentle impact
• Time and resources	adequate for design, coordination and construction

It is also thought, by using this Coordination-Procurement System Model and the Coordination Model previously developed, systematic evaluation of a particular procurement in relation to the coordination of building services can be carried out more comprehensively and easily with only one model. However, in the meantime, the basic model can be used:

- to improve the outcome whatever the procurement strategy
- to select an appropriate procurement path based on a functional approach
- to analyse all sub-systems in relation to management of building services design and construction

The development of this Coordination-Procurement System Model based on a qualitative approach gives a unique and structured framework of reference which enables an objective appraisal, identification and comparison of various procurement methods for highly serviced building projects. It must be noted that the model does not attempt to give a direct answer to the selection of procurement path, and in fact, it would be wrong to have this concept as procurement is a complex issue and necessitates detailed evaluation for each case.

As seen from the sub-systems in the model, the procurement path for a particular project is thus seen to be an important strategy as the selected path must satisfy all, i.e. clients, designers, all contractors and also meet the particular project constraints. This is obviously a difficult task since no single contract strategy can satisfy all parties in a contract. Furthermore, the selection of procurement paths for any but the simplest project is difficult owing to the many options available. There is no short cut to the selection of an appropriate choice and all criteria affecting decision making must be fully established and evaluated in relation to the complexity of the highly serviced project.

Preliminary study of procurement path

To test the models, the authors have examined several large hospital projects using various traditional procurement paths with or without nominated services sub-contractors(NSC). For this paper, only two large hospitals owned by the same client (Case 1 and 2) are to be discussed. Coordination of services in Case 1 is unsatisfactory, but the result of Case 2 is considered very satisfactory. The analyses can be summarized with reference to the Coordination Procurement Model as detailed below:

Case 1 (traditional path with NSC)	*Case 2 (traditional path with NSC)*
Client	
Inexperienced client, multi-headed client problem, unclear brief and requirements, late decisions and too many changes. No feedback from previous projects.	Same client, improves project management based on lesson learnt from Case 1. Effective organization of multi-headed client, good brief and detailed requirements, changes are well managed.
Project characteristics	
Complicated building, building services and hospital engineering systems, construction period is unrealistic. Many uncertainties in construction.	More complicated than Case 1, construction period again is very tight but site condition is not so onerous(due to good management)
Appointment of designers	
Conditions of engagement are based on normal service. Coordination drawings are not provided by designers.	Special conditions with provision of detailed coordination drawings and information and site supervision.
Design team	
Experienced hospital planner and engineers from a single organization, powerful architect overrides services engineers. Inadequate site coordination initially.	Experienced hospital architect with M&E services consulting engineer, good working relationship with equal status. A special team has been set up on site.
Construction team	
Inexperienced and lack of management of services, no provision of coordinated services drawings. Adversarial attitude.	Experienced Japanese contractors. Sub-contractors have no experience in hospital projects, but they have good management of services, plus provision of detailed coordinated services drawings.
Management	
TQM is missing in the designer's design. Contractor and sub-contractors have inadequate project management.	Good management in design team, Japanese management by main contractor. Good support from sub-contractors.

Contract/risk	
Unclear contract document and ambiguous requirements of coordination of services	Improved contract document based on lesson learnt from Case 1. Special requirements of coordination of services have been spelled out in detail.
Teamworking	
'Inadequate' in design team but very bad in construction team.	Overall, very good building team.
Project environment	
Harsh, all tendered sums are low.	Better than Case 1, competition is still high.
Time and Resources	
Sufficient time but inadequate resources for coordination by main contractor, resources for coordination by sub-contractor have not been allowed in tenders.	Still unrealistic contract time, but sufficient resources for coordination by all contractors

The authors have used the procurement model to study the impacts of other non-traditional procurement paths on the management of building services. The research results also reveal that the approach is workable. However, there is a need to combine the procurement model with the coordination model (Fig. 1) so that more detailed evaluation can be obtained.

Analysis of case studies

The case studies have also been examined in relation to the characteristics of the procurement path selected. Inherently, traditional building procurement does not create a spirit of team work and is therefore counterproductive to integration and coordination between various participants. In Case 1, because of the adversarial nature of the traditional path, the construction team is not working in harmony. As seen from the analysis, the obvious causes of project failure are inadequacy in a) client's involvement, b) detailed design information, c) site management of all contractors, d) contractors' cooperation and e) overall project management in all technical and managerial issues. Whilst in Case 2, owing to the feedback from Case 1, the same client has learnt a painful lesson and is prepared to rectify all root causes. Significant improvements in all technical and management issues, as depicted in the coordination model, have been adopted and managed quite successfully. The most important factors of project success are good teamworking and excellent management offered by all the parties. Obviously, special attention has been given to coordination of services right from the beginning to the end of this project.

These two case studies (and many others - data not shown) have demonstrated the applicability of the model, which, however, is bound to be influenced by subjective judgement. This however should not be seen as a weakness as human experience is a useful form of feedback and this should help in the selection of a particular procurement path. They have also illustrated an important fact that the same procurement path can be unsuccessful in one project, but can also be successful in another case.

To sustain this study, the authors have also carried out an in-depth study of another large hospital, again using the traditional procurement path. Initially, the result was found to be

totally unsatisfactory in terms of planning, design and management. To rectify the problems, the client has re-selected the project architect and a project management team is being introduced as the client's project manager. This project manager uses a total quality management system in the management of the project and the outcome is a better design and a good quality hospital. The services again are fully integrated and coordinated during the design and construction stages, and this project success has demonstrated that coordination can be managed technically and managerially. The procurement pattern is not the only critical factor. However, a procurement path can influence teamworking which can affect the outcome of a project.

For a new project, the model can be used to analyse each of the sub-systems in relation to the management of building services design and installation and the most appropriate procurement path can be determined after the evaluation process. However, the use of both qualitative and quantitative approaches may be necessary to overcome a particular method's limitations and weakness. Based on the research findings, it has been identified that no single method of procurement is suitable for every project all of the time as the project characteristics and the members in the design and construction teams vary from project to project; the use of a particular procurement route can achieve a higher level of project success and overall performance. Furthermore, it may be necessary for several of the procurement paths to be used in combination for large and more complex projects. One thing is sure, project success can be achieved by the use of both traditional and non-traditional procurement paths and through the use of effective project management.

Conclusion

Coordination of building services has a direct bearing on the success of a building project. Services must be fully integrated and coordinated. The way in which many clients and their advisors select the methods used to control the design and construction of their highly serviced building projects, i.e., the procurement system, can be haphazard, ill-timed and lacking in logic and discipline. Selection of a procurement method is difficult, but the coordination-procurement system model developed can be used to help select a procurement method with due regard to coordination of complex engineering services. However, further improvement in this modelling is required from the viewpoint of quantitative analysis for better results. It is anticipated that the outcome of the research will allow better advice to be provided to the building industry.

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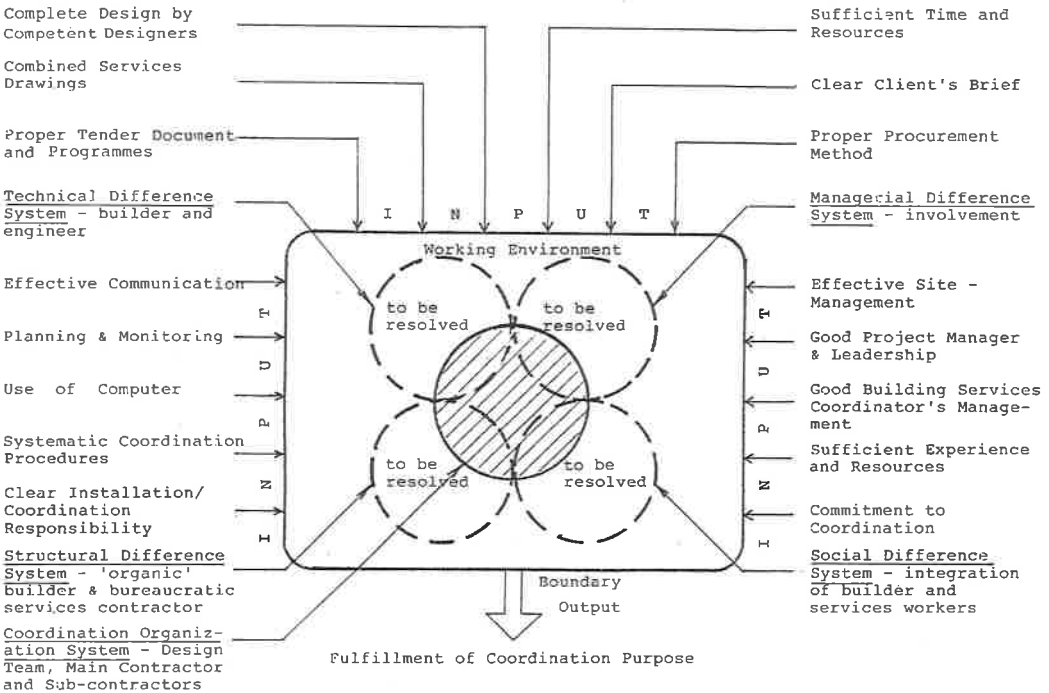

Figure 1: Coordination Model

This Coordination Model consists of five sub-systems, i.e. Technical Difference; Managerial Difference; Structural Difference; Social Difference and Coordination Organization. To achieve project success, all these differentiations must be managed and minimized with all inputs and good teamwork spirit.

QUALITY ASSURANCE AND CONSTRUCTABILITY IN PROCUREMENT OF HIGHLY SERVICED BUILDINGS

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Abstract

Building procurement for highly serviced buildings is a formidable task in today's construction industry. Designers and contractors must satisfy the needs of their clients and produce high quality buildings which are value for money. To achieve this goal, the building professions should consider procurement selection strategy in conjunction with the application of Total Quality Management (TQM) for quality attainment. The paper discusses the importance and relationship of quality assurance and constructability in conceptual planning, design and construction of highly serviced buildings, and gives a Quality-Procurement Model for selection of procurement path based on TQM thinking.

Introduction

The contents of this paper form part of the research being conducted at the Loughborough University, in order to identify the most appropriate procurement path for highly serviced buildings and also to develop a research model that can assist selection of building procurement with particular emphasis on management of building services. The research is still on-going; however, preliminary research findings have indicated that the latest thinking regarding quality assurance, constructability and TQM does have profound influences on conceptual planning, design and construction of buildings, particularly for complex and highly serviced buildings like hospitals, large hotels and intelligent sky-scrapers, etc. in modern cities.

Building services design and installation

Building consists of three major parts, namely: building element, structural element and building services elements. As soon as a building is occupied, its dynamic services will undergo many changes in order to cope with the users' needs during the useful life of the building. Obviously, to satisfy the ultimate customers' requirements, services must be totally planned and managed during the design and construction processes so that all mechanical and electrical services will:

- integrate with other elements to form a perfect 'whole' (i.e. building) and be properly coordinated for proper and smooth installation;
- perform satisfactorily in terms of maintenance of environmental comfort and provision of maximum convenience to users;
- operate effectively and use energy efficiently and be environment-friendly;
- be cost effective in terms of life-cycle costs; and
- be designed with flexibility, adaptability and manageability in minds.

Building services are not a single entity. They are made by the interventions of a diverse number of active participants, namely:

- the clients and end users who have influence on it;
- the designers who design and integrate the building and M&E services;
- the manufacturers/suppliers which design and produce the components and equipment; and
- the contractors who coordinate and construct the entire building.

Problems in building services engineering

By their very nature M&E services cannot be designed and installed independently as this vital element is interacted and interrelated with other elements in a building. Hence, close working with other building designers and contractors is necessary to produce an integrated building in which all the three elements are fully planned, systematically organized and combined and brought into a whole as required by the client, i.e. a perfect building with good design, high quality, short completion time and last but not least, reasonable cost. As buildings grow in size and complexity, services would also be more sophisticated. Obviously, if services are inadequately planned and managed by all members in the design and construction teams, many contractual/technical/management/ financial/human/quality problems will emerge. All these problems are detrimental to the success of building projects; hence, customer satisfaction cannot then be achieved. Surely, the building industry will be condemned for their poor performance and the professionals will blame one another for causing the problems. Indeed, the client will also be criticized by the industry too as he should also be responsible for some of the faults (i.e. poor brief/information, frequent changes, inadequate fees and acceptance of tender by cost instead of quality).

The aforementioned problems have all been examined by Barton (1978), Michie (1981), Kwok (1988), Pasquire (1994), Lam (1996), Gibb (1995, 1996) and many other researchers. In the context of building services, the problems can be broadly divided into three categories, namely:

- Technical Problem - this includes inadequate brief, inaccurate or inadequate detail of design concepts, lack of integrated/coordinated design, incomplete design/information, mistakes/discrepancies, impractical/complicated design and unclear design/construction responsibilities.
- Management Problem - this includes inadequate management in the client's own organization, inadequate management of design and site supervision, inadequate management of services installation and building construction, inadequate management of multi-organizations, poor communication and site supervision.
- Human Relationship - this can best be related to effectiveness of teamworking and cooperation. Adversarial relationship with 'them and us' attitude and differentiation of the operating units are critical factors.

The first two problems are all related to quality of design and excellence in management and they can only be tackled by professionals fully committed to the pursuit of good quality building. The human issue is difficult to overcome as the state of legal independence between participants and their traditional methods of working together are often an obstacle to adopting a team environment. To improve working relationship, a

cultural change away from the way (i.e." them and us") participants traditionally work in the construction industry is required. Obviously, for quality building to succeed, we must begin with a return to basics. This starts with the formation of a coherent project team, one in which the customer's interests are the interest of all involved. By satisfying the client's needs, all other team members are likely in turn to reach their individual goals. This concept appears to be "wishful thinking". However, the authors have already identified several projects using this concept. All these projects are considered very successful.

Co-relating Quality, Quality Assurance, Constructability and Total Quality Management

The word "quality" can have a number of different meanings. It can be defined from an aesthetic, functional or legal point of view. However, quality is synonymous with reliability and with excellence. As far as building construction is concerned, quality is the sum of: faultless building, punctual delivery, value for money and fitness for purpose.

Depending on who concerns and who is concerned, quality can be defined in various ways. Cornick (1991) highlights that the client has an implicit expectation of quality for his building, the designers have their own professional view of quality depending on architectural and engineering tradition, and the contractors and manufacturers/suppliers have to make commercial judgements about quality related to price. Apparently, all this serves to create confusion over concepts of quality.

The result of all this confusion and the inadequate management of design and construction processes is often a dissatisfied client, as faults have been developed in design, construction and building products as a result of the difficult problem of defining quality in the construction industry. From our analysis of research data, these faults, however, can be drastically reduced by implementing systematic quality management from the beginning of a project.

Quality Assurance (QA) is a systematic way of ensuring that organized activities such as design and construction processes happen in the way they are planned. It is a management discipline concerned with anticipating problems and creating the attributes and controls which prevent problems arising. Thus, the requirement of QA places great responsibility upon the four main parties involved:

client	- quality of briefing
designers	- quality of design process
contractors	- quality of building services installation and construction process
manufacturer	- quality of products

Implementation of QA solely within the domains of responsibility of individual participants is a must but will not necessarily enable them to achieve quality on the construction site. Therefore, for efficient building construction, an overall QA system must be implemented and appropriately interfaced between all parties involved in order to achieve more effective planning, improved management, better design, improved building process and quality, better cost effectiveness, and fewer delays and disruptions.

Also, various procurement methods available will have different implications and impacts on the relationship between the four parties and the performance of the project. Hence, the choice of an appropriate procurement method as an integrated part of quality attainment should also be carefully considered.

Constructability is a system for achieving optimum integration of construction knowledge in the project delivery process to achieve maximisation of project goals and building performance. It is an approach that links design and construction processes which have traditionally been isolated in the industry. There is little doubt that good constructability can result in tangible financial benefits for the client, as it can lead to more straightforward design and low development costs for the designers, and produce simpler construction and lower production costs for the contractor. Hence, the client should seek to consider carefully and implement good constructability and use the best procurement system in pursuit of a quality building.

Construction projects are becoming much larger and increasingly complex, and each of the design and construction process involves a chain of activities which involves many people and organizations. Many design and construction faults or problems would emerge if there is a lack of quality management from the client, designers, contractors and the manufacturers. The effects of this deficiency often result in building defects; poor quality of work and consequently high maintenance costs; high level of variations and uncertainty of cost; high incidence of claims and often late completion of work. Griffith (1990), Griffith and Sidwell (1995), Kumaraswamy (1996), Colin, Langford and Kennedy (1996), Lewis and Atherley (1996) and other researchers have identified many problems in buildings which are related to failure in quality of design and construction. From our analysis, these problems can be found to stem from:

- Client - inadequate brief; lack of information or decisiveness; unrealistic time, cost and quality targets; too many changes and unclear responsibility and risk allocation.
- Designer - inaccurate or inadequate details of design information; incorrectly specified or misused materials or components; inadequate coordination between client/designers; lack of design empathy for construction; inadequate contract document; inappropriate contract type, inadequate site supervision; poor interaction between client/designers and contractors; and lack of professionalism of project participants.
- Contractors - unrealistic tender pricing; inadequate planning and management; lack of competence of project participants, inappropriate contractor selection, inappropriate contract form, inadequate coordination between designers and contractors, poor communication; inadequate supervision and unclear or unfair risk allocation.

All these problems are detrimental to the success of building projects and must be overcome and avoided. For a quality building project, an overall quality management system must be traceable across the total building process that assures quality from top to bottom, i.e. client to suppliers. In this respect, Total Quality Management (TQM) provides a good environment for achieving this objective. TQM is different from QA in that it is a corporate philosophy founded on customer satisfaction, rather than a supplier procedure (Drummond, 1992). Customer satisfaction and continuous improvement are the fundamental goals of TQM. Building construction is a 'people' activity demanding a high level personal skills from the conception of the design and throughout construction with extended ability requirements in terms of problem solving. TQM in this regard must relate

to all concerned with the building project, whether they be individual or a party of the design and construction teams.

TQM differs from the traditional approach to management insofar that TQM extends the basic requirement for an administrative system to a wholly strategic approach. This style of approach encompasses matters relating to people, to cultures and to patterns of behaviour where personal skill, motivation and initiative are considered to be fundamental prerequisites to successful achievement, and therefore TQM is demanding of personal commitment. Moreover TQM is a corporate strategy concerned with the business as a whole and not factions of it.

As is well-known, the construction process involves a number of parties (i.e. client, designers, contractors and suppliers) receiving a product or service one from the other. If they all achieve improvement in their own businesses, the result would be the overall quality improvement. Obviously, total involvement of all people/parties; total commitment; customer and supplier working together; and objectives, standards and systems as well as selection of building procurement path are essential and inevitable for achieving good quality building. It is also clear that without teamwork spirit, leadership, trust, shared vision, commitment and cooperation at all levels, it is impossible to work towards the common goal - customer satisfaction.

In reality, the coordination of all the separate management processes which go to make up TQM is difficult to achieve in building construction due to the nature of the works. Difficulties can arise as a result of:

- complexity of the layers of internal and external customers involved in a single project;
- lack of compatibility between members of the various teams;
- inappropriate choice of procurement arrangement;
- conflict of interests and differences in objective;
- the state of legal independence between participants;
- widely diverse nature of the building industry, the naturally occurring and imposed constraints; and
- differences in culture and the variances in patterns of behaviour.

All these characteristics would hinder any attempt towards containment and can introduce complexity and over-sophistication of a TQM strategy and therefore must be avoided. To implement TQM successfully, the building industry should adopt reengineering and emphasize teamwork and partnering (short or long term) between participants, and use the best procurement path to accomplish the requirements of the client.

The effect of procurement method on quality

Though the research is on-going, it has been found from the results obtained so far that there is a correlation between the type of procurement adopted and the quality to be achieved.

Burt (1978) does not consider that the impact of a contracting arrangement on quality is critical, but he agrees that in particular circumstances one arrangement may offer advantages over another.

Griffith and Sidwell (1995) have however recognized that the method of procurement has a profound influence upon quality and therefore the procurement system must be carefully chosen.

Holness and Osborne (1996) have also agreed that the various procurement methods available have different implications on quality and they contend that the choice of contracting arrangements is an integrated part of quality attainment, but not the determining factor.

Our research findings have indicated that the procurement method is a crucial factor for attaining project success. The research identifies the importance of working in harmony and the good management of design and construction, and concludes that without this good management, building projects can never be brought to the satisfaction of the client. However, effective management of design and construction will rely on good teamworking which are ingredients of a TQM, hence, the authors strongly argue that quality attainment would be influenced by the building procurement path since any one procurement strategy would have a direct bearing on the performance of the client, designers and contractors under a particular project environment.

In order to examine the correlation between quality attainment and use of a particular procurement path, it is thought necessary to study this with the help of a research model.

Based on our research on procurement method for highly serviced buildings, we have made use the Coordination-Procurement Model (Lam, 1996) and developed a Quality-Procurement Model (QPM). The QPM gives a framework for a better understanding and analysis of TQM and procurement path working together, and is able to facilitate appraisal and comparison of different procurement methods in relation to quality assurance. The model encompasses functional requirements (i.e. sub-systems in the model) in terms of resources and time required for management of design and construction processes; knowledge and competence of the design and construction teams; management issues; contractual matters and human factors which are all shown below:

Function	Quality- Procurement attributes
Time constraint	• sufficient time for provision of complete design information • contractors' preparation of works, i.e. planning of all works, coordination of services and building construction • satisfactory execution of the whole project within a realistic contract period
Resources	• adequate funding for design and construction and realistic tender pricing • adequate resources for preparation of client's brief, design and construction by all parties involved

Competence and professionalism	• competent design and construction participants of the right calibre and experiences
Managerial control	• good design management for the integrated design team based on TQM • effective and flexible project management during the construction stage based on TQM • creation of teamworking with good leadership and partnering relationship • effective and structured management of project information
Contract arrangement	• unambiguous contract with fair contract terms based on TQM • fair and clear risk allocation • creation of equal status
Vision	• commitment to project success • trust • every one is satisfied (not just the client)

Research methodology

The overall research methodology comprises a comparative study of project performance in Hong Kong, using in-depth case studies for selected projects which are highly serviced buildings, i.e. the building services account for about 40% of the total building cost. Details to be investigated and analysed in each case study are:

- project characteristics
- management of design
- management of construction
- teamworking
- quality of overall project
- project success or failure factors

For this research, ten samples are considered both manageable and large enough for analysis of the research topic.The authors have made use of the QPM to examine several highly serviced buildings and have made comparisons with other researchers' data. For this paper, we will only discuss five case studies and they are detailed below.

Case 1 - Traditional procurement, large and complex hospital.
Project result is unsatisfactory
Reasons:

- client - inadequate brief, poor communication and too many changes.
- designers - inadequate design information, design errors, difficult design, inadequate site management, inadequate and unclear contract documentation and lack of professionalism of project participants.
- contractors - inadequate construction and coordination information, lack of site management, errors, inappropriate contractor selection, poor communication, lack of competence, professionalism of project participants and adversarial attitude.

The failure of this project is mainly due to unclear contract documentation concerning coordination of services, inadequate management of design and poor management during the construction stage. Selection of contractor is also unsatisfactory. However, the root cause of the project failure lies on the adversarial attitude between contractors and the lacking of teamwork spirit.

In this case, the traditional procurement method appears to be inappropriate and fails to achieve quality in design and construction. The reasons are:

- tenders are obtained on the basis of an incomplete design, i.e. inadequate management of design.
- poor working relationship/communication between the design and construction teams as a result of the confrontational nature of this procurement system.
- inadequate management of construction.
- lack of QA.

The obvious cause of failure is the poor control of nominated services sub-contractors which is an inherent weakness of the traditional procurement system. However, it does not automatically mean that the traditional system is not a workable system.

Case 2 - Traditional procurement, large and complex hospital

Project result is deemed to be satisfactory eventhough there is delay in completion since the client's target date is unrealistic.

Reasons:

- client - good management, complete brief and structured communication system.
- designer - adequate design information, extra coordination work, good site management, clear documentation, effective communication with all participants and good professionalism of project participants.
- contractors - adequate planning and management (Japanese style), well planned coordination work with all contractors, effective communication, competence of project participants, quick resolution of problems and good teamworking.

Notwithstanding the use of a traditional procurement path, case 2 has demonstrated the impact of effective management of design and construction on the project. The other reasons are that all participants are working toward a common goal with high teamworking spirit. There are of course problems in this project; should all contractors have belonged to the same organization, perhaps the overall result would be even better. However, one thing is sure that TQM improves outcome of this project significantly.

In theory, the traditional procurement method does not always give satisfactory result. However, in this case, this procurement turns out to be a very satisfactory system. Obviously, all the demerits of this procurement method, i.e. incomplete design, poor working relationship, poor coordination of services contractors' works and poor communication between the project teams have been tackled by effective management of design and construction and well organized control of nominated sub-contractors.

Case 3 - Traditional procurement with project management, large hospital complex

Project result is not satisfactory initially; however, with the introduction of project management, there is significant improvement in project result.

Reasons:

- client and designers - before use of PM - inadequate management, planning and design.
- all parties - with strong PM and QA management system, there is significant improvement in project result.

Again, the success of this project lies on provision of adequate quality management of design and construction, especially since there is a professional construction management team in this project which manages management and creates teamworking.
Similar to the case 1. When there is a lack of management of design and construction, the traditional procurement method will not work satisfactorily. However, with the aid of an efficient project management system, there is significant improvement in the overall project result, i.e. from design to construction. Again, good teamworking and TQM system have been identified to be important ingredients in attaining this successful project. It is clear that the traditional system can go wrong easily if there is inadequate project management. On the other hand, the traditional system can be a workable system if special attention is given to project management.

Case 4 - Design and build procurement, a general hospital.
Project result - not fully known, but overall performance is satisfactory.
Reasons:

- client - very effective management and good brief.
- designer - competent client's advisors, clear documentation, adequate design information and good site supervision.
- contractor and designer - single organization, effective management, commitment to project success for getting more business and the existence of good teamwork spirit based on long-term partnering relationship.

Design and Build system has proven to be a very effective procurement method as long as there is strong project management of design and construction. Obviously, TQM system does exist in all parties of this project. Both the client and the D&B contractor have committed themselves whole-heartedly to the pursuit of a quality building. The contractor wants to sell the D&B expertise and the client needs to provide the hospital in 1997. They all work very cooperatively. Hence, the project outcome is a successful one.

Case 5 - Traditional procurement with project management, large convention infrastructure
Project result is very satisfactory. The project is very complex in design and construction programme is very tight. Services are very sophisticated and large in sizes. Both the design and construction teams have not much experiences in work of this type of special infrastructure, but the project can be completed on time and the building quality is high.
Reasons:

- client - effective project management.
- designer - good management of design and supervision of project.
- contractor - excellent management of construction and dynamic approach to meeting targets.
- contractor and designer - sufficient resources for management of design and construction, and there is very effective and efficient teamworking.
- TQM coupled with strong desire for project success.

Eventhough this project is based on the traditional procurement system, adversarial working relationship is hardly seen in this project and all domestic sub-contractors are working very cooperatively with the main-contractor as a united team. As the project is a very complex one, additional project management for both design and construction teams is considered an attribute to the successful management of all design and construction processes. Also, TQM system plays an important role in the project success.

From all our case studies, we have identified that the performance of a project can be influenced by:

- the procurement method chosen - for highly serviced buildings, the procurement method should give (1) complete design and construction information; (2) clear allocation of design/installation responsibilities for building services; (3) cooperative working relationships between all members of the design and construction teams; and (4) clear and fair contract documents.
- the use of project management - for complex project, strong management is required in the design and construction teams.
- careful selection of designers and contractors - good quality team members usually achieve better project results.
- understanding of the benefits of the Total Quality Management System - for improvement in quality of design and construction.
- realistic design fees and construction costs - low/unrealistic fees and tendered sums do not normally encourage complete design and good quality buildings.
- project programme - realistic period should be allowed for adequate planning, design and construction.
- attitude and motivation towards the pursuit of good quality project.

Reconciliation of case studies

Even with only five cases, it has been clearly demonstrated that good quality of management of design and construction is the most important factor in attaining a high level of quality. It is still a little premature to draw a definitive conclusion of the impact of the procurement method on the quality issue. However, from the authors' analyses, all results do suggest that the procurement method is not a determining factor but that the use of an appropriate procurement method for a particular set of project characteristics and environment, together with the most suitable management strategy would have a significant effect on quality attainment. Obviously, when teamwork is treated as a first priority, as called for in TQM, the non-traditional procurement methods would in theory give better results. However, this does not automatically mean the need for a design and build method of procurement, although this method has a distinct advantage over others in applying quality management to its process (e.g. better brief, simplified contractual arrangements, integrated design and construction, improved communication, increased operational efficiency, single project team and harmony in design and construction). As seen from the case studies (and from the authors' other investigation - data not shown), good quality could also be achieved through other methods of procurement such as traditional path with project management, Construction Management, Joint-Venture or other methods which all allow for a good teamworking spirit, and through the existence of a good team of professional designers and contractors. It is clear that management structures based on TQM approach for design and construction have considerable influence on quality of project. But contractual arrangements do have significant effect on the working of the building team in terms of contractual relationship; working relationship, management of design and construction processes. Hence, procurement must be carefully selected to achieve the best quality attainment.

Conclusion

Highly serviced buildings are complex and costly projects. The procurement of this type of building is always fraught with expensive and complex problems of complicated and difficult coordination of building services, higher design and construction faults and the difficulty in managing numerous contractors. These problems are detrimental to the success of a project, and must be resolved by a rational approach to the management of design and construction.

The building industry must respond to the needs of clients and give good quality of service and value for money. To accomplish this task, TQM should be used. However, for total project success one must also consider the selection of procurement method as the right procurement method together with the right team can give very satisfactory results. However, preliminary results suggest that the procurement method is not the only determining factor, but is an integrated part of quality attainment. Further research efforts should therefore focus on a better understanding of the combined effect of TQM and procurement as it is the authors' belief that they are interacted and interrelated and surely they bear a very close correlation.

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AN INNOVATIVE INCREMENTAL APPROACH FOR INTELLIGENT AUTHORING OF CONSTRUCTION CONTRACTS

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ABSTRACT

The current research project aims to provide a stimulus for innovation in the contract forming process that will help to improve efficiency and effectiveness during construction process by considering the client's objectives. The objectives of the research includes the introduction of a contract authoring environment which will provide customised solutions from standardised textual components to:

(1) reduce the problems arising from amendments to standard forms of contracts,
(2) increase understanding of the reasons behind the selection and use of model contract clauses,
(3) increase the awareness of the importance of risk apportionment and its analysis by providing a systematised decision making environment.
(4) accurately reflect the users' (both client's and contractor's) requirements.

The objectives have been established by considering the concepts supporting the formalisation of the NEC (New Engineering and Construction Contract) and the development of the knowledge base during the INCA (Intelligent Contract Authoring) project. This paper discusses the logic behind the innovative incremental approach that is expected to be utilised during the research, and the methodology required to be undertaken for the completion of the project.

Keywords : Intelligent authoring of contracts, knowledge based modelling, standard forms of contracts, risk apportionment, client's objectives

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INTRODUCTION

A major problem in the use of the standard forms of contracts is that they require to be amended frequently due to the changing construction environment. The aim of the current research is to develop a knowledge based computer model using the concepts supporting the formalisation of the NEC (New Engineering and Construction Contract), and Intelligent Contract Authoring, to:

(1) reduce the problems arising from amendments to standard forms of contracts,
(2) increase understanding of the reasons behind the selection and use of model contract clauses,
(3) increase the awareness of the importance of risk apportionment and its analysis by providing a systematised decision making environment.
(4) accurately reflect the users' (both client's and contractor's) requirements.

This paper firstly identifies the main problems related to the use of standard forms of construction contracts. The existing solutions to these problems are then discussed. Finally, an alternative approach to the solution of these problems is presented.

THE PROBLEM

The Latham Report (1994) states that the main strengths of the standard contractual arrangements (as stated by construction practitioners) are that they are well known within the industry and are unbiased towards any involved party. However, the use of new procurement methods, new technologies during the building process and changes in law affect the use of the standard forms of contracts and these are amended frequently (Latham, 1994). Five main problems which arise from amendments are discussed by Chappell (1991, p.6) and Brandon *et al.*,1993, p.6). These are:

"(1) Inconsistency of amendments with existing provisions.
(2) Unknowing transfer of risks as a result of incorrect phrasing.
(3) Interpretation of the amendment *contra proferentem* in the case of ambiguity.
(4) Ineffectiveness of the amendment as a result of the operation of the Unfair Contract Terms Act 1977, because the amendment is construed as an exclusion or restriction of liability.
(5) Important terms may be omitted."

Additional to the problems due to the amendments, there is a growing concern that standard forms of contracts lack any systematic or logical approach to the placement and control of risk (Uff, 1995).

Uff (1995) also states that contractual risk is a complex, many sided issue which has not been adequately analysed from the viewpoint of contract drafting. While the principles of risk placement may be clear, the way in which this is brought about in real contracts is usually complex. It is often difficult to ascertain which party is carrying what risks and to what degree.

It is also stated by Capper (1995) that the norm for construction projects is to postpone addressing uncertainties, leaving enormous discretion to be exercised in the future by those administering the contract. The author then states that it would be more beneficial to utilise more pro-active contractual strategies for the management of construction risks. It should be stated here that flexibility in the contract may be considered as a virtue in that it ameliorates the opportunity for entrenchment of views. However, precision in the apportionment and definition of risk has the clear advantage in that it may lessen the propensity to litigate.

EXISTING APPROACHES TO THE PROBLEM

Two recent approaches to the problems due to the amendments to the construction contracts are discussed by Brandon *et al.* (1993) and Latham (1994). While Brandon *et al.* (1993) state that the solution is to be found either by attempting to reduce the problems due to the amendments or by moving away from the standard forms towards new methods of producing contracts efficiently, the Latham Report (1994) shows that it may be very difficult for a contract to achieve acceptance if it is not produced through the industry's established procedures (such as the JCT and the CCSJC).

Latham (1994) states that both flexibility and familiarity can be brought to contracts if different modules are put together into a standard format and appropriate modules are selected by the mutual agreement of the client and the contractor. According to Latham (1994) the New Engineering Contract (although it needs some alterations) contains virtually all of the assumptions that the most efficient form of a modern contract should include. On the other hand Brandon *et al.* (1993) consider the benefits of Intelligent Contract Authoring in reducing the problems due to the amendments to the standard forms of contracts.

Brandon *et al.* (1993) state that Intelligent Contract Authoring which has been the foundation of the INCA project is "concerned primarily with enabling the authors and instigators of contracts for construction projects to translate their specific requirements more precisely into contract structures and instruments. The intention is to take standard forms of contract already familiar to these practitioners, put them into a computable form, and allow them to be used in a more flexible way than has been possible hitherto".

While these approaches are presented to provide a solution to the problems due to the amendments to the standard forms of contracts, no existing approach could be found to consider the problems of risk identification or risk management through the system of contracts (Raftery, 1996).

AN INNOVATIVE APPROACH TO THE PROBLEM

The aim of the current research has been to utilise a new method of forming and producing contracts which would not only decrease the problems related to the amendments to the standard forms of contracts but also would increase the understanding of the risk involved in the inclusion of various clauses within the contract. The new approach is discussed within the following paragraphs.

According to Skitmore (1989) client and contractor relationship is such that each decision maker tries to get the best deal. What constitutes a 'best deal' depends on the judgement of

the individual decision maker. But in general, the client will be looking for the contractor to provide the goods/services at the right price, while the contractor looks for providing the goods/services to the client at the right price (while what constitutes 'the right price' may vary depending on whose viewpoint is being considered). The two parties will be looking for a contract to provide an opportunity for them to get a 'best deal'. Thus, the 'the most basic best deal' may be stated as 'getting the work done' for the client and 'getting paid' for the contractor (with the responsibility for all risks being on the contractor). The 'one stop shop' approach to risk has attractions to users and is to some extent evidenced by the increase in the use of design and build (McLellan, 1994, Akintoye, 1994).

As a starting point, the proposed knowledge based computer model will provide the NEC based contract clauses (although there exist significant terminological and philosophical problems) related with 'the most basic best deal'. The required contract is then formed by the incremental provision of clauses which maximises the client's objectives considering the parties' desires and abilities to undertake the responsibilities, control the risk and accept liability. This will result in the formation and production of the simplest form of a contract compatible to need (refer Figure 1)

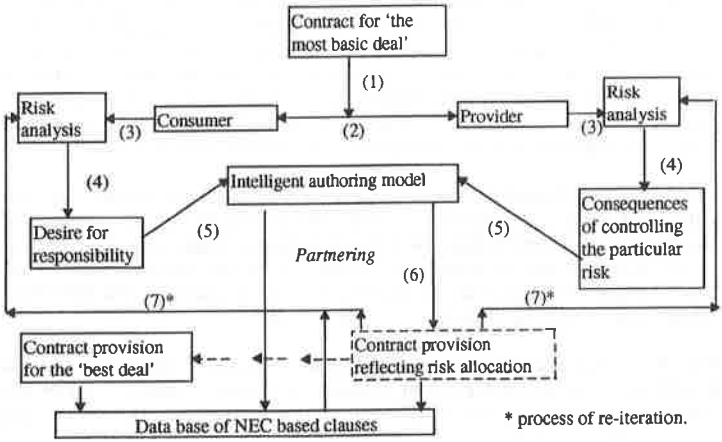

Figure 1. The logic behind the knowledge based model development

It is an established fact that each construction project is unique and as Kashiwagi *et al.* (1996) state no two individual (clients) or companies (contractors) have the same perceptions, capabilities and performance. As Capper (1995) states, contracts are to be viewed as adaptable tools to define the objectives of the project, qualified by its constraints. Thus, the new approach would help to provide a systematised decision making environment for producing customised solutions (a unique contract for each unique project environment) from standardised textual components (clauses, sub-clauses) by considering the client's objectives.

While the new approach may get criticism that it would lose the benefits of understanding and legal precedent that come with using standard forms of contract. However, the rationale for the customised contract solution proposed is that it enhances understanding, especially of risk transference.

THE CURRENT STAGE OF THE RESEARCH

Knowledge elicitation and knowledge presentation for the development of the model are divided into three main sections. These are classified as design related, time related and cost related. Different modules will be developed for the three sections. These modules will then be combined.

The knowledge elicitation stage for the development of the knowledge base model has been initiated. The first stage of the model, which is the knowledge elicitation related to the apportionment of responsibilities and risks related to design is currently being undertaken. A questionnaire survey is also being undertaken and 60 questionnaires have been sent to contractor and client organisations who are in the NEC Users Group. The aim of the questionnaire survey is mainly to get the contractors' / clients' point of view related to the design responsibilities and related risks.

The questionnaire was prepared by considering the issues dealt with within NEC related to design responsibilities. The issues raised during the questionnaire survey are related to the reasons behind the allocation of design responsibilities between the client and the contractor, the patent and copyright of design, design of equipment, limitations on design liability, variation and compensation, communication between two parties for design work and the use of contract clauses for different clients' objectives.

CONCLUSION

Despite the various strengths of standard forms of contracts (i.e. being well known by the industry, being unbiased towards any involved parties), problems arise due to the amendments and lack of a systematic and logical approach to the placement and control of risk. Different approaches for the problems arising due to the amendments to the standard forms of contracts have been identified. However, no existing approach has been identified to consider the problem of risk identification and risk management through the use of contracts.

The current research project is in its initial stages in utilising an innovative incremental approach to intelligent authoring of contracts to provide customised solutions from standardised components. While such an approach may get criticism in that it would lose the benefits of understanding and legal precedent that come with using standard forms of contract, the rationale of the customised contract solution proposed is that it enhances understanding of risk apportionment and accurately reflect the users' requirements.

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FEASIBILITY OF FAILURE MODE AND EFFECTS ANALYSIS IN THE CLADDING INDUSTRY

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Abstract

The procurement process in the construction industry is not as well developed as that in some other industries, for instance the automotive industry. The construction procurement process involves lengthy supply chains that go deep into manufacturing industries and the contractor is often not aware of the decision-making that occurs with regard to component and material selection. Conversely, decisions may be made in manufacture and supply companies by people unaware of the product's end use on the particular building.

This paper looks at the feasibility of implementing Failure Mode and Effects Analysis (FMEA) in the cladding industry. FMEA is currently used in the automotive and aerospace industries. The technique seeks to identify the effects of all selection/design/specification decisions and force the decision-maker to assess the impact of failure (in terms of cost, disruption etc.).

This paper describes a study of the supply chain for building envelopes and shows the structure of communication required to inform decision-makers at every stage. A pre-requisite for the successful implementation of FMEA is the decision-maker's access to project information and knowledge. Only then will informed and robust decisions be made about component selection and specification. This requires not only a vertical flow of knowledge but also horizontal communication regarding compatibility of components.

The paper concludes that an elementary form of FMEA is feasible and would lead to a large reduction in the costs of rework, delays and premature failure of facades.

THE CLADDING SUPPLY CHAIN

Cladding has a major impact on the integrity and service life of the building structure, and provides and preserves its appearance. The term cladding embraces a broad range of building envelope constructions including traditional fully-sealed and modern pressure-equalised cladding panels and more prestigious curtain walling (stick/unitised/panellised) and structural

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glazing systems. Some cladding is designed, manufactured and tested by system suppliers and packaged as standard systems for arrangement and fabrication to suit the building. Alternatively, a system can be designed, manufactured and tested specifically for a contract by a specialist contractor/engineer. Whether a standard or bespoke system is used depends on the type, complexity and budget of the project. Cladding systems comprise a large number of components produced from different generic materials, each with a multitude of individual types, available from numerous manufacturers. Cladding accounts for up to 25 per cent of the cost of a building.

The cladding industry encompasses a large number of specialist contractors of varying levels of expertise. Contractors are small in size compared with their main suppliers and customers (e.g. main contractors) but large in number.

The production structure for cladding is shown in Figure 1. The most fragmented cladding supply chain is shown, which is typical for small-scale, standard curtain walls (the largest market sector). The cladding system components are supplied to a franchised cladding contractor for arrangement to suit the building; the cladding contractor procures components that are non-standard to the system, produces a design that integrates all of the components into the system and fabricates components prior to assembly on site. If the proposed system is to be used in similar circumstances to the manufacturer's existing performance and test data, further verification that it will satisfy the project requirements is usually unnecessary.

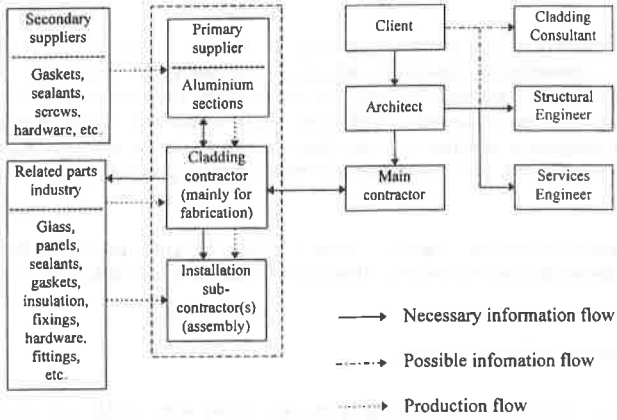

Figure 1. Communication/production structure for cladding (separate design, fabricate and install).

Two, less fragmented, supply chain models can also be distinguished and broadly relate to the type of cladding and size of contract:

- integrated system design/manufacture with sub-contract installation (e.g. medium-range bespoke cladding);
- fully integrated cladding contractor (e.g. high-end bespoke cladding).

The crucial function of the cladding contractor is one of 'integrator', both of the large number of individual components within a cladding system, and of the system as a whole with the building. This places heavy demands on a cladding contractor's management expertise of time and finances - demands which are compounded if the contract programme is unrealistic and/or contract information deficient.

CLADDING FAILURES

Failure is said to have occurred when a component or system does not function according to the design intent; a failure mode is the manner in which a component or system failure occurs. According to a qualitative survey of construction and cladding industry professionals, water penetration remains the most frequent failure mode of cladding; the buildability and durability of cladding are additional concerns, as shown in Table 1 (CWCT, 1997).

Table 1. Failure modes of cladding in order of occurrence rate according to survey.

1	Water penetration	9	Maintainability
2	Air permeability	10	Budget
3	Buildability	11	Acoustic performance
4	Durability	12	Security
5	Condensation	13	Thermal performance
6	Programme	14	Hygiene (resistance to vermin/rot)
7	Aesthetic	15	Fire performance
8	Structural	16	Environmental

A quantified study of over 100 cladding systems under test substantiates, in part, these findings. Of the 93 facade test specimens examined (excluding roofing samples), just 13 (14 per cent) satisfied the performance testing requirements of the project specification without requiring remedial work. The first-time-pass rates for static water penetration, air permeability and structural serviceability of 26, 86 and 92 per cent respectively, show water penetration as unequivocally the most common cladding failure mode under test (CWCT, 1997).

The five main cladding components/elements causing water penetration and subject to remedial work were sealants (e.g. window perimeter joints and infill panel butt-joints), gaskets (e.g. incorrect selection and poor sealing of corners), windows (e.g. poor mitre joints and locking adjustment), poorly sealed cladding frame connections, omitted/sealed drainage holes and redundant fixing holes.

Sealants, gaskets, glass and metal finishes are the components of cladding most likely to fail according to the qualitative survey (CWCT, 1997). Subsequent investigation revealed that these component failures are caused by inappropriate selection and use. Inferior quality components are also a cause of failure and their use stems from the lack of knowledge of, or detail from, the specifier or forced/deliberate attempts to reduce costs by the main or sub-contractor. In some cases, design or workmanship defects with other building elements have manifested themselves as cladding component failures.

The main underlying causes of cladding failure on a system and component level are summarised below:

Incorrect selection/specification
The four cladding components most likely to fail (sealants, gaskets, glass and metal finishes) receive too little consideration from initial selection to final use. For example, despite their low cost and fundamental role, sealants can be a low priority, an afterthought or even the target for cost savings. Specifications for cladding components can be incorrect or contain vague requirements that transfer decision-making to a potentially disreputable contractor to exploit and increase his profit margin; either scenario will greatly increase the risk of technical failure.

Poor communication
Poor communication can be symptomatic of commercial pressures or a lack of knowledge. Correct, complete and timely communication is crucial to successful procurement. Up to date cladding system information should be disseminated, and be readily available and discernible, to fabricators and installers.

Cost cutting
The culture of cutting capital costs is damaging to the cladding industry and is not in the client's long-term interests because it increases the risk of failure with repair costs out of all proportion to any initial saving. A change of culture would mean the best value-engineered solution is selected as opposed to the cheapest solution.

Subversion of specifications
Care in writing a correct and explicit specification may be all for nothing because of the problem of deliberate non-compliance later in the construction process in order to reduce costs. This can be reduced by a cultural change and effective supervision and inspection.

Installation errors
On-site practice was said to present the greatest potential for failure because of the lack of knowledge of installers. In defence of installers, they may be under pressure to complete the job or be required to build complex details, perhaps without proper installation manuals or appropriate drawings/instructions. In the UK, CWCT registered and certified installers have a known level of experience and expertise.

Fabrication errors
Fabrication errors - typically incorrect, or lack of, sealing and/or drainage provision - occur on both standard and bespoke cladding systems. The facilities for training cladding contractors already exist but are largely under-utilised.

Poor supervision
The low level and superficial nature of supervision has been widely criticised. All parties should take an interest in cladding installation because the standard of site workmanship can be improved by rigorous, knowledgeable inspection and supervision.

Poor motivation
Co-operation, not conflict, should exist between participants at all stages of the construction process. Site working conditions should be conducive to a high standard of workmanship and promote a regime of making sure every process is carried out satisfactorily for both internal and external customers.

Contractual pressures
Cost and time pressures can result in poor quality, regardless of training. Initiatives to assess and address the risk of failure at the design stage must not be compromised or sub-ordinated by commercial pressures later in the construction process.

FAILURE MODE AND EFFECTS ANALYSIS

Failure Mode and Effects Analysis (FMEA) is a systematic and analytical quality planning tool that was developed in the aerospace and defence industries to identify and prevent potential problems. It has been used in the automotive industry since the 1970s. Rigorous use of FMEA should:

1. Identify potential and previously unknown failure modes and all corresponding failure mode causes and effects;

2. Rank causes of failure according to likelihood (probability of occurrence and of non-detection) and impact (severity of the effects of the resulting failure mode);

3. Provide for problem follow-up and identify corrective action to be taken.

The sequential, formalised steps of FMEA are listed below:

1. Specify the part or process being analysed by name and indicate its function.

2. List each potential failure mode (e.g. fatigue or corrosion).

3. Describe the effects of failure (assuming the failure mode has occurred) in terms of what the customer might notice or experience in terms of system performance (e.g. draught, smell and poor appearance).

4. List every conceivable potential cause of failure corresponding to each failure mode (e.g. incorrect material used/specified, omission and over-stress).

5. List all current controls which are intended to prevent or detect the cause(s) of failure or the resultant failure mode (e.g. inspection and specifications).

6. Estimate on a scale of 1 to 10 the probability of *occurrence* of each failure mode, the *severity* of the effects of failure to the 'customer' and the probability of *not detecting* the cause of failure or failure mode before it reaches the customer. The final estimate assesses the capabilities of all current controls to detect the failure, assuming the cause of failure has happened; a ranking of 10 is given where it is unlikely to be detected. The product of these three estimates form the risk priority number (RPN). The maximum RPN is 1000 and the minimum is 1.

7. Recommend corrective actions to address those causes of failure with unacceptably high RPNs, together with the person responsible for their implementation. After the corrective action has been agreed, estimate the new RPN. The need for taking follow-up positive corrective actions is the key to yielding the potential benefits of FMEA.

8. Monitor the corrective actions and measures that have been taken for their effect on the incidence of failure.

The principles of FMEA have wide application with many possible extensions. As a result, each industry, or even individual company, tends to develop its own system and style peculiar to its own circumstances. In the automotive industry for example, FMEA is practiced by the vehicle assembler/manufacturer and the parts supply industry, in the latter case often as a mandatory requirement. For each component or production/system-assembly process, all potential failures are identified and a measured form of risk analysis used to prioritise corrective actions (e.g. design or process changes, increased quality control inspection) that address areas of concern.

IMPLEMENTATION

It is in the building owner's/occupier's interest that FMEA be used in the production of the building. Fundamentally, this means that those building elements that have a high risk of failure and/or have particularly severe consequences upon failure (in terms of cost, inconvenience, safety, security etc.) are given due consideration from the initial selection, specification, design and detailing of that element through to its production and incorporation within the building. The potential benefits are improved quality, reliability and durability of the completed works and a consequential reduction in life-cycle costs.

In the case of cladding which concerns us here (an instance of high risk and severe consequences of failure), FMEA could be used in the construction industry as a means for making more robust, informed decisions to reduce the risk of failure by:

1. Highlighting the potential effects of design decisions by identifying potential failure modes and failure mode causes and effects of cladding components so that no aspect of performance nor cause of failure remains un-checked (risk identification);

2. Evaluating the likelihood and impact of failure as a means to prioritising the importance given to components (risk analysis).

3. Managing the risk of failure by developing failure reduction strategies to avoid or reduce the likelihood (i.e. risk of occurrence and of non-detection) and/or impact of failure to acceptable levels (risk response).

Use of FMEA would lead to a greater level of consideration of high-risk components, regardless of size or cost. Potentially, FMEA would be used more thoroughly in the decision-making process to help argue the case for decisions regarding, for example, the type of cladding system, component or assembly method that yield cost effective risk reduction/enhanced performance.

The construction and cladding industries contain obstacles to the effective use of FMEA that do not afflict the automotive industry, where the technique has been widely established. The barriers are of two main types:

Barrier 1.
The information required to perform the technique, compared with that available;

Barrier 2.
The motivation within the construction industry to address areas of concern identified by the technique by implementing corrective actions.

Referring to barrier '1', to apply the FMEA technique effectively, it is necessary to obtain some quantitative figures for ranking the probability of occurrence of causes of failure; the other two risk assessments of the technique ('severity of effects' and 'probability of non-detection') are more subjective and therefore easier to rank.

The construction industry is nowhere near the stage where the probability of occurrence of all causes of failure can be calculated - this would require feedback to the design team when failure occurs which is not undertaken in the industry at present. However, information on the absolute and relative incidence of failure modes and causes of failure (CWCT, 1997) enables priorities for corrective action to be set, and consequently a simplified version of FMEA to be adopted:

- In the form of a framework for decision-making, that is, a list of questions to be asked of suppliers when selecting/designing components;

- As a list of prioritised potential failures to address by specific selection/design decisions (e.g. use of frame gaskets) and/or check during cladding installation; the latter course of action might show that, for example, it is crucial for the Clerk of Works to alert the architect if a sealant joint width is found to be incorrect.

Referring to barrier '2', it is important that FMEA is seen not just as an exercise or a catalogue of potential failure modes but as a tool for pursuing improvement; a thoroughly thought out and well developed FMEA will be of limited value unless positive and effective actions are taken to address areas of concern. Correcting the areas of concern of cladding identified by FMEA will entail addressing the underlying causes of failure and contributory factors listed above. Consequently FMEA, as a potential cost saver and tool for reducing failures, faces a number of industry/cultural barriers to implementation:

- FMEA demands resources 'up front' (but will save money in the long run). Its use therefore faces commercial pressure and requires the industry to accept change (e.g. a price increase, increased inspection/supervision) which will entail a change in culture or a long-term learning process so that every operation is undertaken satisfactorily for those who follow.

- The benefits of FMEA to the client are measured in terms of life-cycle costs. Unfortunately, the practice of life-cycle costing is not yet widespread within the construction industry. Moreover, the reduction in life-cycle costs that results, for example, from using a different cladding system (standard/bespoke), assembly method (site/factory) or component, or an extra clerk of works on site cannot presently be quantified. This relates to barrier '1' and means that additional capital costs to save overall costs are hard to justify to the client.

CONCLUSIONS

FMEA is similar to risk management, wider use of which is currently being advocated within the UK construction industry to improve out-turn costs and value for money, and reduce conflict and uncertainty in the construction industry (CIB, 1996). FMEA can have benefits in terms of technical performance (improved quality, reliability and durability), cost (reduced life-cycle costs) and time (less failures/rework) if applied to cladding. However, FMEA is too sophisticated a technique to be practised rigorously in the construction/cladding industries because quantified evidence of actual failures is not fully established. Furthermore, the industry's culture and fragmented structure (Figure 1) results in a lack of motivation and focus for improvement.

However, an elementary form of FMEA can be adopted in the form of a framework for decision-making, possibly based on protocols. Information on the incidence of failure modes and causes of failure can be used for advanced quality planning at the design stage and to facilitate effective supervision during installation (CWCT, 1997).

Further in-depth research on the actual causes of cladding failure and the cost of rectifying them is required before FMEA can be thoroughly practised and improvements fully realised. FMEA was developed in the automotive industry over time - the construction industry should take a similarly long-term view of how to improve.

A plan for implementing FMEA within the building design/construction process is currently being developed for a major building project in the UK and will be reported later.

ACKNOWLEDGEMENT

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THE INVOLVEMENT OF AUSTRALIAN OWNERS IN THE PROCUREMENT PROCESS

Dennis Lenard [1] and Anthony Sidwell [2]

Abstract

The high level of activity during the building boom of the 1980's has influenced the attitude of owners to the procurement of capital facilities in Australia. Studies have shown that the cost of construction during that time was around 20-30% more expensive and took longer than in some other countries, this influenced some owners to invest elsewhere. In the early 90's there were two major reviews, the New South Wales Royal Commission into the Building Industry that highlighted malpractice in the industry and the Construction Industry Development Agency which promoted reform. Tangible outcomes have been the development of new procurement procedures, particularly in the public sector where authorities have combined their buying power and developed (a) more organised approach(s) to procurement such as prequalification requirements. However a recent survey of owners by the Construction Industry Institute Australia (CIIA) reveals that few are interested in being involved with the process, rather expecting the industry to attend to its own innovation and development and rely on the competitive process to elicit the most effective bidder. Recent analysis by McKinsey & Co has benchmarked the Australian construction industry as one of the most efficient in the world, however research by CIIA into innovation in construction finds that the structure of the industry mitigates against real substantive innovation and that the recent productivity gains are likely to be ephemeral.

Keywords: construction, procurement, innovation, projects, task forces.

INTRODUCTION

The issue of the relationship between building owners and the construction industry was most notably addressed by the American Business Roundtable in 1983. When they expressed concern that owners were not getting value for money, they produced the cost effectiveness report that eventually resulted in the establishment of the Construction Industry Institute (CII) based at the University of Texas. The main objective of the CII was, and possibly still is, to build bridges between owners and contractors and to undertake research projects on mutually beneficial projects. A similar European CII (ECI) was established in 1989 with similar objectives and success. In Australia the Business Council of Australia in 1992 conducted an analysis of ten case studies of major projects. Their main conclusion indicating that a more active participation of owners in the construction procurement process is required.

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The Construction Industry Institute Australia (CIIA) was established in 1992 and has successfully addressed a number of issues in collaborative research projects involving participants from universities owner organisations and contractors. In early 1996 CIIA conducted a survey of 61 owners and contractors to find out their attitude to involvement in collaborative research projects. This survey was supplemented by an additional 62 interviews later that year. In addition the CIIA supported a research project investigating aspects of cultural change, particularly with respect to the role played by owners in driving innovation in the construction industry. Some of the findings are presented in this paper.

THE ROLE OF THE OWNER IN DRIVING INNOVATION IN CONSTRUCTION [3]

The project team

The importance of the project team must not be overlooked. It is, after all, the project team who is at the 'coal face' of the construction industry, and who often has direct control over the use of innovative or established products and practices.

In the past, the term 'project team' was used to describe a group of personnel drawn solely from the construction organisation, and there was little interaction between this team and outside organisations and particularly with the building owner. As a result, their efforts were solely directed at meeting the construction organisation's objectives which were often related to project profitability alone (Lenard, 1981) and provided little, if any, scope for innovation. More recently, the term 'project team' has been used to describe those parties brought together for the sole purpose of delivering the construction project. This might include the client (owner) or end user, the principal contractor, consultants, subcontractors and suppliers.

With such a diverse range of participants, the project team could provide an effective vehicle for success and innovation in the procurement process. However, investigations in this area indicate that this is far from the case. In the early 1990s the Business Council of Australia (BCA) commissioned a task force of senior executives to examine a series of case studies, aimed at identifying the factors contributing to the success or failure of construction projects. These studies revealed that a number of the issues (in the context of construction industry competitiveness) are deemed to be significant barriers to innovation in the construction industry.

First, the main players: clients, contractors (including suppliers and subcontractors), consultants, regulators and unions representing construction employees; do not feel that the successful completion of projects is an absolute necessity and in their interests (BCA, 1992). Second, was the question of whether contract structures and quality assurance programs are devised with a team approach in mind. Third the quality of staff deployed during each phase of the project and the extent of involvement of key players in the discussion, planning and design prior to commencement was considered insufficient (BCA, 1992).

[3] Acknowledgement for this section which is reproduced in part from Lenard (1996).

These findings were reinforced by the *Gyles Royal Commission into Productivity in the Building Industry in New South Wales* (1992), which described an industry culture characterised by:

> "dubious business and industrial practices and chronic contractual disputation, and an adversarial environment defined by mistrust, lack of shared objectives, the use of onerous contracts and the ever-present risk of litigation" (Uher, 1994).

Commissioner Gyles recommended that the Australian construction industry address this issue as a matter of urgency, by adopting a more cooperative stance, similar to the partnering arrangements adopted in the US. This arrangement aims to improve communication and interaction between the parties involved in the procurement process. While the issues addressed by the Royal Commission and the BCA are not the focus of this paper, the issues that they highlight and their subsequent recommendations have some bearing on the innovation process.

In a study conducted by the Construction Industry Institute Australia (1996b), it was established that the exchange of knowledge and transfer of technology within the project team had the potential to promote innovation and improve established practices. However, this required a cooperative environment where all parties had agreed on a common goal, the establishment of an effective dispute resolution process, and the early assignment of experienced personnel with construction experience during the design of the facility (CIIA, 1996a). Most importantly it involved the active involvement of the owner in the process. Owners were crucial to the organisational and project team learning process as they could often introduce processes and technologies used on past projects.

Owners participation in research and development

Research and Development

It has long been recognised that research and development drives diversification into technologically related areas that can improve an organisation's, an industry's and a nation's performance (Gold, 1991). In nations with high labour costs, competitiveness critically depends on the way in which innovations are encouraged, developed and diffused. Moreover, to achieve maximum benefit from innovation it is important that productivity improvements occur across a broad section of organisations rather than one or two organisations at the leading edge (CIDA, 1995a). This requires substantial investment in research and development, undertaken by and accessible to the industry and its clients as a whole.

An OECD study conducted in 1991 revealed that many companies, nations and regions have strong programs to obtain and diffuse technological intelligence. In fact, the most technically advanced nations, whose organisations should be the most capable in the world and presumably be in the least need of assistance, have some of the largest programs to assist diffusion. Japan and Germany for example spend significantly more on research and

development than any other nations (OECD, 1991), with Japan spending $500 million annually on innovation centres, while the annual budget of the German Fraunhofer Institutes is around $550 million. Interestingly, Singapore recently set up a centre focusing on the receipt and dissemination of new ideas and processes.

The importance of learning centres is taken up by Pavitt (1980), who argues that in line with the notion of 'centrality of learning', such centres provide a vehicle for the diffusion of innovation across the industry. Perhaps more importantly, Pavitt suggests that while the innovative product, practice or technology may be significant, the 'learning-curve' effect may in fact lead to developments that far exceed the initial impetus. This point is taken up by Eisenhardt (1989) who argues that the establishment of national centres focused on the diffusion of innovations and new organisational process is essential if general industry performance is to be raised. The CIIs have taken up this challenge and hundreds of publications are now available to industry on three continents.

Studies also indicate that the emphasis on research and development varies from industry to industry (Hambrick and MacMillan, 1985). For instance, in the OECD funded countries since 1973, the rate of growth of business funded research and development activities in sectors such as electronics, aircraft and chemicals has increased to levels where some company's expenditure on research and development is greater than their investment in process equipment and plant (OECD, 1991). This is reinforced by a comprehensive study of nearly 5000 technical innovations in large and small organisations in 1988, which found that traditionally innovative sectors (eg. electronic computing equipment, process control instruments, pharmaceuticals) 'produced' approximately four times more technical innovations than less innovative sectors (eg. fabricated metal products, industrial trucks and tractors) (Acs and Audretsch, 1988). Many of the industries that have an advanced innovation culture contain the construction industry owners who, as verified by the CIIA survey (CIIA, 1996c), are not willing to invest in construction industry research. The CII's around the world do however, have the active input of owners, albeit small, who are willing to invest time and money into the industry and believe that they are obtaining substantial benefit.

Research and development in Australia

As a result of a forum at Parliament House, Canberra, on 19 December 1990, four working parties were established to examine contracts, industry development, skills information and industrial relations in the construction industry.

The findings of the working parties led to the establishment of the Construction Industry Development Agency (CIDA) which was to be the vehicle for reform in the areas covered by the working parties. At the same time, the government recognised the importance of industry commitment to the reform process. In 1992, the *Construction Industry In-Principle Reform and Development Agreement* (IPA), was signed by leading industry, union and employer associations, and the then governments of Victoria, South Australia, Western Australia, Queensland and the Australian Capital Territory. The signatories committed themselves to a number of issues but most specifically to:

> "... the development of strategies and programs within companies and government agencies to address innovation, export quality, project delivery, management practices, contractual issues and client and contractor performance" (IPA, 1992).

To implement the IPA, CIDA established a number of action teams which spanned across most sections of the construction industry. CIDA achieved some noticeable results in developing a range of tools to assist owners and contractors to improve the effectiveness of managerial decisions, but by and large did not achieve measurable results in terms of fostering innovation in the industry. The lack of industry support (Barda, 1995) in terms of funding may have been a major contributor to this. Nevertheless, in establishing CIDA, the government acknowledged that industry competitiveness was an issue in the national economy.

By contrast however, is the severe curtailing in projected funding during the next phase of construction industry reform. In 1995, the Australian government only provided enough funding for the operation of a secretariat ($600,000 was the only sum committed for a three year period). This is in sharp contrast to the amount invested in the early 1990s. Predictably, in reducing funding to the reform process, the government, by implication, suggested that the construction industry itself needs to contribute significantly in terms of innovative research and development. However, in a country with low levels of demand and high company taxation this may have been an unrealistic expectation on the government's part. The government also largely ignored the recommendations set out in the *Construction Industry Innovation Strategy* (CIDA, 1995a), which strongly recommended that innovation should become an integral part of the Australian Construction Industry Council's strategy to make the construction industry internationally competitive (CIDA, 1995a).

In essence, Australian government assistance in fostering research and development in the construction industry has been minimal. Whilst recognising the importance of the construction industry to the national economy, it has not provided the necessary seed money or venture capital necessary to encourage innovation through research and development. This is borne out by the relatively small number of Australian research grants and the fact that a cooperative research centre has never been supported or encouraged by the government.

As a major owner and user of constructed facilities, the government has a role to play and perhaps should take the lead from some of the large multinational corporations. The Royal Dutch Shell Group, for example, recognised innovative research and development as a critical success factor in the early 1980s (Bienayme, 1986). The group acknowledges the importance of setting aside a proportion of any research and development budget for the purpose of identifying and assuring the continuous transfer of scientific discoveries into business. It also recognised the importance of having a centre focused on transferring innovations outside a particular country (Bienayme, 1986). The Australian government is the only entity in a country made up of comparatively small construction organisations to have the motivation and resources to follow Shell's lead. However, the current stance of the Australian government does not provide adequate leadership, and such an approach is seen as a barrier to innovation (CERF, 1996).

Industry research and development

While some industry sectors invest considerable resources into research and development, it is felt that the low capital intensity of the construction industry often limits its interest in investment in new technologies and automation. As a result, the total amount of research and development conducted by the industry is small (CIDA, 1995a) and its focus diffused. Rather than viewing investment in research and development as a means of maintaining or improving market share and competitive advantage, the construction industry approaches such investment with caution as it is not seen as contributing to short term profit. In both location-dependent and speciality segments of the construction industry, competitive conditions may limit willingness to take the technical and financial risks associated with new construction technologies. Moreover, if an organisation is maintaining an adequate share of a market (regional or by speciality operation), then pressures to take the risks of innovation are reduced (CERF, 1996).

The reason for this reluctance to invest in research and development lies in the fact that market uncertainty has led many contractors to be almost exclusively motivated by cost efficiency and short term goals related to the single project focus (Lenard, 1996). In this environment, investment in research and development (which requires a long term commitment) is rarely attractive. At some point, cost of technological innovation becomes prohibitively high and the increasing cost of competition erodes margins below levels that can support large categories of indirect expense on research and development.

Another feature of the industry affecting investment in research and development and type of innovation that follows is the lack of commitment on the part of the purchasers of construction. Clients generally have a major role to play both at the project and industry level (BCA, 1992; Ireland, 1992). However, clients rarely regard the constructed facility as integral to a profit making enterprise and as such, do not view investment in possibly risky innovative ventures as warranted. Moreover the fact that construction is only a small percentage of total project costs means that the client may be reluctant to invest in new construction processes and technologies. This argument is reinforced by Slaughter (1993) who cites an example of a single family dwelling in 1970 where land and financing accounted for only 26% of total cost. This increased to 36% in 1980 and to 62.5% in 1985. Whilst residential construction and financing are beyond the scope of this work, nevertheless the general principles may apply to commercial construction.

BARRIERS TO OWNER INVOLVEMENT

In 1996 the CIIA surveyed 100 owners and 23 contractors using an interview protocol. The interviews were explorative and covered a broad range of questions focusing on their involvement in research and development and improving the relationship between owners and contractors in the industry. The results were interesting because virtually all of the respondents thought the concept of research and development collaboration admirable but, when faced with the prospect of actually committing resources to the idea, few had the

courage of their convictions. Thirteen reasons identified why they were unwilling to commit resources to industry collaboration. The major reasons are discussed below.

Organisational focus leading to outsourcing

Over eighty percent of the industry owners interviewed admitted that market conditions were forcing them to focus on core business activities and the procurement of constructed facilities could be most appropriately handled by outsourcing most activities to consultants and or project managers. In many cases engineering and property departments within the owner organisations were downsized to the extent that technical expertise was no longer evident. Hence, the owners felt that their dwindling human resources could be better placed in trying to improve core business activities rather than trying to improve the construction industry generally.

False perception of competition

In the extreme some owners were hostile to the notion of providing any assistance to the construction industry, one major supermarket chain property manager said that since they had so much of a building programme the consultants and contractors would vie with each other to earn their repeat business, and that the competitive process ensured best value for money for them. It was up to the industry to undertake its own innovation in order to win their work. Some contractors also were reluctant to invest time with owners as they felt that owners always resorted to selecting contractors on the lowest price basis anyway and as such it would be a waste of effort. In addition, they felt that some owners gathered a great deal of project information from them and then shopped it around to other contractors in order to obtain better prices.

Lack of resources

Restructuring is now prevalent in industries and organisations. Staffing resources now centre on core business activities and the number of available staff for peripheral activities has reduced to the extent where it is of serious concern. All of the owners surveyed suggest that the major barrier to involvement is lack of people and time. It was surprising to find that large multi-national companies only had two or three people in their engineering and property departments to manage the procurement of their constructed facilities.

Partnered project failures

In some cases owners referred to partnering arrangements as possible test cases of collaborative efforts with contractors. They cited partnering failures and eventual breakdowns of relationships with contractors. CIIA, (1996b) conducted independent research in this area and found that twenty five percent of partnered projects failed to achieve their common objectives. These arrangements did not develop a shared understanding of, and commitment to, common goals; individual, realistic understanding of the expectations, interests and values of the contracting parties; an atmosphere of trust grounded in a commitment to maintaining the partnering relationship; an awareness of the

spread of risk and reward; a willingness to resolve conflict creatively. Critically, the partnering process, in its simplest form, aims to foster cooperative and mutually beneficial relationships among project owners and contractors and these failures created a sense that the industry was not ready for further collaborative projects, albeit in areas of research and development.

Lack of senior management commitment

Commitment to improving the relationships with contractors is fundamentally a responsibility of senior management. It must be visible, supportive, on-going, and sensitive to the time and resources required for skills training and development. At the organisational level, many senior managers interviewed were not willing to give their active support to collaborative projects.

CONCLUSION

Implicit in any collaborative arrangement is a sense of, and desire for, quality improvement. The development of research and development consortia is a quality management -- as well as a risk management -- strategy. The CIIA facilitates quality management largely because it calls on stakeholders to look beyond the words of an individual project contract and to establish how the project procurement process can be improved generally. By looking beyond individual projects an innovation strategy requires an appraisal of current and future processes and systems relevant to particular projects, and, indeed to, the stakeholders in general. A fundamental requirement is that the two major participants, the owners and the contractors, are working together to improve processes and systems.

However, projects, organisations, people and contracts do not exist in a vacuum; they are embedded in a variety of industrial, social, legal and other contexts that determine what is possible and, often, what is desirable. The collaborative process, then, is a matter of inter- and intra- organisational *cultural* assessment and development. The processes, habits and techniques of organisations, as well as all those indefinable features of group life that give an organisation its identity comprise its culture -- its personality, so to speak.

Likewise, the interaction of organisations reflects industrial and other cultural factors. In establishing a working relationship, participants endeavour to shape a new and more profitable culture that will define their interaction. They are explicitly accepting the need to do things better and smarter -- and more cooperatively. No ventures can succeed without a favourable cultural backdrop. The commitment of all, and in particular, senior management is an absolute necessity.

As an agent of organisational change, then, collaboration between owners and contractors can be a powerful technique. First, it focuses on the need of the respective organisations to succeed together in a potentially hostile external environment -- after all, if there were no perceived threats to organisational success, why make more commitments than one is legally

obliged to? Second, by addressing specific research projects the collaboration is grounded in reality rather than mere wish fulfilment. Third, internal organisational change is driven by interaction with other parties and the need to adapt; the frame of reference for change is established by necessity rather than convenience.

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COMBINING RULE-BASED EXPERT SYSTEMS AND ARTIFICIAL NEURAL NETWORKS FOR ESTIMATING CONTRACTORS MARK-UP

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Abstract

This paper presents an innovative approach for estimating a contractors mark-up percentage for a construction project. A computer based mark-up decision support system called *InMES* (Integrated Mark-up Estimation System) that integrates a rule-based expert system and an Artificial Neural Network (ANN) based Expert System is presented. A rule extraction method is developed to generate rules from the trained ANN. By using the explanation facility embedded in the rule-based expert system, the *InMES* provides users with a clear explanation to justify the rationality of the estimated mark-up output. Cost data derived from a contractor's successful bids were used to train an ANN and, in conjunction with a rule based expert system, select the expected mark-up for a project. The combination of both ANN and rule based expert systems for estimating mark-up allows significant benefits to be made from each individual system, such as understanding why and how the mark-up estimated was derived and also the effects of imposing rules and constraints on a company's mark-up estimation.

INTRODUCTION

In the construction industry, tendering is the most popular form of price determination although negotiation also plays its part. Nevertheless contractors can choose to compete on the basis of lowest cost, flexibility and quality of service, innovation, delivery or indeed a combination of the above. It is not possible to excel in all of these dimensions. Consequently, the contractor should decide in advance on a limited subset of dimensions on which it will base its comparative advantage. As most work is obtained on the basis of tenders in Australia, the dimension of cost generally predominates (Tucker *et al.*, 1996). Therefore it is not considered possible for a contractor to anticipate in advance exactly what proportion of tenders submitted will be successful.

Tucker *et al.* (1996) noted from their research that a majority of contractors sampled were successful in 1 of 6 tenders. More interestingly, however, in a number of research projects in which one of the authors is currently involved, the estimated mark-up for a number of projects ranges from 2.5% to 4% with contract values ranging from $4.5M to $15M.

Such percentages are low considering the risk and uncertainty associated with procuring construction projects. In one way or another the contractor has to assess the extent of risk and uncertainties involved with a project and include them within the actual total cost of the estimate in order to balance them against the profit they may obtain. Hillebrandt (1985) suggests that contractors are not always successful in making these assessments.

Subcontracting is a well-established practice in the Australian construction industry, accounting for up to 100% of the contract value (Uher, 1988). The popularity of subcontracting can therefore be attributed to the general contractor attempts to minimise their overheads by reducing their work-force. Nevertheless, the extent of mark-up to be applied to a contract during tender preparation is perhaps one of most difficult decisions that faces the contractor.

ESTIMATING CONTRACTORS MARK-UP

The estimation appears to be linked to a range of factors, some of which are considered to be obvious and can be easily externalised, such as 'number of bidders', 'project size', 'location', and 'project complexity' (eg, Broemser, 1968; Hillebrandt, 1985, Li, 1996), while others are abstract and cannot be made clear in the same way. Furthermore it is difficult to manually extract principles of mark-up estimation from estimators, as there seem to be features that are inseparably inherent in the mark-up calculation task, although the mental process that estimators adopt is difficult to describe and capture. Thus it appears that mark-up decisions 'emerge' in a single step from a mixture of experience, intuition and gut feeling, without going through a sequence of discourses or deep reasoning steps (Moselhi *et al.*, 1993; Li, 1996).

The typical decision-making characteristics associated with the estimation of mark-up suggest that Artificial Neural Networks (ANN) and Artificial Intelligent (AI)-based techniques may be suitable tools that could be developed and used as decision aids. In particular, an ANN employs a number of hidden nodes that can simulate the impact of implicit and/or missing factors on the mark-up decision. Research efforts have been made in developing ANN based mark-up estimating systems. For example, Moselhi *et al.* (1991 and 1993) developed a decision support system called DBID using an ANN as the computational engine. Similarly Li (1996) compared the accuracy of ANN-based mark-up systems with regression based systems for modelling historical cost data, identifying the effect of different layers and node numbers on the accuracy of an ANN based mark-up estimating system.

The calculation of a contractor's mark-up is primarily experience-based and is an unstructured problem-solving exercise. Estimators idiosyncratically apply specific rules and constraints for estimating a project's mark-up. For example, a company may have an internal policy to specify that the maximum size of projects the company will bid for is $1M; and the smallest size $100,000. This means that the company will not bid for any projects outside this range. The company may also have an internal policy that gives a higher priority for bidding on certain types of projects, because of their experience and expertise in delivering a specific type of project. Applying these rules will significantly alter the decision making

process for estimating project mark-up. Given that estimators have the ability to combining past data and rules in mark-up estimation, a hybrid application based on Rule-Based (RB) and ANN-based expert systems (ANNES) can be used to develop a mark-up decision support system. Rule-based systems have widespread applications and are essentially formulated on the principles of ANNESs.

The primary strength of these systems lies in their capacity to provide clear explanations about their outputs. The explanation capacity enables users to understand the logic reference of why and how the output is arrived at, and consequently increases the users-acceptance of the output. However, as it is generally recognised that directly implanting knowledge into RB expert systems is a tedious and labour intensive task, recent studies have focused on the automatic acquisition of knowledge for developing knowledge bases (Quinlan, 1986; Li, 1994). For example, machine learning tools have been tools developed to generate knowledge from examples. These tools have been useful for creating and *maintaining* knowledge bases, but they are unable to entirely eliminate the difficulty of *generating* knowledge bases. In particular, the performance of machine learning tools need to be improved for handling noisy and incomplete data.

Essentially ANNs use a learning algorithm to automatically generate functional relationships between inputs and outputs that are presented in a set of historical data, although the data may be noisy, incomplete (Kohonen, 1988). However, it has been widely acknowledged that the major drawback of using ANNs is that the knowledge learned by a neural network is difficult to interpret (eg, Li, 1996). Alternatively a conventional ANN-based mark-up estimating model with no clear declarative knowledge representation has considerable difficulty in generating the required explanation structure. Because of the lack of interpretability, a neural network based mark-up model cannot explain why and how estimates are produced. This may significantly affect the user's acceptance of the results. Moreover, the absence of an 'explanation' capacity within the ANN based mark-up model limits its practical application. Given the relative strengths and limitations of RB and ANN systems, it is proposed by the authors that both systems should be combined to form a hybrid system for estimating a contractor's mark-up.

This paper presents research results from an investigation of a contractor's successful bids and consequently identifies the feasibility for developing an innovative hybrid mark-up estimating system called the **Integrated Mark-up Estimating System** *(InMES)*. The paper describes the computational structure of the *InMES*, and then focuses on three aspects of the *InMES* that differ from the previously described ANN based mark-up decision support systems. The three aspects are: the evaluation of constraints, rule extraction and explanation facilities. The advantages and technical challenges for contractors are summarised in the conclusions.

AN OVERVIEW OF *INMES*

The architecture of *InMES* comprises four modules: an ANN based expert system; a rule-based expert system; and input and output facilities, as illustrated in Figure 1. The

mechanisms that enable the self-organisation of knowledge in an ANN are similar to those described in Li (1996). The ANN uses a three-layered network. This study uses the three-layered network not because it is considered to be the optimal structure, but to simplify the process of *rule extraction* from a trained network. It is necessary to note that the effect of layer and node numbers on the accuracy of output can be considerable and detailed results are presented elsewhere (Li, 1996). Input nodes of the ANN consist of 11 mark-up attributes as listed in Table 1. Identifying the various attributes that affect the mark-up decision making process has been a key area of research for several years (eg, Eastham, 1987; Shash, 1993; Dozzi and AbouRizk, 1996). Dozzi and AbouRizk (1996) developed a bidding model using 21 attributes. In their study, 11 attributes were used to represent factors affecting a mark-up decision. Attributes, as well as their definitions and value ranges, are tabulated in Table 1.

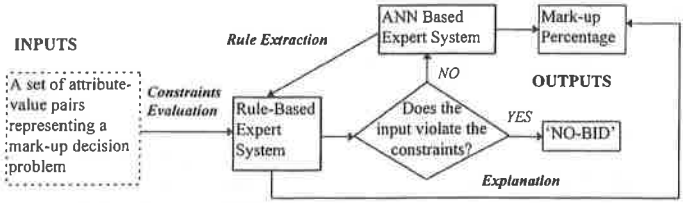

Figure 1. The Computational Structure of *InMES*

An alternative mark-up decision problem is presented by assigning values to the 11 attributes, and the 11 attribute-value pairs formulate the input information for the *InMES*. It is noteworthy that the focus of this study is not to identify mark-up attributes, but to demonstrate the capacity of a hybrid application based on a RB expert system and ANN for assisting contractors to calculate their mark-up for a project. Cost data used for training the ANN was derived from 19 successful bids collected from a construction company in Victoria, Australia. The example used herein includes 12 building projects, 5 industrial projects, and 2 civil engineering projects. The training of the ANN is based on a feed-forward mechanism with backpropagation. Throughout the ANN's training process, weights are modified to highlight the interrelationships with the training data. The training and testing procedures and methods are not described in this paper, and detailed information can be found elsewhere (Rumelhart and McClelland 1986; Li 1996).

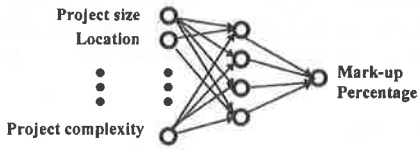

Figure 2. The Artificial Neural Network

Table 1. Mark-up Attributes, Definitions, and Value Ranges

No.	*Input Attribute*	*Definition*	*Value Range*
1	Project Size	Project size estimated in dollar volume.	Max = 100,000,000 Min = 100,000
2	Location	Is project within company boundaries.	Yes = 1 No = 0
3	Market Conditions	Current construction market.	Good = 1 Medium = 0.5 Bad = 0
4	No of Competitors	Number of bidders on the project.	Max = 20 Min = 1
5	Project Type	Is the type within the scope of the company?	Yes = 1 No = 0
7	Working Cash Requirement	Estimated working cash requirement	Dollars ($)
8	Overhead Rate	Overhead rate required to be covered	Percentage
9	Current Workload	Volume of all current project the company has committed.	High = 1 Medium = 0.5 Low = 1
10	Labour Availability	What is the availability of local labour?	Yes = 1 No = 0
11	Project Complexity	What is the degree of complexity of the project?	High = 0 Medium = 0.5 Low = 1

Table 2. Examples of Rules Elicited Manually/Automatically by the Rule-Extraction Function

No	*Rule Context*	*Creation*
1	IF Project Size > 100,000,000 OR Project Size < 100,000, THEN Mark-up Decision = 'NO BID'.	Manual
2	IF No. of Bidders > 15, THEN Mark-up Decision = 'NO BID'.	Manual
3	IF Mark-up Decision > 10% AND Effect of 'Project Complexity = high' on the output is greater than the average, THEN 'Project Complexity = high' is a reason causing the high mark-up percentage AND the Effect is 0.56.	Automatic

Figure 2 indicates the three-layer ANN with 11 input nodes, 4 hidden nodes and 1 output node. The RB consists of two knowledge bases. The first knowledge base contains rules that are manually elicited through interpreting the internal policies of the construction company. The manually elicited rules are mainly used for evaluating the constraints of the input bidding conditions. These rules will remain unchanged as long as the internal policies are effective. The second knowledge base contains rules that are extracted from the trained ANN. These rules are used to generate explanations for the output. Because the extracted rules are related to a specific mark-up problem, they are solely useful for explaining the output of a particular mark-up problem. When a new mark-up problem is presented to the ANN system, a new set of rules will be generated to overwrite existing ones.

Table 2 indicates three examples of rules used when implementing the rule-based expert system. The first two are manually elicited to reflect the internal policies of the construction company. The third one is generated by the rule-extraction function that will be presented later. The inference engine that facilitates RB reasoning is provided in the *LPA* which is the pre-programmed expert system (ES) shell used in this study. This paper focuses on the following three functions of the *InMES* (see Figure 1):

- Evaluation of constraints using the RB;
- Rule Extraction from the trained ANN; and,
- Generating explanations for the mark-up decision making.

The following sections describe each of the above functions.

EVALUATION OF CONSTRAINTS

The process of evaluating constraints is primarily concerned with checking to make sure a specific mark-up decision problem satisfies all constraints set by the company's internal policies. It was mentioned that internal policies of a company are interpreted into rules and stored in a knowledge base. Consequently when a mark-up problem is presented as a set of attribute-value pairs, the *InMES* retrieves relevant rules from the knowledge base to examine if the values of the attributes exceed thresholds and constraints defined by the company's internal policies. If no constraint violation is detected, then the attribute-pairs are passed to the ANN based expert system as inputs for generating a mark-up percentage. If a constraint violation occurs then 'NO-BID' is recommended to be the mark-up decision without going through the ANN based expert system. For example, the policy of not bidding projects with sizes beyond the range of 100,000 to 100,000,000 is interpreted using the following rule:

IF Project Size > 100,000,000 OR Project Size < 100,000,
THEN Mark-up Decision = 'NO BID'

If in a mark-up problem the value of the attribute *Project Size* is *95,000*, then it will activate the above rule, and the *InMES* will produce the output of 'NO BID', bypassing the ANN based expert system. In this study, 12 manually elicited rules are stored in the first knowledge base for facilitating the evaluation of constraints.

The objective of evaluating the constraints is to provide a filter so that only those problems associated with mark-up estimation does not violate the thresholds and constraints set by the internal policies of the company.

RULE EXTRACTION AND EXPLANATION FACILITY

Rule Extraction

It had been suggested that one of the major limitations of using an ANN based expert system is that knowledge embedded in the network is not 'readable' (Li, 1996). Consequently, because of this 'unreadability', it is difficult for users to understand why and how the results have been obtained. The rule extraction function automatically generates rules from a trained

ANN system. Two measures are important in extracting rules from a trained ANN: RS_i (Relative Strength between the ith input and the output), and E_i (Effect of the ith input variable upon value of the output).

RS_i is measured using the statistic set as specified in Equation 1,

$$RS_i = \frac{\sum_{k=0}^{n}(W_{ki} * W_k)}{\sum_{i=0}^{m} ABS\left(\sum_{k=0}^{n} W_{ki} * W_k\right)} \quad \text{.....(1)}$$

where,

RS_i is the relative strength between the ith input and the output,
W_{ki} is the weight between the kth hidden unit and the ith input node,
W_k is the weight between the kth hidden unit and the output,
m is the total number of input nodes,
n is the total number of hidden nodes.

The effect of ith input node on the output E_i is calculated using Equation 2 as following,

$$E_i = \frac{(I_i * RS_i)}{\sum_{k=0}^{n}(I_k * RS_k)} \quad \text{.....(2)}$$

where,

E_i is the effect of ith input node on the output,
RS_i is the relative strength between the ith input and the output,
RS_k is the relative strength between the kth input and the output,
n is the total number of hidden nodes.
I_i is the value of ith input node,
I_k is the value of kth input node.

During the process of rule extraction, the effects of inputting all the attribute-value pairs are calculated by applying Equations 1 and 2, and the average of the effects is computed as E_{av}. Rules are formulated by pinning down inputting attribute-value pairs with effects greater than the average ($E_i \geq E_{av}$) as reasons that led to the mark-up decision. For example, if the output *mark-up percentage* is 10%; the average effect is 0.43; and the effect for the attribute-value pair for *Project Complexity* = *high* is 0.61, since this is greater than the average effect (0.43), the following rule is formulated:

IF *Mark-up Decision ≥ 10% AND Effect of 'Project Complexity = high' is greater than the average,*
THEN *'Project Complexity = high' is a reason causing the high mark-up percentage AND the Effect is 0.61.*

Another example demonstrates the above formula: If the output *mark-up percentage* is 2.5% (which is considered to be relatively low), and the effect of input pair *No. of Competitors = 10* is 0.3 which is greater than the average effect of 0.16, then another rule is formulated as:

IF *Mark-up Decision ≤ 2.5% AND Effect of 'No of Competitors = 10' is greater than the average,*
THEN *'No of Competitors = 10' is a reason causing the low mark-up percentage AND the Effect is 0.37.*

It is possible that for each mark-up percentage generated by the ANNES, more than one rule may be extracted and stored in the second knowledge base of the RB expert system to form the basis for explaining why the output is derived. The extracted rules are considered to be only useful for explaining the current mark-up decision. Essentially these rules will be replaced by new rules extracted from another mark-up decision presented to the ANN based expert system as a set of attribute-value pairs.

Explanation Facility

The ability to explain the reasoning process that an ES employs to solve problems is recognised as an important factor that determines the user's acceptance of the system (Ye and Johnson, 1995). The explanation facility has the potential to establish the reasonableness of the generated solutions by assisting users to understand the underlying reasoning processes associated with the ES. If users are considered to be responsible for the decisions made, then they are more likely to accept a system's recommendation if they understand why and how the recommendation is conceived.

Three types of ES explanations have been identified from previous research (Wick 1992; Clancy 1993; Ye and Johnson 1995):

- *Trace* - which is a record of the inferential steps taken by an ES to reach a conclusion;
- *Justification* - which is an explicit description of the causal argument or rationale behind each inferential step taken by the ES; and
- *Strategy* - which is a goal structure that determines how the ES uses its domain knowledge to accomplish a task.

Justification is believed to be effective for enhancing the users-acceptance of an ES because it is the most frequently requested explanation type. (Ye and Johnson, 1995). The explanation facility in *InMES* provides justification for a mark-up decision by identifying the input and attribute-values that are considered to have a strong effect on the mark-up decision.

Rules extracted by the rule extraction function display causal relationships between the mark-up output and input attribute-value pairs. By aggregating the extracted rules as explanations, the *InMES* enables users to establish the causality between the mark-up decision and attribute-value pairs.

CONCLUSION

The hybrid application of a rule-based expert system and an ANN has enabled the authors to develop a mark-up estimation system that captures the experiences and satisfies the constraints that may be imposed by a contractor when deciding on a mark-up to apply for a tender. Furthermore the proposed system may actually assist contractors in their tender decision making, that is, whether or not to submit a bid for a project considering the estimated mark-up output given the system inputs.

The hybrid system gains significant advantages from the rule-based system and the ANN. The ANN learning algorithms construct a mapping from input to output of non-linear or incomplete mark-up data that are otherwise difficult to model using traditional AI methods. Knowledge in the RB system consists of rules extracted from a trained ANN. The rule extraction algorithm measures the relative strength between input and output nodes.

Input nodes that have strong effects on the mark-up output are interpreted into causal relations in which input nodes are wired as causes of the output. The application of the rule-extraction algorithm indicates that it is possible to automatically construct a knowledge base from historical data instead of a series of interviews with domain experts, easing the task of knowledge acquisition.

A limitation of the rule-extraction method is that extracted rules are only based on individual mark-up problem. Simply extracted rules may only be valid to a specific mark-up problem. Further research is needed to investigate the consistency of rules generated from different mark-up problems, so that the rules can be refined and upgraded to form a generic knowledge base. Another limitation of the rule-extraction is that for a more complicated ANN (with more than three layers), the relative strength between input and output becomes less intuitive. Thus the statistical measure used in this application may become unreliable. To overcome this limitation we suggest that further research should be undertaken to develop rule extraction algorithms for ANNs with more than three layers.

The explanation facility of the *InMES* utilises rules extracted by the rule extraction algorithm to provide a clear explanation of the mark-up decision. Such a facility enhances the system's user-acceptance by addressing the ANN's inability to justify the reasoning process.

The hybrid system can be developed in many ways, but perhaps the easiest way is to utilise a commercial ANN simulator to train a network and save the set of weights in a file. A computer program needs to be developed to read the weights and measure the effects of input nodes on the output. Extracted rules would then be stored in a commercial RB expert system

shell that provides the facilities to check the constraint's and generate explanations for the estimated mark-up output.

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PROCURING DESIGN SERVICES FOR DESIGN-BUILD PROJECTS

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Abstract

In design-build projects, there are two major methods to fulfill the contractor's design responsibility; using in-house designers or procure services of external consultants. The major disadvantages of using in-house designers are the 'proletarianization' of professionals, high overheads, and limited versatility, creativity, originality, capability and flexibility. The advantages are better integration and communication. The major advantages of procuring the services of external consultants are gaining reciprocal work in future and better quality of design. The disadvantages include more distant working relationships, difficulty to control and motivate these designers, weak communication links and coordination problems. The two case studies presented show that the issues of deprofessionalization or not depends on the leadership provided by the contractor, the experience of contractor in design-build projects and the number of in-house designers, and not whether in-house designers or external consultants have been used.

INTRODUCTION

Design-build (D/B) is a form of building procurement whereby the contractor who constructs the works, also undertake all of, or a portion of, the design of the Works (Janssens, 1991). Unlike many other contractual arrangements, D/B requires the contractor to undertake design for the project. Contractors have three major methods to discharge their design responsibilities; by employing in-house designers, engaging external consultants or a mixture of both.

The aim of this paper is to study the advantages and disadvantages of the three methods used to procure design services and identify the problems in using internal and external designers.

In-house designers

In this arrangement, architects and engineers (A/Es) are employed as permanent staff in the contractor's organization, and in the process, the contractor acquires in-house design capability. In-house designers are said to be cheaper than external consultants (Nahapiet & Nahapiet, 1985; Turner, 1995). With proper staffing, competitive advantage can be attained (Schneider & Bowen, 1993; Schuler & MacMillan, 1984). Heavy investment in computers is possible (Rowlinson, 1987) as there are economies of scale. As all designers belong to the same organization, internal communication is better than communicating with external

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consultants (Nahapiet & Nahapiet, 1985; Turner, 1995). Feedback from the project can help the firm to be more economical and produce better designs to win future contracts (Turner, 1995). These designers become the servants of the contractor and need to follow working procedures set up by the contractor (Turner, 1995). The contractor can therefore exercise closer control (Franks, 1993: p. 19). All this gives rise to integration of design and construction activities which is beneficial to the D/B project.

However, contractors are cautious about setting up permanent design teams to solely undertake D/B projects (Ho, et. al., 1996). This is because of the cyclical nature of the construction industry, and the uncertain demand for D/B projects, making it unaffordable to engage design teams on a permanent basis (Golightly, 1985); there may not be enough projects to keep them occupied (Gosney, 1989). In order to undertake design in-house, this design team needs to be large enough and skilled enough with each type of expertise to handle a variety of projects with originality (Golightly, 1985; Gosney, 1989). However, it may be difficult to set up this team (Golightly, 1985), and costly to acquire and maintain these experts (Golightly, 1985; Gosney, 1989; Sheppard & Tuchinsky, 1996). The experts are also difficult to manage and difficult for them to keep current when technology is changing rapidly (Sheppard & Tuchinsky, 1996).

Even with a large team, contractors' in-house designers may still not be experienced enough to undertake some complex projects. These are projects which require broader domains of deep expertise and information which are interdependent, and which have dispersed knowledge and technology bases which are rapidly changing (Sheppard & Tuchinsky, 1996). The big manpower base makes the contractors inflexible as they are tied to the existing personnel (Ho, et. al. 1996). With many foci for the contractor, it is difficult to be lean, fast, complete, competitive and maximize value (Sheppard & Tuchinsky, 1996). Alternatively, the contractor can decide to have a few designers who are more specialized in some types of development. This is not advantageous as the types of D/B projects that the contractor can carry out becomes limited (Swan, 1987), thus limiting the contractor's versatility and creativity (Inman, 1987: p. 22). One disadvantage to owners occurs when the contractor goes into liquidation. In this instance, the owners cannot make use of the contractor's in-house designers (Janssens, 1991: p. 91) to complete designing the project by way of a supplementary agreement.

Another disadvantage of having in-house designers who are professionals working in contractors' non-professional organizations is the possible eroding of the professionals' status and lost of professionalism leading to deprofessionalization as explained by the proletarianization thesis (Boreham, 1983; Haug, 1973; Oppenheimer, 1973; Toren, 1975). This happens because the professionals represent only a minority of the staff within the contractor's organization and they work in small, subordinate subunits or departments within the larger bureaucratic organization (Scott, 1966). The professionals are deprofessionalized because they have less authority to participate in and make decisions, and they also have less autonomy in controlling how they want to carry out their tasks. All these happen because of the highly bureaucratic condition (Rothman, 1984) in the non-professional organizations

which give rise to highly structured and formalized rules and procedures. This normalization leads to purely rational and mechanical judgments which threaten the professional's autonomy (Montagna, 1968; Organ & Greene, 1981). The proletarianization thesis has however been challenged by Wallace (1995).

External consultants

More D/B contractors are known to hire design consultants to assist them in discharging their design responsibilities than to use in-house designers (Franks, 1993: p. 20; Janssens, 1991: p. 126; Yates, 1995). External consultants provide flexibility and help contractors to overcome uncertainty and fluctuating demand in D/B projects (Wilson, 1989: p. 306). External consultants can bring with them their specialist knowledge and wealth of experience, new perspectives, ideas and thinking, and ideas gained from other projects (Bennett, 1990; Olian & Rynes, 1984; Swan, 1987).

A decision to engage external consultants should be made when the project is large scale, design is intricate and highly specialized (Turner, 1995). External consultants are advantageous because contractors are able to form a team with the best expertise and skill (Cheng & Koh, 1995; Gosney, 1989; Inman, 1987) and which are suitable for the job (Inman, 1987: p. 22). Repetitive and in-bred designs are avoided (Inman, 1987: p. 21). External design consultants who have high standings also bring prestige to the project. Another advantage of using external consultants is that there is greater possibility of gaining reciprocal work from consultants in the future (Swan, 1987). For contractors who are non indigenous, having local consultants is advantageous because local consultants understand the rules and regulations, are more familiar with architectural preferences in the geographical location, have more experience in material and systems performance, and local climatic conditions (Inman, 1987: p. 23).

In D/B, the main advantage as seen earlier is single point responsibility. This is a recognition that fragmentation is not desirable. Groak (1994) observes that the separation of design and production skills and other division of labor is seen as creating problems for the industry and some form of coordinated or unified organization is preferable. And yet, for firms to survive, out-sourcing and subcontracting is crucial. There is therefore an incongruent situation - to have in-house designers ensures integration and coordination but causes contractors to be uncompetititve due to large overheads. To engage external consultants will be advantageous in terms of getting the best skills and having lower overheads, but makes integration and coordination of external consultants more problematic. Another disadvantage is the potentially weak communication links between contractor and consultants and among the consultants, and the need for contractors to provide a liaison among the parties (Turner, 1995).

Mixture of in-house and external designers

It is common to have a mixture of in-house designers, supplemented by external consultants for special projects (CIOB, 1988; Gosney, 1989). In Japan, schematic and detailed designs are normally undertaken in-house, while the working drawings are being farmed out to small, independent firms (Coxe, 1994). This is to avoid having a large pool of in-house designers, which the Japanese do not retrench because of their life time employment policy (Coxe, 1994). In Singapore, mixed arrangements are often used (Cheng & Koh, 1995; Kok, 1995). In the DBS Tower 2 project, the in-house designers undertake concept design and external consultants undertake detailed design (Kok, 1995). For special projects, in-house capability is normally supplemented by external consultants (Cheng & Koh, 1995; Gosney, 1989).

METHOD

The method adopted to study the issues relating to procuring design services for D/B projects is carried out by way of case studies. Two D/B projects located in Singapore are studied. The first project is an office building designed and constructed by a Japanese contractor. The second project is a public residential apartment-building designed and constructed by a Singapore contractor.

FINDINGS

Case study no. 1: office building

The Japanese contractor for this project is one of the Big-5 contractors in Japan with a turnover of US$10 billion. The company has been operating in Singapore for more than 25 years and has undertaken more than 30 D/B projects in Singapore. The company has a strong in-house design department comprising 50 designers who are based in Tokyo, which reports directly to the managing director in Tokyo. The designers participate in all decision making concerning the design of buildings. Authority is given to the designers on the basis that they have superior knowledge and expertness. They also have full autonomy, with full control over how they carry out their tasks. The designers in this department further specialize in certain types of buildings and facilities. They are treated as experts and not as one of the general staff in the contractor's firm. The designers are observed to have strong commitment to the profession, and being Japanese, also have strong organizational commitment.

The project is a 38-story office building costing approximately US$120 million with a gross floor area of 65,000 m^2 located in Singapore's Central Business District. The client's requirements include maximum utilization of plot ratio allowed for the site, minimum circulation area, maximum rentable area, and highly efficient mechanical and electrical systems.

There were two groups of designers for this project. The first group comprised in-house designers who are based in Tokyo, and flew to Singapore several times to meet the client.

These in-house designers undertook concept and schematic design. After the client had approved the design, the second group of designers, who were external consultants practicing in Singapore, were engaged. They were selected on the basis of their technical competence, track record, previous working relationship with the contractor, and experience in designing offices. These external consultants were responsible for detailed design, applying for planning and building approvals, and advising Japanese designers on Singapore's building and planning regulations, codes, and practice. During the course of the design development, the external consultants remained subordinated to the in-house designers who acted as the project leader. There was close coordination and communication between the external consultants and in-house designers, despite the language differences between the two parties. There was no evidence of proletarianization of the internal designers or deprofessionalization as they made all design decisions and had full authority and autonomy.

The outcome of this arrangement was that no significant design errors occurred and the parties had mutual trust and respect for each other. The project was completed ahead of schedule, within budget and the client is known to be very satisfied with the quality and design of the building.

Case study no. 2: residential building

The Singapore contractor for this project is one of the larger contractors in Singapore with a turnover of US$60 million. The company has been operating in Singapore for more than 20 years and has undertaken more than 5 D/B projects. The company has only 5 in-house designers. The design team is subsumed under layers of bureaucratic structure, as a sub-unit, under the Construction Department. They report to a non-professional project manager, who reports to a non-professional director. The designers are generally being utilized to propose alternative designs in conventional design-bid-build projects. They do not participate in decision making concerning the design of buildings. They do not have authority even though they have superior knowledge and expertness. Instead, in the company, authority depends on the position of the individual. These designers do not have autonomy. Instead, they follow the company's formalized rules and procedures in carrying out their tasks. There is no specialization for the designers. They design a wide variety of project types and carry out a wide variety of tasks, sometimes standing in for project managers to manage site construction activities. They are treated as general staff employees in the firm. The designers are observed to have no strong commitment to the profession, nor do they have strong organizational commitment.

The project comprises 7 blocks of 18-story public residential apartments. The building cost is approximately US$51 million with a gross floor area of 95,000 m^2 located in the north of Singapore. The client's requirements include provision of as many residential units as possible within the planning constraints in order to maximize revenue, well designed apartment units incorporating cross ventilation, each unit having the specified minimum floor area, provision of fire escape, and a car-park that is completely sheltered and connected to all the ground floors of the 7 blocks of apartments..

There were also two groups of designers for this project. The first group comprised external consultants who are based in Singapore. They were selected on the basis of their acceptance of the contractor as the project leader, quality of consultants' personnel attached to the project, and cost effectiveness of their design. It should be noted that experience in D/B was not a criterion for selection. These external consultants undertook concept and schematic design and were responsible for applying for planning and building approvals. After the client had approved the design, it was passed to the second group of designers, who were in-house designers, to undertake design development.

Throughout the course of the design, the external consultants and in-house designers remained subordinated to the non-professional director from the contractor's company, who was the project leader. Coordination and communication between the external consultants and in-house designers were poor. Many mistakes were made. For example, the external consultants' tender drawings overlooked the client's requirement to provide a car-park that is linked to all the 7 blocks of buildings and instead proposed a multistory car-park. As such, the contractor had to build one underground car-park below the blocks of flats, without being paid extra by the client. The design also did not incorporate cross-ventilation, as the consultants thought that this would be handled by the in-house designers but the in-house designers did not regard interpreting the client's brief as part of their job. Fire escapes were also left out in the tender drawings. The problems uncovered after the contract was awarded caused a loss in mutual trust and respect between the external consultants and the contractor. To make matters worse, the client engaged these external consultants to supervise the construction works!

There was evidence of proletarianization of the internal designers as well as the external consultants, as all decisions were made by the non-professional director. Deprofessionalization was detected in both groups of designers as they did not have authority and autonomy. The project was completed four months behind schedule. Even though it was within the client's budget, the contractor incurred a substantial loss.

DISCUSSION & CONCLUSION

The cases described above show that performance of designers in D/B projects is not dependent on the method in which their services are procured, ie. whether they are in-house designers or external consultants does not make a huge difference. Deprofessionalization may occur with in-house consultants or external consultants in D/B projects. The main factor appears to be the attitude of the D/B contractor who is the project leader. Therefore, leadership of the contractor is more important than the procurement route adopted to provide design for the project.

Besides leadership, experience in D/B projects is another important factor in determining the performance of designers. Contractors with sufficient D/B experience will be able to handle the design process better, whether using in-house designers or external consultants.

Another factor that determines the degree of proletarianization appears to be the size of the in-house design team. When there are as many as 50 designers within a non-professional organization, it is more conducive to set up a separate department which functions as a mini professional organization within the contractor's non-professional organization.

A major weakness of this study is that the data were obtained from only two companies. However, these two firms are fairly representative foreign firms and local firms operating in Singapore.

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A Model for Application of Conjoint Analysis in Value Management

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Abstract

The client is concerned with attaining value for money in the building product (or the services which it ultimately provides); often such an aim is expressed in the project parameters of completion time, project price and product quality. These three parameters are interdependent and decisions concerning the three parameters are taken at various stages of the project. A decision model is proposed in this paper embedding the value engineering concept in project procurement. Conjoint analysis, a multiple-criteria decision-making technique (which utilises the ideal point model to represent the ideal/preferred solution in a multidimensional space), is used to demonstrate the application of value engineering in the various stages (pre-decision, partial decision and post-decision) of the proposed decision model.

Keywords: value management; conjoint analysis; decision-making.

INTRODUCTION

The client's objectives are usually modelled upon the triangulation of cost, time and quality but this triangulation needs amplification to include the concept of 'utility' to emphasise the inevitable exercise of choice/trade-offs between these objectives. Utility theory in decision-making, which is based on the use of numerical measures to represent the value of alternative courses of action, provides the underpinning theory to explain the client's and/or project team's decision process in the trade-offs between design options.

The availability of alternative courses of action often requires the decision maker (an individual or group) to make a choice. Cost generally refers to project price and may initially be represented by the project's elemental cost estimate; in this context, choice refers to the allocation of budgets and contingencies. Time is often represented by the project completion programme; choice refers to the adjustment of timing, timescales and float. Quality is the level of specification, and choice therefore means the adjustment of the specification level, i.e. to basic, medium or high. However, this model is over simplifying the interrelationships between these parameters of cost, time and quality, e.g. small changes in the level of specification could lead to significant time and cost penalties. The focus on 'utility' provides further explanation of these interdependencies by including such variables as running costs, maintenance issues, buildability and flexibility for alterations or other uses. Choice in this context of specification change may mean making value judgements between higher initial costs and longer term savings.

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CONCEPT OF VALUE

Whilst it is simple to claim that the objective of value management is to achieve maximum value, major difficulties exist in the measurement of value and its definition. There have been various classifications of value, such as

- terminal and instrumental values (e.g. Rokeach, 1968)
- intrinsic and extrinsic values (e.g. Feather, 1982)
- relative and absolute values (e.g. Feather, 1982)

Rokeach (1968) identifies 18 terminal values and 18 instrumental values. The terminal value of an object relates to the end-state of its existence and its instrumental value relates to the mode of conduct (or function), i.e. the means to an end. Intrinsic value is determined by the properties of the particular task as seen by a particular individual and extrinsic value refers to the expected outcomes such as money and prizes or other determinants of motivation such as affiliation and power. Relative value involves preference judgement (want) and absolute value refers to the objective requiredness of the desirable (need). Johnson (1990) expresses value as an input/output ratio of cost and benefit.

If a building element does not perform in the manner in which it is intended to, no amount of cost reduction will improve its value . Any 'cost reduction' action that sacrifices the utility of the element actually reduces its value to the owner. The value standard of the decision maker used for appraising the utility functions of the design ultimately affects the choice of the design solution, e.g. both the functions of a window and a hole in the wall are to provide light and ventilation; if their benefits (in terms of values) are perceived to be the same, their cost/benefit ratios may vary due to their different costs, and the decision maker will choose the one with the more desirable cost/benefit ratio.

VALUE MANAGEMENT

A review of the relevant literature indicates that the notion of value maximisation has become almost synonymous with that of design optimisation through the emphasis on value management (VM) in the design stage; Szoke (1987), among others, has argued that the prospects for using VM in building design are dependent upon progress being made in solving the general problems of design optimisation. Wilson (1987) suggested that 'the only true objective for design optimisation is value'. If this is to be achieved, then it is necessary to establish an objective function which represents the design's value.

Warszawski (1980) has suggested the construction of a utility function for a building design which could, in theory, be maximised. However, there are a number of obvious difficulties with this approach. Firstly, it has to be established whose utility is being maximised. Secondly, the approach is dependent upon the assumption that the individual's utility function remains consistent over time. Thirdly, it is necessary to adopt a rigorous method for measuring utility on an interval scale.

The first difficulty of whose utility is to be maximised is a major question since there are many different claimants for a building project, e.g. funding banks, venture capitalists, developers, purchasers, tenants, consultants, contractors and subcontractors. These claimants have different goals and expectations of the project. The difficulties of identifying the project's objectives are further complicated by such variables as project size and complexity. Identification of project objectives becomes a resultant/reflection of the power distribution/balance of the various claimants.

A suitable management tool is required – value engineering (VE), since VE allows one to evaluate managerial and technological alternatives, including qualitative and quantitative options, thus seeking a balanced solution to the conflicting objectives. In theory, optimisation should be possible through a thorough evaluation of every option. In practice, there are too many options, and the client's project objectives may not be absolutely/clearly defined. Pareto's law dictates that the key elements contributing towards the client's goals achievement should be identified and controlled.

Value engineering is described as a function oriented, systematic team approach by the Society of American Value Engineers and is defined as a systematic evaluation of a project design to obtain the most value for every dollar of cost (Fisk, 1992). The idea is to improve the effectiveness of project expenditure by carefully investigating cost/benefit values. The entire value engineering effort is aimed at a careful analysis of each function and the elimination or modification of anything that adds to the project cost without adding to its functional capabilities.

VE literature shows that in the USA, a standard system has developed for implementing VE at the design stage. The system provides for a 40-hour workshop that analyses the project design over a period of a week, away from the normal design environment and free of all interruptions. The agenda for the study is a job plan that provides a series of logical steps for effective project analysis. Within the framework of the workshop and the job plan, VE uses a technique known as function analysis which comprises a three step approach of function definition, function evaluation and creativity (often using brainstorming technique).

There are basically two approaches in VE. One approach advocates a study at the concept design stage with the design team using FAST diagrams (Gilleard, 1990; Fowler, 1990) and value mismatches [verb-noun approach (Miles, 1967)]. Another approach recommends a study at the scheme design stage with an external team using the cost/worth ratio as a means of highlighting areas of poor value (Dell'Isola, 1982).

DECISION-MAKING PROCESS

Whilst different sources (Dell'Isola, 1982; Macedo et al, 1978; Zimmerman and Hart, 1982) describe the stages of the value management job plan slightly differently, the basic procedural sequence in deciding which design option to adopt is similar; hence, VM is a structured

method of decision-making (Green 1992). VanGrundy (1988) also describes several methods of creative problem-solving which are based on similar staged methodologies.

Perhaps the key characteristics of value management are: (1) the group nature of the VE workshop exercise and (2) the way in which the group members are isolated from their normal activities for the duration of the study (e.g. in a 40-hour workshop). VM studies conducted during briefing and outline design involve the active participation of the client and user representatives. This decision-making process is both explicit and rational.

Function evaluation evaluates the defined function based on the lowest possible cost of achieving it, e.g. the provision of light can be achieved through a window or a mere hole in the wall. The purpose of function evaluation is not to provide a technical alternative to the window but to illustrate that there are alternative methods of achieving that function.

Green (1992) asserts that if VM is to be applied to the higher-level decisions taken during conceptual design, then the design problem is open ended in nature and the scope of the study is consequently much wider. It is clear that the assessment of competing designs will not be made on the basis of cost alone, other criteria will need to be taken into account. The choice of the best design solution is therefore a multiattribute decision problem where MAUT (multi-attribute utility theory) and utility functions can be applied. However, the second and third difficulties in applying the utility function approach to design optimisation (i.e. assuming a consistent utility function over time and the measurement of this utility function) must be kept in mind.

There are two basic approaches (Zeleny, 1982) to modelling human decision-making: (1) outcome-oriented approach and (2) process-oriented approach. The outcome-oriented approach is based on normative decision analysis such as single- and multi-attribute utility theories, which predicts the outcome of the decision process. The process-oriented approach is essentially descriptive, and has prescriptive and normative features; knowing how decisions are made may shed light on how they should be made.

Traditionally, decision theory is mostly concerned with the measurement of the total attractiveness of each available alternative, so that the most attractive one will be chosen. In this sense, technical measurement, followed by a mechanical search designed to predict the most attractive alternative, becomes a substitute for decision-making and its theory. However, when there are multiple attributes, objectives, criteria and functions, the alternatives of choice become more complex and the problem of combining these various aspects into a single measure of utility becomes more difficult and less practical.

The formalisation of the decision-making process is difficult to attain and can hardly be captured by a decision tree or by a single utility function. This is because decision-making is functional in nature, and capable of generating its own path, i.e. the final decision unfolds through a process of learning, understanding, information processing, assessing and defining the problem and its environment. The process-oriented approach emphasises the dynamism of the decision-making process rather than the act or the outcome of making a decision.

TOWARDS A DECISION-MAKING MODEL

"(D)ecision making is a dynamic process : a complex search for information, full of detours, enriched by feedback from casting about it all directions, gathering and discarding information, fuelled by fluctuating uncertainty, indistinct and conflicting concepts, some sharp some hazy, the process is an organic unity of both predecision and postdecision stages overlapping within the region of partial decision making." (Zeleny, 1982). Based on Zeleny's (1982) decision model which consists of three stages: (1) pre-decision, (2) decision (each decision stage is itself composed of a series of partial decisions, characterised by their own pre- and post-decision stages), and (3) post-decision, a simplified version is shown in fig. 1.

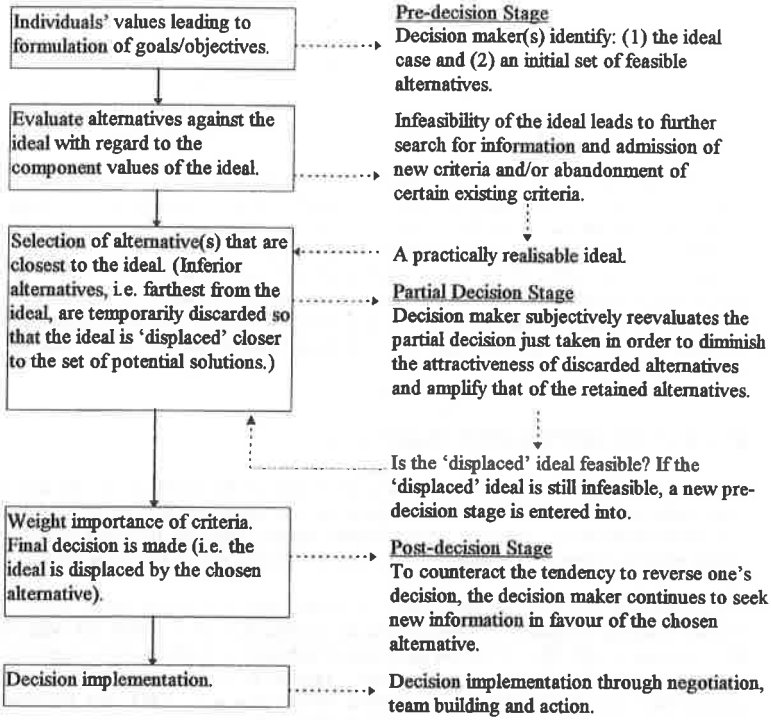

Fig. 1 Decision Model

The three stages in decision-making shown in fig. 1 are interdependent, the post-decision phase often coincides with the pre-decision preparations for the next decision. The idea of partial decisioning includes a directional adjustment of the decision situation, i.e. an adjustment consisting of discarding alternatives that at the moment appear obviously inferior, returning previously rejected alternatives to the feasible set and adding/deleting criteria. The last partial decision becomes the final decision, i.e. a continuum of partial decisions are traversed before the final decision is reached. Any post-decision stage is also the pre-decision stage for other decisions in this continuum of partial decisions.

In applying this decision-making model (fig. 1) to value management, it is viewed that there is a hierarchy of decisions to be made, from identification of design options to selecting an optimised solution. Function definition, the first step in value management, requires the decision maker(s) to go through all stages of the decision model before arriving at a 'unified' definition. [Decision maker(s) may bear different perceptions and value systems so that the function of a reception counter may vary from "enhancing the image of the company" to "a mere point of reference for directory enquiry". The latter function can be served by a directory board.] The last partial decision (final decision of a definition) of the function definition stage leads to another series of pre-decision and partial decision of the function evaluation stage.

The creativity approach in VM which encourages the decision maker(s) to think of a wide array of alternatives (through techniques such as brainstorming) is particularly well depicted in the partial decision stage of the decision model, in which various criteria are being added/deleted during the process of displacement of the ideal by the chosen alternative. At the post-decision stage, although decision maker(s) will seek new information in favour of the chosen design solution so as to reinforce their confidence in the choice, there are occasions when the information from the environment is of a negative nature. The post-decision regret may lead to a new pre-decision stage where decision maker(s) have to seek a new set of alternatives.

APPLICATION OF CONJOINT ANALYSIS

In moving towards selecting the chosen alternative through the stages of pre-decision and partial decision, the criteria to be considered are multidimensional. The VE workshop particularly relies on the nature of group decision-making, requiring the participation of a number of project claimants, each having their own set of value standards and perceptions.

Conjoint analysis is a MCDM (multi-criteria decision making) technique which models the decision maker(s)' judgement profiles (Srinivasan and Shocker, 1973; Green and Srinivasan, 1978; Samson, 1988). The various decision makers' judgement profiles could be combined to produce part-worth values for each decision criterion as explained/applied in previous construction research into contractor's decision models (Liu et al, 1994) and selection of procurement systems (Liu, 1994). The conjoint analysis technique is mostly used in marketing research where the judgement profiles of a large number of consumers have to be combined to provide part-worth values for each of the judgement criteria so that the relative importance of the judgement criteria may be known, e.g. is a power-operated window more important than

auto-doorlock in the purchase of a car? This technique is particularly applicable in selecting a design scheme, say, with the functions of the major component design features as the decision criteria. A desired function of a design feature may be provision of recreation facilities for children, which can be achieved by including a children's playground, an indoor rollerblading ring etc. The comparison of the alternative design schemes will be based on decision makers' preference judgements of their major component design features in a mutli-criteria setting.

Step One

The decision maker is asked to rank nine hypothetical outcomes representing nine design options. Each design option is described by the cost/worth level (low, medium or high) of achieving the desired function specified for each criterion (or design feature).

Here four criteria and three cost/worth levels are used. The nine outcomes are generated by an orthogonal array (Green, 1974) using the Conjoint Designer software (Conjoint Designer, 1992). The ranks in the following example are generated by the author as an illustration.

Table 1 Ranking of Design Options

	Criterion				Design options	Rank
	α	β	γ	λ		
Desirability of cost/ worth ratio	low	high	low	medium	A	3
	medium	medium	high	medium	B	7
	high	low	medium	medium	C	4
	low	medium	medium	low	D	1
	medium	low	low	low	E	6
	high	high	high	low	F	8
	low	low	high	high	G	9
	medium	high	medium	high	H	2
	high	medium	low	high	I	5

For example, design option A does not have a desirable cost/worth ratio (low level) in provision of children's recreation facilities (criterion α).

Step Two

Part-worth values for each criterion of α, β, γ and λ are calculated using the Conjoint Analyser software (Conjoint Analyser, 1992). Let y_{ip} denote the level of the p^{th} criterion for the j^{th} stimulus (alternative). Let S_j be the preference for the j^{th} stimulus. It assumes the modelling function of :

$$S_j = \sum_{p=1}^{m} f_p(y_{jp})$$

where f_p is the function denoting the part worth of different levels of y_{jp} for the p^{th} criterion. The ordinary least square method is used to estimate all the part worth values for each criterion level (Conjoint Analyser 1992). The following is an example generated by the author based on the preference rankings shown under step one.

Table 2 Part Worth Values of Criteria

Desirability of cost/worth ratio	Part worth values			
	α	β	γ	λ
low	-1.000	-1.000	-3.000	0.333
medium	0.667	-0.333	1.000	0.667
high	0.333	1.333	2.000	-1.000

Step Three

Steps one and two are repeated for each participant (decision maker) in the VM team to generate a set of part worth values for each decision maker. The average part worth value for individual criterion is obtained after normalisation of every participant's part worth values.

Step Four

The VM team is now asked to consider the design schemes of the actual project under study by assessing the desirability of the cost/worth ratios of each criterion of the schemes.

Table 3 Total Part Worth Values of the Design Schemes

Design scheme	Criterion								Total of part worth values
	α		β		γ		λ		
	Cost/ worth	Average Part worth	Cost/ worth	Average Part worth	Cost/ worth	Average Part worth	Cost/ worth	Average Part worth	
A	medium	1.000	high	4.404	medium	1.802	medium	-0.200	7.006
B	high	3.203	medium	0.401	high	3.002	low	-0.800	5.806

The choice of design scheme is the one with the larger sum of part worths. It is therefore assumed that the VM team in this case will pick design scheme A.

CONCLUSION

When a decision maker is faced with a set of alternatives, the available evaluation strategies can be conjunctive, disjunctive, lexicographic, elimination by aspects, additive, additive difference, multiplicative, majority of confirming instances or random. The wide range of strategies one can use in any given situation poses important questions about how one decides to choose (Beach and Mitchell, 1978; Svenson, 1979; Wallsten, 1980). Strategies have been theorised to be organised in some way (e.g. hierarchically) and Abelson's script theory (1976) concerns such metastrategies. Because of the wide range of available strategies, there is a need for an underlying principle for choice processes at all levels --- the cost/benefit analysis suggested by Christensen-Szalanski (1980).

The cost/worth ratios applied in VM are based on cost/benefit analysis. The overall evaluation of alternative design options calls for a multi-criteria approach in decision-making because of the various functional attributes in each design option. In this context, application of conjoint analysis has certain desirable features:

1. it can capture the decision maker's policy/judgement profile,
2. it can combine the judgement profiles of the various members in the VM team,
3. it allows quick comparison to be done amongst alternatives when alternative design schemes are being added or deleted in the partial decision stage.

However, one of the most important issues in decision-making is to "go beyond the information given" (Nisbett and Ross, 1983), i.e. to venture beyond the most immediate implications of the data. According to Nisbett and Ross (1983), it is not only people's eagerness to apply simple heuristics that leads to grief but also the failure to make necessary adjustments of initial judgements. This is particularly important in VM. Once subjects have made a first pass at a problem, the initial judgement may prove remarkably resistant to further information, alternative modes of reasoning, and even logical or evidential challenges (Tversky and Kahneman, 1974). Attempts to integrate new information may find the individual surprisingly conservative, unwilling to yield and challenging the relevance, reliability or authority of subsequent information. As a result, the method of first choice – heuristics may have disproportionate impact, while other considerations (e.g. possible sources of unreliability in the data) – have relatively little impact.

The facilitator of the VM team has to guard against this conservatism amongst members to promote the creativity approach in generating design alternatives. This is particularly crucial in the partial decision stage of the VM process.

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TOWARD AN INNOVATIVE PROCUREMENT PROCESS FOR CONSTRUCTION

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Abstract

A major weakness of the traditional construction procurement process that has been heavily criticised is its fragmented approach toward the delivery of construction projects. This has affected project effectiveness inasmuch as current procurement practices do not effectively encourage the integration, coordination and communication between participants. In addition, there is an ephemeral shifting coalition of participants and divergent goals and objectives often emanate. This inhibits the scope for creativity and innovation throughout the procurement process. To overcome the difficulties often associated with procuring projects, industry practitioners and researchers have turned to the manufacturing industry as a point of reference and a potential source of innovation. Accordingly, a concept known as Concurrent Engineering (CE) has become a focal point for research. Concurrent engineering is a holistic approach to the design, development and production of a product. A multi-disciplinary team approach is required, whereby participants are brought together during the design to determine how downstream issues may be affected by design decisions. This paper suggests that a CE approach in construction may significantly improve the way in which projects are procured. A simple model demonstrating how CE can contribute to project effectiveness is proposed.

INTRODUCTION

A recurring problem facing the construction industry is to bridge the "design and construction gap". This gap has contributed to major behavioural, cultural, and organisational differences between project individuals and groups, and, perhaps most of all, the communication process. With construction so often separated from design, much of the construction production expertise is considered to be ostracised from the design process. Attempts have been made to integrate construction production expertise into the design process and stimulate teamwork through the use of non-traditional procurement strategies.

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However such cases are rare. Thus clients often receive less than optimal design solutions as contractors are divorced from the design team's decision making processes. Furthermore non-traditional procurement strategies have not successfully accommodated the differentiated and interdependent nature of the construction process. Functional disciplines operate independently, making design decisions without considering their impact on other disciplines. Latham (1994) suggests that there is a need to coordinate and integrate individuals and groups toward a unified procurement process so as to stimulate the development of inter-organisational communication and team building.

In an attempt to reduce the difficulties often encountered with procuring projects, industry practitioners and researchers have turned to the manufacturing industry as a point of reference and a potential source of innovation. Accordingly, a concept known as Concurrent Engineering (CE) has become a focal point for research. Concurrent engineering is a holistic approach to the design, development and procurement of a product. A multi-disciplinary team[1] (MDT) approach is required, whereby participants are brought together during the design to determine how downstream issues may be affected by design decisions. This paper suggests that a MDT approach may significantly improve the way in which projects are procured by positively contributing to team and project (organisational, managerial and operational) effectiveness[2]. A simple model illustrating how CE may improve project effectiveness is proposed.

CONCURRENT ENGINEERING

Concurrent engineering is beginning to receive attention in the construction industry (eg, Evbuomwan and Anumba, 1996). The implementation of a CE methodology however, has yet to mature into a grounded theoretical construct. The concept of CE is used to shorten the cycle time of product development and production processes, as well as improving the quality of the final product. Several definitions have evolved (eg, Carter and Baker, 1992). But perhaps the most recognised is that of Winner (1988) who defines CE as "*a systematic approach to the integrated, concurrent design of products and their related processes, including manufacturing and support. This approach is intended to cause developers from the outset, to consider all elements of the product life-cycle from conception through disposal including quality, cost, schedule, and user requirements*". In essence, CE is conceptually an effort to effectively integrate all aspects of product development, by performing simultaneously a variety of activities that used to be done sequentially.

[1] A *multi-disciplinary team* consists of multiple functions/disciplines combined into one unit. This facilitates the functional interface and parallel design of activities. A broad set of skills and viewpoints are required from members' of the team. Consequently, a MDT may increase the likelihood that the output the team produces meets multi-functional requirements (Love and Gunasekaran, 1997).

[2] An effective organisation is one that satisfies the demands of those constituencies in its environment from whom it requires support for its continued existence (Pfeffer and Salanick, 1978). This approach can be viewed either as a summary measure of the organisation's goals or as a series of different weighting's for specific goals for a variety of constituencies.

The Traditional Development Process

Figure 1 illustrates the traditional sequential development process in construction. The design process for a construction project is considered to be composed of a series of dependent tasks. Different functional disciplines perform activities that are directly related to themselves. Consequently, this has led to the creation of 'walls' between disciplines over which the project is figuratively thrown once one functional discipline has completed its respective tasks. This wall has affected each discipline's ability to effectively communicate. As tasks move downstream, and information is gathered, each discipline may notice that information provided by the preceding task is inappropriate. In order to ascertain the information required, members must move upstream against the natural flow process to be able to complete their task.

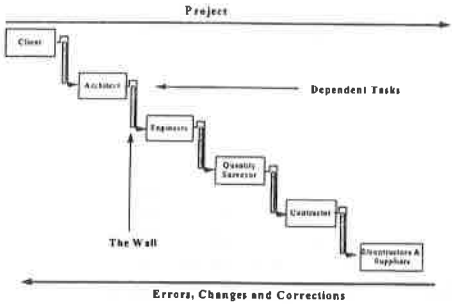

Figure 1 Traditional sequential development process

Non-traditional procurement routes have attempted to eliminate the sequential approach but have been unsuccessful. When the design process is overlapped with construction, design tasks proceed as independent tasks leading to '*sub-optimal*' design solutions. Primarily, this is due to the lack of interaction between team members, which often leads to increased uncertainty and rework. The uses of interdependent *coupled* tasks whereby information transfer is rudimentary and iteration inevitable offers a solution and are fundamental to CE.

Principles and Objectives of Concurrent Engineering

The successful application of CE to construction is dependent upon the ability of project participants to interact, exchange ideas, have common goals, and take a holistic approach to the design and construction process. Some fundamental principles and objectives of CE approach applied to construction include (Love and Gunasekaran, 1997):

- detailed analysis of client requirements;
- detailed analysis of the product life-cycle;

- development of innovative design solutions that are simple to manufacture and construct;
- integration and coordination of interdependent tasks (*coupling*);
- integration of the design, production and manufacturing processes;
- minimisation of downstream design changes;
- minimisation of non-value adding activities (*waste*);
- implementation of a multi-disciplinary team; and
- implementation of continuous process improvement.

By applying the principles associated with CE it is envisaged that clients and project participants will share several benefits. These may include:

- improved understanding and implementation of client and end-user requirements;
- improved communication and cooperation between project participants;
- improved team and project effectiveness;
- reductions in rework (eg, redesigns, non-conformances etc) and in variations; and
- reductions in project time and cost.

Significant savings in project time and cost may be achieved by adopting a holistic approach to project procurement. Such a holistic approach is initiated during the design development process by the introduction of a MDT. That is, the team essentially becomes client focused and develops common goals. The primary task of the team would be to cooperate collectively during the early stages of the design process to establish and develop a creative, innovative and functional design (product) that fulfils the clients' requirements. Typically, production planning and maintenance are not considered until late in the design process. This lack of consideration often results in redesigns downstream. Studies have shown that approximately 70% of costs associated with a project are committed during the design phase (Prasad, 1996). Consequently decisions made during the design development process (DDP) have a significant influence on the final cost and time of the project. Therefore by utilising the MDT, downstream aspects may be detected and resolved as early as possible, enabling project cost and time to be reduced by as much as 30% (Evbuomwan and Anumba, 1996).

CONCURRENT ENGINEERING APPLIED TO CONSTRUCTION

Construction project organisations are characterised by a high degree of task specialisation. This differentiation arises due to particular individuals and groups being responsible for the performance of specialised activities. Moreover it occurs in two directions: *vertically* and *horizontally*. The vertical differentiation is represented by the hierarchy moving from the client's representative, to the consultants, to the main contractor (MC), to the subcontractors and to the suppliers (Figure 2). The vertical differentiation establishes the managerial (*hierarchy*) structure, whereas the horizontal differentiation defines the various subdivisions of the structure. Simultaneously these configurations establish the formal organisational structure (Blau, 1970). Therefore to effectively apply a CE approach, we have to look beyond the traditional, pyramid-shaped organisation and implement an alternative form of

organisation that encourages open communication and minimises the barriers to information flow. It is suggested that we progress beyond the traditional boundaries associated with organisational structure toward a horizontal based organisation that focuses exclusively on the MDT. This implies that individuals and groups come together to form a MDT and work concurrently rather than sequentially, to design and develop the product and the process, and identify materials and equipment required for production.

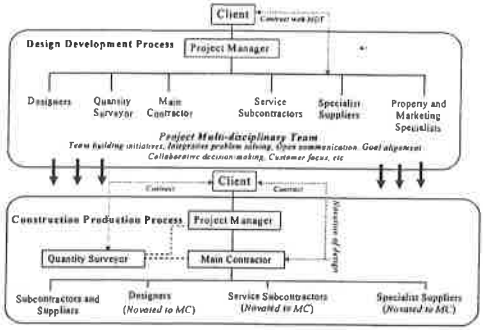

Figure 2 Proposed project structure for implementing CE

Figure 2 illustrates a simple structure for implementing a CE approach. The proposed structure is a hybrid form of management and design-and-construct system (D&C). Each member of the team is assumed to have a direct contract with the client during the DDP. The structure has been designed to encourage teamwork and influence the development of the psychosocial system. It offers the opportunity for members to work together at an early stage to collaboratively develop the design and resolve conflicts in a concurrent style. Essentially, team members perform better when they have a share in the development of the project. This has a positive effect on reducing the overall development time by limiting design iterations, variations and sacrifices in quality (Love and Mohamed, 1996). The project manager may oversee negotiations, keep track of the resources used and monitor and evaluate the progress of the design on the client's behalf during the design phase. Instead of assuming a single point responsibility (eg, D&C projects), the responsibility for the DDP is divided amongst the MDT team. For such an approach to work effectively there is a need for a leader who can act as a coordination and integration mechanism.

Research suggests that such a role should be undertaken by an independent project management organisation (Love and Mohamed, 1996). As the leader of the project, the project manager faces the challenge of obtaining the most out of the team without implying any hierarchical authority (*implied power*). The project manager is responsible for extracting a working and functional brief from the client. Together with the client, the project manager selects the MDT. It is suggested that traditional price-driven selection procedures should not

be used as they may limit the flexibility of the designers and contractors to explore innovative avenues which result in optimal performance. Furthermore traditional price-driven selection procedures are deemed to be ineffective, as they are used to ensure that clients procure their buildings for the least possible cost for a less than best product. Ideally the MDT should be selected from weighted pre-qualification criteria, past performance and through the process of negotiation. For example a reputable designer would be awarded weightings for certain criteria such as experience, personnel etc. The designer with the highest aggregate weighting would then be selected and subsequently a fee would be negotiated after the parameters for the scope of work are established.

Once the MDT has been selected, the clients' needs and requirements would then be communicated by the project manager to the team members. The client would be encouraged to be actively involved throughout the DDP, as a committed client can play a crucial role in assuming responsibility for initiating, directing and maintaining the momentum of a project (Walker, 1990). During the design development the project manager would essentially assume the role of *design brief manager*. Design specialists would present ideas on how the clients requirements can be met aesthetically and functionally; engineers design and develop the structural and services capabilities required; construction production personnel (including hydraulics, mechanical and electrical subcontractors) develop and plan workable production strategies, schedules, work methods; key suppliers propose material and equipment alternatives; and property and marketing specialists organise tenant's or purchasers.

Throughout the construction production process (CPP), the project manager would assume an active coordination role to ensure that the project runs smoothly. The MC would be novated the design and the design consultants, therefore accepting the risk and assuming single point responsibility for the CPP. The QS would take a passive role, acting in an advisory capacity to the client, project manager, and MC. The key subcontractors and suppliers would be paid a fee for their input into the design and then would also be novated to the MC. It is envisaged that the MC would offer a guaranteed maximum price to complete the project with any savings shared between themselves, the client, and possibly the designers, key subcontractors and suppliers. The key subcontractors and suppliers would be asked to submit a competitive price to undertake the work. In this case the QS would act as an auditor for the client, and would have preliminary benchmarks for the cost of the works to be undertaken. The MC would be responsible for selecting the remaining subcontractors and suppliers, although it is suggested that those who the MC had formed a strategic alliance with would be preferred. To better understand the clients requirements and improve communication between team members it is suggested that the following techniques and tools would be implemented to assist the MDT: quality function deployment (QFD); and information technology (IT).

Quality Function Deployment

Quality function deployment is a technique used to translate customer's requirements - known as the *voice of the customer* (VC) - into appropriate terms so that their requirements and needs can be satisfied. The technique's basic principle resides in the conviction that

products must be designed to reflect the customers' desires and tastes; hence the importance of the MDT. The QFD process begins by analysing and listening to customers to determine the characteristics of the product. Through detailed discussion during the design process each customer's needs and preferences are defined and broken down into categories called customer attributes. Customer attribute information forms the basis for a matrix called the house of quality (see Clausing, 1994). By building a matrix of customer requirements the multi-disciplinary QFD team can use customer feedback to make design, engineering and production decisions. The matrix assists the team to translate customer attribute information into specific operating goals. The important product characteristics and goals for improvement are *jointly* agreed on and detailed in the house of quality matrix. This process encourages the different disciplines to work closely together and results in a better understanding of one another's goals: ultimately the team becomes customer focused.

Information Technology

The extensive development of computer aided engineering (CAE) may aid the implementation of CE. By using CAE, most facets of the product development process can access the same design from different disciplines by using a common CAE database. In implementing CE there must be a convenient platform on which different organisations involved in procuring a project can work and communicate simultaneously. For example, for architects and engineers, this platform could be an advanced CAD/CIC/CAM which has solid and parametric modeling capabilities. Increasing evidence suggests that utilising CAD/CIC/CAM can lead to major reductions in development time (Voss *et al.*, 1986).

By applying CE and utilising QFD and IT, it is suggested that the cultural, behavioural and organisational barriers that currently exist between disciplines can be eliminated. Consequently this may improve team and project effectiveness.

CONCURRENT ENGINEERING AND PROJECT EFFECTIVENESS

A simple model demonstrating the potential of a CE approach for improving the effectiveness of project procurement is illustrated in Figure 3. Integral to CE is the ability of team members to become customer focused as early as possible in the project. As mentioned, QFD is a technique that enables team members to understand exactly what customers require. As the team is brought together early in the DDP and QFD is implemented, it is suggested that this may stimulate a high degree of commitment and an increased level of motivation from team members. For teamwork to flourish within a MDT, all members need to pursue common goals. These goals will be basically formulated by the project manager at the beginning of the project. Once these principal goals have been collectively agreed, then together with the project manager the project team will establish a group mission, a series of project objectives, milestones and a number of critical success factors and performance indicators. But perhaps more importantly the goals that are established need to be realistic. Consequently progress toward them should be seen to be a significant motivation factor for team members.

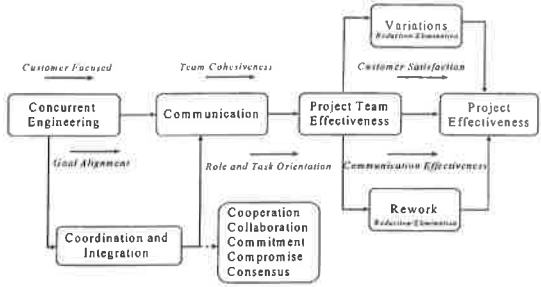

Figure 3 Concurrent engineering and project effectiveness.

Implicitly, project effectiveness is intricately linked with the ability of the project team to be cohesive. Cohesiveness is the extent to which individuals or groups are attracted to a team and desire to remain in it (Levine and Moreland, 1990). The degree of cohesiveness in a group is a complex phenomenon that results from combining the net *attraction* or *repulsion* for each member (Kast and Rosenzweig, 1985). As values, norms and attitudes invariably differ, there will be instances when either attraction or repulsion will occur. Hence, there may be instances that lead to either highly functional or dysfunctional teams.

The degree of cohesiveness in a team can lead toward uncoordinated or coordinated behaviour. If each individual and group aligns their goals with that of the project organisation (eg, time, cost, quality, client satisfaction, innovation etc), then behaviour will most likely be functional from an organisational perspective. Nevertheless, each participating individual and group will invariably have sub-goals which they will follow (eg, marketing, turnover, survival, training, etc). These may clash with one another, and may not be compatible with those of the project. As mentioned above it is therefore important that the project manager aligns these sub-goals with those of the project so that there is a *win-win* scenario for those concerned. The likelihood of the project team becoming cohesive will be increased through the use of MDT. However, excessive levels of team cohesiveness may have dysfunctional consequences such as tendencies to negatively stereotype outsiders, team illusions of invulnerability, and team isolation.

The nature of a project organisation has an adverse affect on project effectiveness because of inherent ambiguity in role and task orientation experienced by individuals and groups (Katz, 1982). Therefore the CE approach attempts to eliminate role ambiguity through the use of the MDT. A degree of empowerment is given to team members as they are encouraged to be creative and innovative. Each member is made aware that they are solely accountable to the project manager. Furthermore, team members are given a role to perform and are

subsequently encouraged to interact with each other. As the degree of cohesiveness between members becomes explicit, role and task orientation will evidently become multi-functional.

Communication has been linked to team effectiveness, the integration of work units across organisational levels, characteristics of effective supervision, job satisfaction, and overall organisational effectiveness. In fact, Shockley-Zalaback (1991) suggests that organisations are essentially complex communication processes that create and change events. Consequently, improved organisational communication will play a significant part in determining the effectiveness of a CE approach to construction. The degree of communication effectiveness is essentially a product of the MDTs ability to gel as a cohesive unit. The horizontal structure proposed in Figure 2 allows team members to have greater accessibility to one another. This enables a greater degree of interaction between team members, thus contributing to an effective communication process. Information technology has an important role to play as information can be stored more efficiently and decision-making enhanced. Moreover, IT can be used as an interface between functional disciplines, facilitating rapid information exchange, and shared information. Improving the flow of information during the DDP will consequently minimise variations and rework. As variations and rework are minimised, perhaps even eliminated, then a greater degree of client satisfaction will be attained.

A CE approach seeks to produce an effective team that is cohesive and motivated in directions that are in line with the project goals. A MDT encourages face-to-face relationships and interaction between team members, thereby improving the communication process. Overall project effectiveness and efficiency will depend on the coordinated efforts of the individual's and the group's ability to become customer focused and work together toward common goals within a projects' organisational system. Nevertheless inter-group conflict will be an inevitable fact, consequently its dysfunctional aspects should be recognised and managed accordingly. A CE form of organisation may stimulate team building, inter-group problem solving, and inter-group relations, all of which are not considered to be adequately catered for by today's procurement strategies.

CONCLUSION

The construction industry is heavily criticised in for its fragmented approach to construction. Inter-organisational communication has suffered inasmuch as each discipline has become dedicated to the optimisation of its own function with little regard, or understanding of, its effect on the performance of the construction process. This has affected the ability of participants to form effective teams, and consequently hindered project effectiveness. There is a need to encourage interaction and open communication between project participants so as to stimulate an innovative and functional product that better meets the needs of clients. A CE approach to project procurement has been advocated as being the elixir for improving project effectiveness. This approach attempts to integrate all aspects of product development into a unified process, by performing tasks concurrently.

A project structure for implementing CE focusing on a multi-disciplinary team has been introduced. It is suggested that the main contractor, key subcontractors and suppliers should be introduced during the design development process to determine how downstream issues may be affected by design decisions. It has been proposed that a CE approach to project procurement could significantly improve project effectiveness. A simple model demonstrating how CE can contribute to project effectiveness was presented. By introducing a CE approach focusing on the facets of the MDT, it is argued that the psychosocial system will be encouraged to develop. This may lead to an effective team that is cohesive and motivated in directions that are in line the project goals.

Before a concurrent engineering approach can be practically implemented we suggest that further research with regard to contractual and selection procedures is required.

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LA PASSATION COMPÉTITIVE DES MARCHÉS: ÉTUDE ET ANALYSE DE TRAVAUX PUBLICS EN SUÈDE

A.S. Mériaux*

Abstract

Competition is considered necessary to develop a robust and innovative public works sector. Public sector legislation strives to encourage competition between civil engineering companies; however, in many cases, pro-competition laws hamper innovations because of the emphasis they place on traditional tendering. New forms of tendering must be developed and tested to strengthen the industry.

A survey of contemporary calls for tenders provided a reference for making future evaluations of new contracts. In Sweden, where 85% of the civil engineering market is controlled by five companies, 300 tenders were analyzed out of a total of 1000 released from January 1994 to June 1996. Of the 150 companies that responded with tenders during this period, 70 were awarded contracts. There were on average 7 bids per tender with wide variations in price. Generally, the lowest price bids won, but in a few cases higher priced proposals showing superior quality were retained.

Competition, Innovation, Public Works, Tenders, Tendering, Civil Engineering

INTRODUCTION

Antécédents

Par consensus général, on admet que la forme actuelle des contrats pour les projets d'infrastructures ne donnent pas suffisamment de motivations pour développer de nouvelles techniques et méthodes (Atkins, 1994). Pour stimuler les innovations il faut donc développer de nouvelles formes de contrat. L'adaptation progressive des règles suédoises aux règles européennes conduit, dans une certaine mesure, à des exigences différentes concernant la passation des marchés et la concurrence. C'est pourquoi il est important que les nouvelles formes de contrat soient adaptées aux directives européennes.

Les formes de contrat qui ont pour but de stimuler un procédé innovateur exigent des entrepreneurs un haut niveau de compréhension globale et des compétences techniques. Pour que ces

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intentions soient remplies, il faut qu'il y ait suffisamment d'entreprises qui satisfassent ces exigences. Les demandes qu'imposent ces nouvelles formes de contrat pourraient finir par influencer la concurrence. Un premier pas vers le développement de ces nouvelles formes de contrat serait donc d'étudier le rôle de la concurrence de nos jours.

But de l'étude

Le but de cette étude est de clarifier la situation de la concurrence et de la passation des marchés pour des projets d'infrastructure en Suède. D'une façon générale, ce travail devrait aboutir à une meilleure connaissance du rôle de la concurrence dans le secteur des travaux publics. Plus spécifiquement, l'objectif de ce projet est de développer des outils (tels que des modèles pour l'évaluation des offres) qui facilitent le travail des maîtres d'ouvrage (dans ce cas, la Direction des routes) pour choisir la meilleure entreprise lorsqu'on utilise de nouveaux types de contrat.

Les limites de l'étude

L'étude couvre la passation des marchés (PM) menée par le Direction des routes (DR) entre janvier 1994 et juin 1996. Durant cette période, environ 1000 projets d'une valeur supérieure à 1 million de couronnes suédoises (0.15 million $ US) dans chaque cas ont été traités. Parmi ceux-ci, 300 ont été étudiés d'une façon plus détaillée. Les marchés ont été classés selon le type de travaux concernés: la construction de nouvelles routes et de nouveaux ponts, la réhabilitation de ces mêmes types d'ouvrages, les opérations de revêtement des chaussées ainsi que des travaux de maintenance et d'entretien (M & E).

Méthodes d'enquête et d'analyse

Le travail a commencé par une étude de la littérature qui a conduit à une connaissance plus approfondie de la législation en vigueur et des théories sur la concurrence. La collecte d'informations a été menée de deux façons. Dans le premier cas, un travail d'information a été fait auprès d'une association (Byggfakta AB); le but était de rassembler et de répartir les informations concernant le secteur des travaux publics. Dans le deuxième cas, les informations sur les PMs qui ont été étudiées plus en détail, ont été recueillies lors de visites dans les régions. Les différentes classes de travaux concernés (constructions, revêtements etc.) ont été retenues en fonction des différents types de travaux effectués suite aux marchés accordés. Les informations ont été entrées dans une base de données pour faciliter leur interprétation.

LA PASSATION DES MARCHÉS PUBLICS EN SUÈDE

La passation des marchés de projets routiers est le plus souvent une affaire publique régie par des lois élaborées spécialement dans ce but. La Loi sur la concurrence et la Loi sut la passation des marchés publics sont les plus importantes réglementations que les maîtres d'ouvrage doivent respecter. La Loi sur la concurrence est adaptée aux règles européennes correspondantes et de ce fait elle est reliée aux articles 85 et 86 du Traité de Rome. Cette loi traite les accords qui limitent la concurrence comme la formation de cartels, de consortiums illégaux, de collaboration sur les prix ainsi que des abus de position dominante. La Loi sur la passation des

marchés publics règle la façon d'organiser l'appel d'offres et prescrire les délais, la forme des contrats etc. pour des achats aux niveaux national et municipal.

Les PMs qui dépassent 5 millions d'Euros (environ 5.8 millions $ US) doivent être annoncées au Journal Officiel de la Commision européenne et dans la base de données 'Tenders Electronic Daily'. La procédure de passation des marchés doit être habituellement ouverte ou sélective. L'adjudication négociée est permise dans certaines circonstances. Les PMs qui sont inférieures aux seuils fixés doivent être normalement effectuées par une procédure simplifiée. En bref, cela signifie que tous les fournisseurs et entrepreneurs ont le droit de participer, que les fournisseurs participants doivent déposer une offre écrite et que l'autorité a le droit de négocier avec un ou plusieurs soumissionnaires. L'appel d'offres pour les entrepreneurs concernant le marché se fait soit par annonce dans un quotidien soit par invitation directe.

L'autorité retient soit l'offre qui a le prix le plus bas, soit celle qui est économiquement la plus avantageuse en prenant en considération des conditions comme le prix, les coûts d'exploitation et de maintenance, la qualité, la fonctionnalité, l'impact sur l'environnement etc. Si l'autorité a choisi au départ d'accepter l'offre économiquement la plus rentable, elle doit faire apparaître dans le dossier d'appel d'offres les critères qu'elle va évaluer, l'importance qu'elle va leur associer et comment le classement sera fait. Durant la phase d'évaluation, l'autorité ne peut pas changer les données dans le dossier. Si pour une raison quelconque l'évaluation était faite d'une autre façon, il faudrait absolument recommencer la PM. Il est considéré comme discriminant de ne pas laisser les entrepreneurs refaire leur soumission.

Une offre avec des propositions alternatives ne peut être acceptée que si cette condition a été indiquée dans l'annonce ou dans le dossier d'appel d'offres. Une proposition très basse peut être refusée si l'on considère qu'elle n'est pas réalisable, mais il faut d'abord demander une explication à l'entrepreneur.

LA CONCURRENCE

La structure de notre société est bâtie sur le fait que la vie économique est soumise à une concurrence aussi libre que possible. En général, on considère que la concurrence libre conduit à une croissance rapide ainsi qu'à une bonne exploitation des ressources existantes (Liman, 1994). Dans la réalité, le marché est influencé par différentes sortes d'interventions et de réglementations. Les autorités s'efforcent, dans une certaine mesure, d'égaliser la répartition des revenus et les conséquences négatives de la conjoncture. Les entreprises qui acceptent de concourir ne jouissent pas toujours d'une pleine concurrence puisque les plus faibles d'entre elles tendent à être éliminées. Les entreprises essaient donc de se protéger des risques inhérents à la concurrence par des actions qui tendent à limiter cette dernière comme la formation de cartels, la collaboration sur les prix etc.

On mesure la concurrence dans le secteur de la construction par le nombre des entreprises qui apparaissent sur le marché, même si cela n'est pas toujours un bon indicateur. Parfois l'exploitation à grande échelle d'une entreprise donne des avantages économiques à toute la société, parce qu'une grande entreprise peut être plus efficace que plusieurs petites. En effet, les grandes entreprises peuvent avoir plus de ressources à investir dans le développement

économique et souvent plus de facilités pour adapter leur production à la situation et à la position géographique de projets particuliers. En revanche, une concurrence efficace oblige les producteurs à fabriquer exactement les produits que les clients demandent pour le prix qu'ils sont capables de payer. Une forte concurrence oblige aussi les entreprises à développer de meilleures techniques et à produire aussi bon marché que possible. Le degré de concentration, le nombre d'entreprises et leur importance sont d'autres indicateurs de la concurrence pour un marché donné.

Le secteur de la construction est constitué d'un petit nombre de grandes entreprises œuvrant à l'échelle nationale et d'une quantité de petites entreprises. Depuis le début des années '90, le nombre d'entreprises de taille moyenne a diminué soit parce qu'elles ont été rachetées par de grandes entreprises, soit parce qu'un certain nombre d'entre elles a fait faillite.

Les entreprises étrangères ont été relativement rares sur le marché suédois jusqu'à présent à cause des contraintes sous forme de difficultés concernant les normes de construction et les règles administratives comme, par exemple, le droit au travail. De plus, les maîtres d'ouvrage ont probablement tendance à protéger les entreprises suédoises de la concurrence étrangère. L'adaptation aux règles européennes et le passage à l'utilisation de normes européennes devraient donner plus de possibilités aux entreprises étrangères sur le marché suédois. Ces facteurs pourraient renforcer la concurrence au sein du secteur de la construction.

L'importation des services et des matériaux de construction est également faible, mais une augmentation des importations améliorerait considérablement la pression de la concurrence. Cela permettrait aussi la possibilité de satisfaire le besoin d'une plus grande variété de produits.

LA CONCURRENCE DANS LE SECTEUR DES TRAVAUX PUBLICS

La Direction des routes, qui relève de l'État, est le maître d'ouvrage de tous les travaux sur le réseau routier en dehors des villes. La Direction est divisée en sept bureaux régionaux dont les marchés sont à peu près semblables. Les données sur toutes les PMs qui ont été réalisées durant la période de janvier 1994 à juin 1996 (environ 1000 cas) sont présentées brièvement. Environ 300 marchés des sept bureaux régionaux de la DR ont été étudiés d'une façon plus détaillée.

Types de contrats

80% de tous les projets ont été passés selon des contrats traditionnels avec des entrepreneurs généraux, ce qui signifie que toutes les études d'ingénierie étaient terminées lorsque les entrepreneurs sont intervenus. Deux autres types de contrat ont été passés selon l'approche clé en main et le contrat par lots séparés. L'étude décrite dans cet article porte sur des marchés passés par contrats traditionnels. Les contrats M & E sont tous passés comme des marchés clé en main, comportant une période prolongée de responsabilités connu sous le nom de 'contrat de fonction'.

LE MARCHÉ

La DR dirige aussi sa propre entreprise de travaux publics (la DPDR) qui jusqu'à récemment, avait un monopole total. Au début des années '90, le parlement décida que ce type d'activité devrait être privatisé. La construction et le revêtement d'asphalte ont, depuis 1994, été complétement exposés à la concurrence. La privatisation a été cependant partiellement arrêtée et la DPDR est toujours assurée d'obtenir une ertain nombre de travaux de maintenance et d'entretien.

Dans toute la Suède, il y a environ 150 entreprises qui déposent plus ou moins souvent des offres pour des projets de construction de routes ou pour le revêtement des chaussées. L'étude montre que seulement un peu plus de la moitié d'entre elles ont été employées pendant la période mentionnée. Parmi celles-ci, cinq entreprises se partagent 85% du marché. La DPDR qui a la plus grande part du marché de toutes les régions, est une de ces entreprises. La Skanska et la NCC sont les plus grandes entreprises privées et la DR est un de leurs plus grands maîtres d'ouvrage.

Figure 1. Répartition des parts de marché concernant la construction et le revêtement des chaussées.

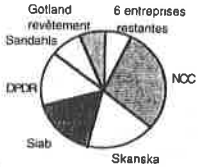

Figure 2. Répartition des parts de marché concernant les travaux de revêtement des chaussées.

Les entreprises nationales ont une forte implantation dans la plupart des régions. Elles travaillent également dans presque tous les domaines d'activités; de plus, elles ont l'avantage de pouvoir proposer des travaux de grande envergure et d'avoir des connaissances locales et des contacts proches avec les constructeurs locaux.

Il est relativement rare qu'une petite entreprise inconnue fasse une offre et encore plus rare qu'une telle entreprise soit employée. Dans la région du nord, il arrive cependant que ce type d'entreprise (en général des entreprises finnoises) participe à la concurrence.

Sur environ 90 opérations de revêtement étudiées, 20 entreprises avaient déposé des offres et douze d'entre elles ont été employées. Skanska et NCC réalisent près de 50% de tous les travaux. Ces deux entreprises sont aussi les plus grandes productrices de ballast et d'asphalte. Si l'entreprise a à sa disposition une carrière de ballast et une station de production d'asphalte dans un rayon proche du chantier, on peut s'attendre à ce que le prix proposé soit compétitif. Le nombre de producteurs de ballast est relativement limité en Suède. Les marchés de ballast existent seulement à l'intérieur de zones situées autour de chaque carrière (concasser des graviers exige une autorisation administrative). Si une entreprise n'a pas naturellement accès à une carrière située à une distance raisonnable, elle risque d'avoir besoin d'augmenter son prix à cause du coût du transport. Le marché de l'asphalte est également limité à des zones situées à

l'intérieur d'un certain rayon (environ 200 km de la station de production). Les deux entreprises qui ont les plus grandes parts du marché de la production d'asphalte se partagent environ 75% de la totalité.

En ce qui concerne l'adjudication de la M & E, la DPDR réalise environ 75% de tous les travaux. En effet, pour ce type d'opération, la DR a eu des difficultés pour trouver un nombre suffisant d'entrepreneurs capables de mener ce genre de travail à terme. En 1994, 25 entreprises ont déposé des offres mais seules quatre d'entre elles ont été employées pour réaliser les travaux. En 1996, les chiffres s'élevaient à 8 et 3 respectivement. Les contrats de ce type de travaux durent normalement trois ans et de ce fait ils n'ont été exposés à la concurrence qu'une ou deux fois. Le caractère particulier du travail et les longs délais exigent de bonnes connaissances et de l'expérience pour bien calculer le prix et pour diriger la mission d'une façon continue et satisfaisante. Dans la plupart des cas, la DPDR proposait les offres les plus avantageuses en ce qui concerne le prix. Elle a également obtenu les meilleurs points pour les paramètres souples mentionnés ci-dessous. C'est pourquoi la DPDR, à cause de sa longue expérience, a été jugée comme la plus capable de mener à bien les travaux de M & E.

Le nombre et la dispersion des offres

Quelques-unes des PMs avaient une valeur nominale supérieure au seuil des normes européennes; par conséquent, la plupart des PMs ont été abordées selon la procédure simplifiée. En général le maître d'ouvrage avait invité neuf ou dix entreprises à faire une offre, mais le nombre d'offres reçues se situait en moyenne à sept. Pour les travaux de revêtement des chaussées, onze à douze entrepreneurs sont généralement invités. Cependant le nombre de soumissions est souvent plus faible (environ 6 par PM). La plupart de ces appels d'offres sont faits sur invitation plutôt que par annonce. Si un entrepreneur se considère négligé, il a le droit de faire appel mais cette possibilité n'est presque jamais utilisée.

Les entreprises considèrent que la DR est un maître d'ouvrage professionnel et compétent (Henningsson, 1996). Le Bureau de la concurrence a néanmoins reçu plusieurs fois des plaintes de la part d'entreprises privées concernant des institutions publiques agissant dans le cadre des PMs. Certaines se rapportaient à la DPDR car ces entreprises soupçonnaient que des offres avaient été volontairement sous-évaluées. De plus, elles pensaient qu'il n'était pas bon que la DPDR ait un monopole sur certains travaux et qu'en même temps elle puisse se positionner en concurrent sur les marchés ouverts (Kommerskollegium, 1996).

Les soumissions en ce qui concerne les PMs de construction présentent de grandes variations. La dispersion des prix est remarquable puisque ce type de contrat suppose que les entreprises fixent leurs prix en fonction des quantités déjà préparées (sauf pour les ponts, pour lesquels les quantités sont moins bien définies). À l'exception des valeurs extrêmes, les prix étaient moins de 30% plus élevés que le prix des soumissions retenues (voir Fig. 3). Les offres extrêmes apparaissent généralement pour des travaux dont la valeur est inférieure à 3 millions de couronnes (0.43 million $ US). La différence de prix est sans doute due au fait que les fournisseurs et les entreprises de transport exercent une plus grande influence concernant les 'petits travaux'.

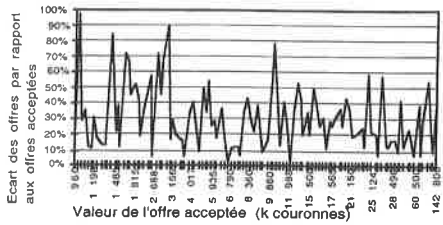

Figure 3. Offres les plus élevées concernant les PMs de construction: distribution des prix extrêmes des PMs, exprimés en pourcentage des offres retenues.

Environ 20% des offres les plus élevées proviennent d'une même entreprise dans une région particulière où il est intéressant de noter que cette entreprise a la plus grande partie du marché dans la région. On peut donc supposer que cette entreprise dépose des offres dans le but de montrer au maître d'ouvrage qu'elle est toujours intéressée par le fait d'être invitée aux PMs. On peut se poser la question de savoir s'il est nécessaire dans cette optique de se situer aussi haut par rapport au prix accepté. On peut aussi émettre l'hypothèse que l'entreprise ne savait pas que ses offres s'écartaient dans ces proportions. Cette grande dispersion des prix peut aussi être due à un dossier d'appels mal rédigé, laissant trop de place aux suppositions. Par contre, les entreprises peuvent, de leur propre intiative, faire des propositions techniques autres que celles demandées dans l'appel d'offres.

Dans certains cas, toutes les offres étaient entre 40% et 60% plus chères que celle qui a été retenue. Il est possible que l'entreprise qui a été choisie ait fait une offre de complaisance pour se faire une place sur le marché ou bien qu'elle ait oublié une partie du dossier d'appel et qu'elle ait fait une offre erronée - situation que le maître d'ouvrage aurait dû découvrir.

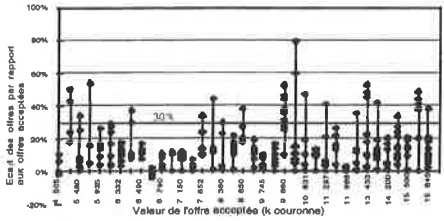

Figure 4. Exemple des écarts des soumissions concernant des projets de construction.

La fréquence de participation aux PMs par des entreprises qui ont déjà été employées est un facteur intéressant. Celles qui obtiennent la plupart des travaux sont aussi celles qui ont déposé des offres le plus souvent (à l'exception d'une firme qui a soumis une offre dans 90% des cas mais qui n'a obtenu que 6% de l'ensemble des projets).

Les offres pour les travaux de revêtement des chaussées montrent un écart moins élevé (environ 20%).

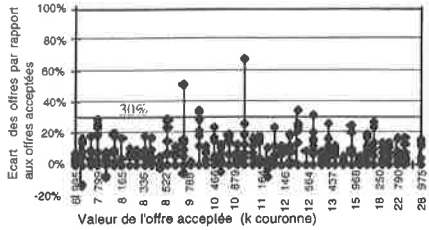

Figure 5. Répartition des offres concernant les PMs des travaux de revêtement.

Les travaux de revêtement sont uniformes et ne laissent pas de place aux variations techniques. Il est probable que les offres viennent d'entreprises qui ont accès aux matières premières (ballast et asphalte) sur des distances raisonnables.

La dispersion des prix concernant des travaux de M & E en 1994 était nettement plus importante que celle de la construction neuve.

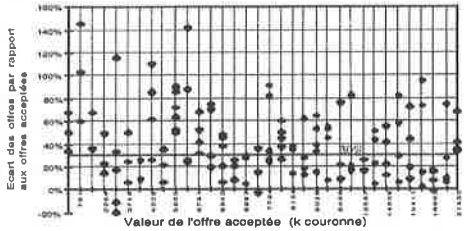

Figure 6. Répartition des offres concernant les PMs des M & E en 1994.

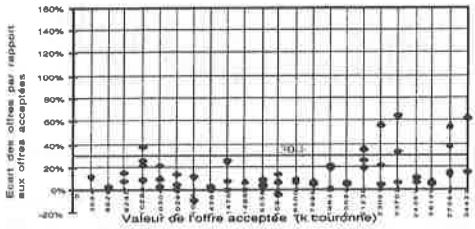

Figure 7. Répartition des offres concernant les PMs des M & E en 1996.

Il est probable que ces grandes différences étaient dues au fait que ce type de travaux était mis en concurrence pour la première fois et que les entreprises n'avaient qu'une idée approximative de ce que cela représentait. En 1996, les offres étaient nettement moins dispersées parce qu'il y avait moins d'entreprises disposées à préparer des offres qui risquaient d'être peu fructueuses comme en 1994, ou qu'elles avaient plus d'informations sur les travaux à effectuer.

MÉTHODE D'ÉVALUATION DES OFFRES

La plupart des appels d'offres sont effectués sur invitation à environ une dizaine d'entreprises auxquelles on propose le plus souvent de fixer des prix sur les quantités prévues dans le dossier d'appel d'offres. La concurrence se joue surtout sur le prix et parfois sur les délais et, depuis quelque temps, sur la qualité ou d'autres paramètres qui sont pris en considération. Les offres étant de ce fait plus complexes, la DR a développé des modèles pour mesurer ces paramètres et pour les comparer avec les prix. Les régions qui dépendent de la DR se comportent en grande partie d'une façon autonome et ne respectent pas le même modèle d'évaluation. Par contre, les PMs de M & E ont adopté depuis 1994 un seul modèle d'évaluation qui est employé dans toutes les régions. L'adjudication des travaux de revêtement est généralement traitée de façon traditionnelle sans prendre en considération les 'paramètres souples'.

Les paramètres 'souples', fixés à l'avance par le maître d'ouvrage, sont évalués par pondération et des points sont attribués à chaque entreprise. La qualité, c'est-à-dire la façon dont l'entreprise se comporte à l'égard du contrôle de ce paramètre, de même que les références de l'entreprise concernant la qualité des travaux antérieurs sont aussi évaluées. Les points sont finalement ajustés suivant des rapports fixés à l'avance, comme par exemple: prix 50%, qualité 20%, etc. La manière dont le maître d'ouvrage juge la qualité des entreprises peut influencer le choix final. Dans certaines régions, les offres sont examinées par différentes personnes; dans d'autres la DR discute avec les entrepreneurs avant l'évaluation des offres.

Il y a parfois des problèmes avec les modèles d'évaluation lorsque la pondération des paramètres souples n'a pas été mentionnée dans le dossier d'appel d'offres. Il peut arriver que ces paramètres n'aient pas été fixés au moment de l'appel ou qu'ils aient été modifiés durent la PM. Malgré la complexité des modèles, c'est souvent l'offre la plus basse qui est encore retenue.

Les grandes entreprises sont généralement cotées à environ 75% pour la qualité alors que les petites ne le sont qu'à 65%. Ces valeurs sont généralement dues au fait que les grandes entreprises ont plus de ressources pour miser sur la qualité et plus de facilités pour s'adapter aux nouvelles tendances. Si le paramètre 'qualité' devient un enjeu important dans le choix de l'offre, il est évident que les petites entreprises doivent à leur tour miser sur ce paramètre. Dans cette optique, les calculs ont montré qu'une offre qui reçoit un maximum de points pour la qualité subit une augmentation de 1,5% du prix (Henningsson, 1996).

On utilise le même modèle d'évaluation dans toutes les régions pour les offres de M & E. On n'utilise pas de paramètres mais on vérifie à l'avance que l'entreprise satisfait certaines exigences essentielles.

CONCLUSIONS

En Suède, l'image de la concurrence est marquée par le fait que peu d'entreprises sont impliquées dans les PMs. Quelques offres d'entreprises étrangères - en général des autres pays scandinaves - sont parfois reçues.

Une méthode complémentaire pour mesurer la concurrence consiste à calculer le degré de concentration du marché. Celui-ci correspond à la somme du carré des parts de marché des entreprises. Puisque cinq entreprises se partagent 85% du marché tandis que les 65 entreprises restantes se partagent 15%, le coefficient de concentration est donc: $0,85^2 + 0.15^2 = 0,745$ sur une échelle de 0 à 1, c'est-à-dire un degré de concentration relativement élevé. Un degré de concentration assez élevé est souvent associé à une situation où l'influence des entreprises sur les produits et les prix est considérable; il peut être aussi l'expression d'une qualité très variée (Kommerskollegium, 1996).

Ces répères traditionnels ne sont pas toujours de bons indicateurs pour mesurer la concurrence. En effet, le nombre d'entreprises sur le marché n'indique pas la situation de la concurrence si seulement la moitié de ces entreprises est impliquée dans les PMs. D'ailleurs, il y a des théories qui prétendent qu'une bonne concurrence existe dès qu'il y a deux concurrents (Kommerskollegium, 1996).

Lorsque les variations de prix concernant certains types de travaux sont excessives, on ne peut pas considérer qque les entreprises concernées participent à une vraie concurrence. Les différences de prix peuvent être influencées par le degré de liberté offerts aux entreprises qui soumissionnent pour des contrats innovateurs. Dans ce cas il est important de pouvoir évaluer une offre en se référant à d'autres paramètres que le prix initial, car un prix élevé pour une construction technique peut s'avérer judicieux à la longue si les coûts d'entretien et de renouvellement sont bas.

Cependant, lorsqu'on introduit de nouvelles formes de contrat, il est important d'éliminer les facteurs qui peuvent limiter la concurrence. Les modèles d'évaluation qui accompagnent ces nouvelles formes de contrat doivent être normalisés pour que les entreprises puissent les reconnaître. Enfin les entreprises ne doivent pas être obligées de dépenser trop d'argent pour répondre à un appel d'offres.

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PROCUREMENT STRATEGIES WHICH ENCOURAGE INNOVATION: THE FUNDAMENTAL ELEMENT OF SUSTAINABLE PUBLIC INFRASTRUCTURE SYSTEMS

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ABSTRACT

The efficiency and effectiveness of public infrastructure systems and services often determine regional economic performance and quality of life. These systems supply basic human necessities of water, water treatment, power, and shelter, and permit the easy movement of people, information, and goods. Yet, direct public investment in infrastructure constitutes only a tiny fraction of GDP, and will never represent more than a strong strategic signal from government as to societal directions, needs, and requirements. Government procurement strategies are critically important in establishing the terms upon which public and private investment, resources, talent, and energy are applied to infrastructure services. Procurement strategies which encourage innovation in infrastructure facilities are a fundamental pre-requisite for sustainable delivery of ever improving infrastructure service, and, in turn, regional economic performance. Projects from the United States, Hong Kong, and Canada are described in the context of how procurement strategies shape innovation in the provision of public infrastructure. Recommendations and a framework for more flexible project delivery and finance are presented.

INTRODUCTION

At the macro level, the ownership, delivery, and operation of infrastructure facilities is a joint public/private activity in many modern economies. Table 1 illustrates this point in the case of the United States, where two-thirds of the nation's public capital stock is privately held.

Table 1 Private/Public Nonresidential Net Capital Stock 1988

Capital Stock	*Trillions of Dollars*	*Percent of Total*
Total	6.8	100
Total Private	4.4	64
Total Public	2.5	36
State and Local	1.7	25

"Capital stock" includes equipment and structures but excludes land inventories and rental residential real estate. (Munnell, 1990)

Public/private cooperation is really a de facto requirement for long term provision of infrastructure facilities. Using the United States and the Commonwealth of Massachusetts as examples, Table 2 indicates that the capital stock described in Table 1

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cannot be properly maintained and replaced on a sustainable basis through public expenditures alone.

Table 2 The American Infrastructure Development Context

US National Gross State Product	$6.0 Trillion
Total US Government Expenditures	$1.30 Trillion
State of Massachusetts GDP	$0.16 Trillion
US Total Infrastructure Spending	$0.04 Trillion
State of Massachusetts Transportation and Construction Budget (Estimated)	$.001 Trillion

(Morgan et al., 1996; CBO, 1995)

Over the last two hundred years, American infrastructure development has been a process of action/reaction on a societal scale between the public and private sectors. Cumulatively, the procurement process has produced innumerable public-private interactions in which constant substitutions have been made in government, officials, firms, technologies, and infrastructure facilities (Miller, 1995a). Procurement systems are the conduit through which innovative methods, techniques, and technologies for infrastructure facilities have been introduced. This paper examines how procurement strategies for project delivery and finance affect both the nature and source of innovation in infrastructure facilities.

BASIC DISTINCTIONS BETWEEN SEGMENTED AND SYSTEM APPROACHES TO PROJECT DELIVERY

The hypothesis of this paper is that choice of project delivery and finance method has a profound impact on the existence and source of innovation in infrastructure systems by dramatically changing the nature and sequence of the elements associated with design, finance, construction, operation, and maintenance of projects. Whether private sector contractors provide one, a few, or all of these key elements is a significant determining factor in the nature and source of innovation. The distinction between segmented and system based approaches to project delivery plays an important role in the source and nature of innovation, which is described below.

SEQUENTIAL DESIGN, BID, BUILD

Figures 1 presents a typical sequence for the commonly used sequential Design-Bid-Build delivery method. The US is used as an example. For federal projects in the United States, this procurement method is mandated by law. Design-Bid-Build can be characterized as a segmented procurement approach because each major element of the delivery process is separated, by statute, by rule, or by contract from each other element.

In the Design-Bid-Build method, the government need is identified and direct public financing arranged, typically through tax revenues or user fees. The design team is then procured, and a complete design furnished. Next, a firm fixed price contractor is selected to perform the work, after which the government receives the facility for life-cycle operation and maintenance. Government takes responsibility for maintenance and operation costs throughout the life of the project.

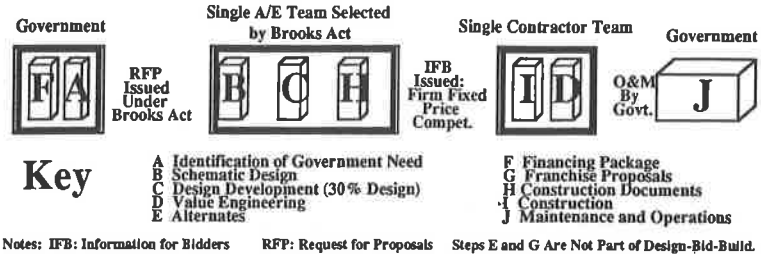

Figure 1 Typical Procurement Process for Design-Bid-Build

THE AMERICAN CONSTRUCTION GRANTS PROGRAM ("CGP") FOR WASTEWATER TREATMENT PLANTS

The US EPA Construction Grants Program is a good example of the Design-Bid-Build procurement approach (Congress, 1972). Over $60B US was provided in federal grants to subsidize the design and construction of municipal waste water treatment plants, lateral and interceptor lines, and pumping stations throughout the country. The federal government reimbursed up to 75% of costs incurred, with states, such as Massachusetts, providing an additional 15%. Cities could procure the design and construction of waste water treatment facilities for 10% of actual costs, which were obtained through locally collected user fees. Procurement regulations issued by the EPA established a segmented Design-Bid-Build process for these facilities, including standard grant agreements between the cities and the US EPA, standard engineering contracts between the cities and their engineers, and standard construction contracts between the cities and their general contractors (EPA, 1975). Municipal grantees were required to execute these prescribed form agreements with EPA, with designers, and with constructors as a condition of receiving federal funds. The program produced significant water treatment works using the Design-Bid-Build method.

The CGP produced innovative conduct, but not the kind expected. Only well-established engineering concepts for wastewater treatment were used. The regulations defined conventional treatment processes as those based on "treatment (by means of biological or physical/chemical unit process) and discharge to surface waters" (EPA, 1972). "[A]lternative" and "innovative processes" could be used only if approved specially by EPA. Few municipal grantees took this route, although reimbursement could be raised from 75% to 85%.

With a 90% subsidy, early grant recipients found that oversizing their facilities was an innovative way to fund future expansion now. Many plants were designed to fill expansive projections of future needs, when both current and future needs could be met with a 90% federal subsidy. The Clean Water Act required cities to meet specified discharge limits, but there was little incentive for cities to investigate more effective means to meet these limits, since engineering alternatives were not eligible for 90% matching funds, and would instead require "100 cent" dollars collected through higher sewer fees or higher real estate taxes (Stiefel, 1994). Other "innovations" occurred. In response to the federal appropriation of $60B for the CGP program, twice this amount

is estimated to have been displaced from pollution control capital programs by local governments (Jondrow and Levy, 1984). In fact, upon the appropriation of $60B for federal grants and loans pursuant to the CGP, local governments reallocated approximately $120B from pollution control programs to other uses.

SYSTEM APPROACHES: DBO AND BOT

Figures 2 presents a typical sequence for the Design-Build-Operate ("DBO") and Build-Operate-Transfer ("BOT") delivery methods, used in the US through the 1800's (Miller, 1996a) and now in much of the world (Walker, 1995; Rivera, 1996; Reinhardt, 1996) DBO and BOT can be characterized as system-based procurement methods because finance, design, construction, operations, and maintenance are typically presented as a combined procurement package to prospective proposers.

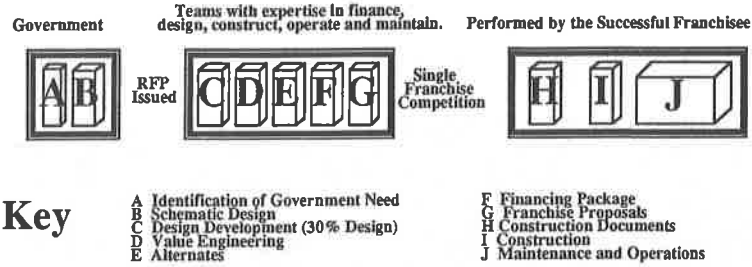

Figure 2 Typical Procurement Process for DBO and BOT

THE WESTERN HARBOR CROSSING, HONG KONG

The Western Harbor Crossing is the third BOT tunnel project to cross Hong Kong's Victoria Harbor. The 2 kilometer tunnel will form a key link in the road system connecting Hong Kong to the new airport at Chek Lap Kok, and will carry up to 180,000 vehicles per day. Prior successes with the first two harbor crossings, coupled with the size of this project and the desire to get the work underway, led to the selection of BOT as the procurement method (Lloyd, 1994). The Government used specialty consultants to conduct a feasibility study which brought the project to approximately 5% design. Substantial approach roads and connections to Route 7, so called community benefits, were added to the Project on the Hong Kong side, after the Government concluded that these benefits would not materially affect the tenderer's opportunity to earn a rate of return between 15% and 18%. The Government then prepared the and issued the Project Brief in March, 1992, which called for the preparation of a firm fixed price tender for designing, constructing, financing, and operating the tunnel over a 30-year franchise period. Each tenderer was to present 25-30% design documents with its tender, and the franchise period (during which tolls can be collected) was to commence with start of construction, not start of revenue service of the project (Hong-Kong, 1992).

Value engineering occurred within the proposing teams, before tenders were made to the Government. Proposals were received from two consortia. During proposal

analysis, one of the proposers dropped out. Three tangible innovations were contributed by the BOT procurement process. The winner's engineers developed a way to raise the tunnel profile by two meters, saving substantial capital expense. The consortium located and purchased its own borrow site which was closer than that offered by the Government. The consortium also developed a shorter design and construction schedule than required in the Project Brief, thus increasing the revenue producing portion of the franchise period (Kumagai-Gumi, 1993). Construction began in August 1993 and is scheduled to be complete in June 1997. The project represents the first dual three lane immersed tube tunnel in the world, formed from 12 pre-cast units each approximately 115 meters long, 33 meters wide, 8.5 meters high and each weighing 35,000 tons.

HIGHWAY 407, TORONTO, ONTARIO - A MIX OF DESIGN BUILD AND DESIGN-BUILD-OPERATE

The Highway 407 Central Project is the world's first multi-lane, fully electronic toll highway - no gates, collectors, or speed restrictions - and will extend 69 kilometers across the top of Metro Toronto. An electronic toll collection system (ETC) supplied by Hughes Electronics will bring "state-of-the-art" electronics technology into overnight service.

The procurement plan for Highway 407 Project originally focused upon a BOT process. Billed as a jobs creation effort by a former government of Ontario, the province issued a Request for Qualifications in May, 1993 to two consortia for the BOT development of Highway 407 as an electronic toll road. The government contracted with each group for "value engineering assessment" reports which identified cost effective design and construction alternatives to existing Ministry of Transportation ("MOT") standards. Based upon these two reports, the MOT issued broad, baseline design/construction standards for the 407 project. The standards did not specify the number of lanes, type of pavement, type and extent of lighting, or means for electronic toll collection. The MOT issued its final RFP, in September, 1993, for detailed proposals and business plans to finance, design, build, maintain, and operate Highway 407 as a toll highway for 30 years. Each team was to make segregable proposals for the road and the ETC facilities, with full descriptions of financing plans. The December, 1993, tenders produced dramatically different results. Table 3 summarizes the proposals (Provincial, 1996).

After careful evaluation, the Government made the surprising decision to unbundle the BOT procurement, selecting the road proposal from Group 1 and the ETC proposal from Group 2. Financing was removed as one of the evaluation factors, and the road portion of the project converted to design-build. The ETC portion of the procurement was converted to Design-Build-Operate. The justifications for changing the procurement approach were, first, that neither team put a substantial amount of its own equity at risk, relying almost exclusively on debt. The Government reasoned that it could finance the same debt at a substantially lower "cost of money". The second rationale related to the quality of basic project elements. Given the decision to finance the project with government debt, the Government decided that taking the higher quality road elements from Group 1 and the higher technology ETC elements from Group 2 offered the best value to the Province.

Table 3 A Comparison of the Highway 407 Tenders

Item	Group 1 Tender	Group 2 Tender
Road Lanes	4-6 initial lanes, expandable to 6-10 lanes	4 initial lanes, expandable to 8 lanes
Lighting	58 Km, fully illuminated, 11 km partially illuminated	Certain interchanges
Pavement	Concrete pavement (30 year estimated design life)	Asphalt 7-10 year design life, Rehabilitation begins in 2003
ETC	Mixed toll collection system, with automatic vehicle ID and manual toll booths	Fully electronic tolling system with video-tracking (Hughes)
Schedule	Complete by 1999	Complete by 1997
Project Finance	Primarily Debt	Primarily Debt
	Nominal Equity Contribution	Nominal Equity Contribution
	Substantial Govt. Subsidy	Substantial Govt. Subsidy

THE IMPACTS ON INNOVATION

The cases indicate that the relationship between procurement method and innovation is strong.[1] Continuing research at MIT is directed at exploring and defining this relationship, particularly as it relates to sustainable incorporation of technology into current and future portfolios of infrastructure projects (Miller, 1996b; Miller, 1995b).

SOURCES OF INNOVATION - THE EPC MARKET

The case studies indicate that early procurement planning plays a critical role in the ways the government gains access to innovative ideas, methods, and conduct in the Engineering Procurement Construction ("EPC") sector, both public and private. This relationship flows from the fundamental nature of the infrastructure development process. Design and construction techniques inexorably change over time, and technological developments supply a similar, yet unpredictable stream of substitute products, systems, and methods. Improvements in engineering knowledge, construction methods, technology, construction management techniques, and public-private financing approaches are rapidly made known throughout the world, creating an open system with ready access to potential innovations. The central challenge for procurement strategists is to create transparent, competitive procurements which reward tenderers for sifting through this pool of innovation to improve the quality, cost, and time for delivery of modern infrastructure systems.

[1] The author's examination of 800 projects in the U.S. between 1789 and 1933 produced consistent results over a larger sample (Miller, 1995a).

INNOVATION IN SEQUENTIAL DESIGN-BID-BUILD

The EPA Construction Grants Program indicates that the process by which government allocates inadequate public funds to projects produces an innovative response in how Design-Bid-Build is used. How to make public money available, and how to spend all of it now, before it becomes unavailable, have become required skill sets for project managers and public owners tethered by their procurement system to public money.

Substantive innovation in Design-Bid-Build centers around the designer, whose task is to produce a complete design after the client has established budget and time parameters for the project. Innovation rises and falls based on the identity of the designer in Design-Bid-Build. In a typical Quality Based Selection (QBS) process, the designer is chosen on the basis of past achievements, not on the basis of a design competition involving the project at hand. The typical QBS procurement for designers evaluates innovation, if at all, indirectly. One A/E team generates the range of design alternatives to be considered by the Owner for the project. Procurement statutes often preclude discussions between the engineer and contractor until that contractor is selected to produce the project. Value engineering, if it occurs at all, takes place after the design is completed, and a firm fixed price has been established between the Owner and the Contractor. The typical Design-Bid-Build procurement process is well applied when there is no synergy to be found by integrating design, finance, construction, and maintenance and operations, or, when there is independent reason to believe the designer selection process will produce a design team that produces such synergy.

INNOVATION IN DBO AND BOT

In typical DBO or BOT procurement processes, innovation is sought in fundamentally different ways, and through different channels. Competition occurs later in the procurement process and covers a significantly enlarged scope. Tenderers are required to compete for combined functions of design, finance, construction, maintenance, and operations, a competition that expressly values innovation in each of these areas and, significantly, in the integration of one or more of these areas. In effect, DBO/BOT procurement processes put tenderers in the position of system integrators whose role is to present alternative formulations of the project that meet the Owner's functional needs with different combinations of quality, time, and life-cycle cost. Tenderers perform this "system integrator" function before the Owner makes a firm commitment to any one package.

The opportunity to package basic project elements differently, with resulting tradeoffs in quality, cost, and time is the driving factor for innovation in DBO and BOT. Multiple evaluation factors are the natural result. These evaluation metrics often include: time to revenue, time to completion, interest rate, life cycle costs, initial capital cost, and long term maintenance and operations costs. Establishing evaluation factors prior to the RFP is more complex than Design-Bid-Build, but the trade-offs are clear. Choosing Design-Bid-Build is a choice not to consider alternative approaches to systems integration in favor of the simplicity of price as the evaluation factor for the construction phase.

OUTLINING AN INNOVATION-BASED PROCUREMENT PROCESS

Encouraging and rewarding innovation in the delivery and long term operation of infrastructure facilities and services is becoming a more important goal of modern procurement systems, particularly as public budgets prove to be inadequate to meet

current infrastructure needs. To institutionalize innovation in public procurement processes, governments need to fundamentally rethink the procurement planning process, conduct more searching pre-solicitation analyses, and tailor the resulting procurement process to fit particular projects.

Step 1 - The first step toward innovation-based procurement is the development of a clear functional description of the proposed project, the infrastructure needs it seeks to address, and the general design, construction, finance, and life-cycle parameters by which the project will be evaluated. The Western Harbor Crossing project and the Highway 407 project provide good examples of Government generated functional descriptions.

Step 2 - The second step is the development of a good understanding of how the proposed project fits into existing EPC markets. Are the opportunities for innovation in finance, in engineering design, in the combination of design and construction, in the choice of technological equipment, in alternative life cycle analyses that consider initial cost v. long term maintenance and operations costs, or in combinations of one, several, or all of these key project elements? In the EPA CGP case, the decisions by the federal government to use Design-Bid-Build and to subsidize 90% of the local cost of wastewater treatment facilities drove innovation toward larger, earlier expenditures for new capital facilities, and away from the exploration of smaller, distributed facilities to meet environmental discharge requirements. In the Western Harbor Crossing case, the procurement decision to use BOT drove innovation toward combining design, construction, construction management, and finance expertise to maintain quality while improving schedule, and reducing excavation and fill costs.

Step 3 - The third step is the selection of the procurement strategy that best matches the project's functional requirements to existing EPC markets. Figure 3 shows the author's framework for making this selection among project delivery and finance methods. The horizontal axis in Figure 3 represents the continuum of project delivery methods. The vertical axis represents the continuum of project finance methods from the government's view (Miller, 1995a).

If innovations in quality, price, and time are likely to be found through system integrators, Quadrant I and II processes are preferred. If innovations are likely to be found through the particular expertise of individual segments of the procurement process - e.g. the engineer, the financier, the equipment or technology supplier - multiple procurements in Quadrant IV may be preferred. Procurement planners need to fit their procurement strategy to focus private sector competition at the points which can produce strategic innovations in quality, cost, and time of delivery. The Western Harbor Crossing is a good example of a procurement process that focused competition and innovation. The EPA construction grants program gave local governments high incentives to spend federal money, and to spend it quickly on new plants using conventional engineering designs. Leaving aside the question whether this was a sound federal procurement strategy, from the point of view of local governments, the choice of Design-Bid-Build as a procurement strategy made sense. It focused on selecting quality designers, and on fixed-priced construction contracts.

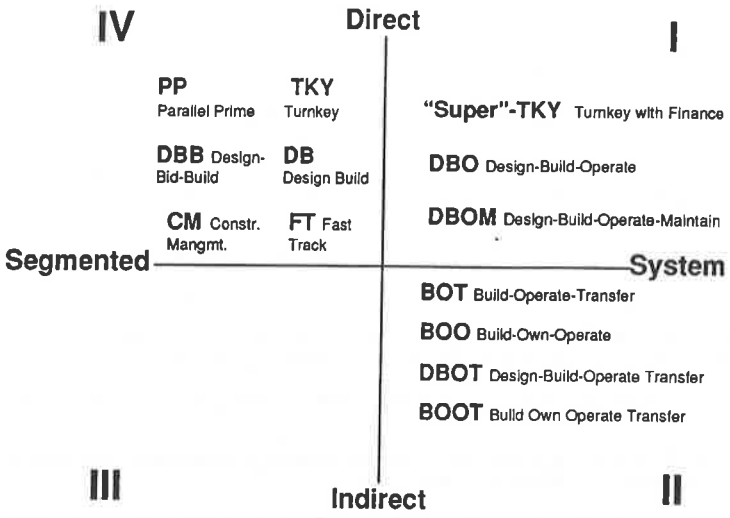

Figure 3 Project Delivery and Finance Methods

CONCLUSION

Most procurement strategies encourage innovation, in both productive and unproductive forms. If innovation is to produce fundamental improvements in quality, cost, and time of delivery of public infrastructure, procurement methods need to be structured to produce competition that focuses upon these improvements. The goal of procurement strategy is a rich mix of tendered options from which government may choose the combination of quality, cost, and time which produces best value. Procurement planners need to rediscover the notion that it is this mix of methods, rather than the exclusive use of one of them, that offers the long term opportunity to use infrastructure as the means to meet larger regional economic goals. A procurement system which openly, and consistently embraces innovation sends a powerful signal to the private sector that government recognizes that continued public-private cooperation is essential to sustainable, self-adjusting improvement in infrastructure facilities and services.

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DESIGN AND BUILD PROCUREMENT METHOD IN HONG KONG - AN OVERVIEW

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Abstract

The growing economy of Hong Kong has had much impact on its building and construction works, in terms of demand for both quantity and quality. Many of its recent building projects have involved participants from all over the world, be it on the design team, the contracting team or the client's team. The growing complexity of building projects and the higher demand on time, cost and quality from a more sophisticated clientele have called for more innovative methods of building procurement. Although the 'traditional' form of building procurement is still predominant, other methods such as design and build, management contracting have become more and more popular over the past decade or so.

There has always been a difference in opinion among professionals on the suitability of design and build procurement method for building projects, despite its acclaimed advantage of design and construction integration. Yet with the changing demand and trend in the industry, would the local professionals give it a new look? This paper aims to present a comparative analysis of the opinions of both Hong Kong architects and contractors on design and build methods for building procurement. Through such a study, it is hoped that a better understanding of the appropriateness of such a method for procurement of building projects in Hong Kong can be formed.

Keywords : procurement method, project complexity, design and build, integration

INTRODUCTION

Despite the political uncertainty caused by the return of Hong Kong to China, Hong Kong's construction industry continues to prosper with its contribution to the GDP maintained at around 5% in the early 90s. Hong Kong's spectacular economic growth and its growing importance as an international port have given much support to its building and infrastructure development.

The demand for more prestigious buildings and sophisticated infrastructure systems has resulted in construction projects of larger scale and complexity. Clients, consultants and contractors involved in the building projects are no longer just limited to those of local companies, but could be from all over the world with different experience and backgrounds.

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Under these circumstances, Hong Kong like many other places of the world, is going through a phase whereby the so-called traditional method is no longer the only answer for the procurement of a building project.

While there is a tendency towards specialisation in the various building professions, a single source of responsibility is much favoured by most clients for the overall management of projects. Time, cost and quality of a project are competing among themselves as priorities in determining the most appropriate method of building procurement. Among other alternative systems aiming at fulfilling new demands with a fresh approach for project delivery, design and build (D & B) appears to be gaining popularity, and has been adopted for use in both private and public projects of Hong Kong in recent years. In view of this trend, a survey by means of a structured questionnaire was carried out to investigate the current views of architects and builders on this procurement route.

THE SURVEY

A total of one hundred and twenty questionnaires were sent, seventy to architects in large architectural firms and fifty to builders in large contracting firms of Hong Kong. The rates of response were 77% and 60% respectively. In order to ensure that the respondents have adequate knowledge in the field of this study, a particular request was made that respondents with substantial years of experience would be preferred although actual experience in D & B projects is not required. As a result, 93% of the respondents have nine or more years of experience in the building industry (out of this percentage, 64% have D & B experience) and 70% are in a senior capacity, with a majority in the manager or director categories. The views of these respondents were analysed.

PROJECT TYPES FOR WHICH DESIGN & BUILD IS SUITABLE

52% of the architects rate D & B as suitable for public works and 39% rate it suitable for private projects, while percentages of the builders are 77% and 70% respectively. Although exact figures are not available, it appears that there are more D & B projects in the government or semi-government sector of the local industry. Recent examples include the North District Hospital, the Senior Staff Quarters of the Hong Kong University of Science and Technology, and the Polytechnic Library. This phenomenon is different from the situation in the UK in that D & B was recorded to be more popular in the private sector according to a recent survey (Akintoye, 1993). This could be due to the fact that private sector clients of Hong Kong are happy with the existing team relationships, and are therefore, less inclined towards departure from the conventional method; whereas the government sector, which has to be accountable for public money, is more proactive in seeking for ways that could improve the traditional system, particularly when construction cost is increasing.

For both architects and builders, more respondents think that D & B is suited to new works than refurbishments. This is understandable as the uncertainty of refurbishment projects make it difficult for a fixed price to be given.

With reference to the types of projects for which D & B is suitable, industrial buildings and infrastructure projects are ranked highest by the architects, with about half of the total architect respondents. All of the given project types are, however, chosen by close to or more than half of the builder respondents, showing a general support for D & B by the builders (see Table 1).

Table 1. % of respondents on types of projects that are suitable to adopt D & B

project types	*architects (%)*	*builders (%)*
commercial (offices, retails, hotels)	35	55
residential (housing)	29	59
industrial (factories)	56	59
educational (schools)	33	62
clinical (hospitals, clinics, nursing homes)	21	48
social (community centres, stadiums)	27	51
infrastructure	49	48

The relatively higher response rates in both disciplines for industrial building types indicate that there still exists a common perception that D & B is more applicable to standard design and simple building projects.

DESIGN AND BUILD METHODS MOST FAVOURED

It is generally understood that with D & B, the contractor assumes the responsibility for both design and construction of the building in meeting the requirements of the client. However, variants occur depending on the clients' preference and belief in what is best for his interests. In the survey, three commonly adopted D & B methods were referred to, to gauge the professionals' opinion:

1. Traditional D & B: contractor responsible for complete design and construction.
2. Enhanced D & B: contractor responsible for design development, working details and construction.
3. Novation D & B: contractor responsible for design development, working details and construction with the assignment of the design consultants from the client.

Among these three types, most architects favour novation D & B and the least favoured is traditional D & B. On the contrary, most builders favour traditional D & B and the least novation D & B. Some respondents have indicated nil, other or more than one preference. The actual percentages are given in the table below:

Table 2. % of respondents on types of D & B most favoured

method types	*architects (%)*	*builders (%)*
traditional D & B	23	48
enhanced D & B	29	37
novation D & B	47	25

The results are not unexpected. Architects would naturally favour novation D & B in order to ensure that their service could continue through from design till completion. On the other hand, builders would like to have better control of the entire process with guaranteed loyalty from their own design team and hence favour traditional D & B. Despite the builders' preference for traditional D & B, the percentage opting for novation D & B in this survey is not as low as might be expected. This may be due to a lack of in-house consultants within contracting firms in Hong Kong as D & B is not widely applied in the local industry. Furthermore, most projects that have used D & B are rather complex and specialised in nature which render novation D & B more practical.

Other relevant remarks drawn from the survey include:

- traditional D & B is more clear-cut and avoids problems that might arise with a change or novation of consultants;
- for novation D & B, there is less conflict of interest with the same consultants being responsible for the entire design work, and better quality of design and final product can be ensured.

FACTORS OF CONSIDERATION IN ADOPTING DESIGN & BUILD

Six factors were identified as areas to be considered in determining whether D & B should be used for a particular project. These are project time, project cost, design quality, project complexity, prestige of project and management of project. The respondents were asked to rank them in order of importance. The responses are summarised in Tables 3a & 3b below:

Table 3a. Ratings of the architects on the importance of factors in adopting D & B

ranking in descending order of importance	*factors*	*mean* *
1	project time	2.06
2	project cost	2.31
3	management of project	3.29
4	project complexity	3.68
5	design quality	4.43
6	prestige of project	5.32

Table 3b. Ratings of the builders on the importance of factors in adopting D & B

ranking in descending order of importance	*factors*	*mean* *
1	project time	2.07
2	project cost	2.59
3	project complexity	3.37
4	management of project	3.74
5	prestige of project	3.78
6	design quality	3.89

* mean = weighted average

Some of the attractions of D & B for building clients are construction time and cost certainties (Griffith, 1989). It appears that local professionals also share a similar view; the survey reflects that a common agreement exists among architects and builders that project time and cost are the most important factors of consideration in adopting the D & B method.

FACTORS PREVENTING DESIGN & BUILD FROM BEING CONSIDERED

While some time and cost benefits in using D & B are widely accepted, many reasons could have stopped it from being considered. Eight factors were proposed to the respondents for prioritising: confused definition of D & B, difficulty in departing from conventional method, lack of support from professionals, lack of suitable projects, lack of experienced D & B contractors, lack of control over variations during construction, lack of checks and balances among parties, and compromising of design quality. The first four factors were meant to be specific for the Hong Kong situation while the latter four more general in nature. Tables 4a & 4b give the ratings of the architects and the builders respectively.

Table 4a. Ratings of the architects on the importance of factors that could have prevented D & B from being adopted

ranking in descending order of importance	*factors*	*mean **
1	compromising of design	3.61
2	lack of experienced D & B contractors	3.94
3	lack of suitable projects	4.31
4	lack of checks and balances among parties	4.31
5	confused definition of D & B	4.40
6	difficulty in departing from conventional method	4.60
7	lack of control over variations during construction	5.00
8	lack of support from professionals	5.05

Table 4b. Ratings of the builders on the importance of factors that could have prevented D & B from being adopted

ranking in descending order of importance	*factors*	*mean **
1	confused definition of D & B	3.56
2	difficulty in departing from conventional method	3.92
3	lack of experienced D & B contractors	4.20
4	lack of checks and balances among parties	4.32
5	lack of control over variations during construction	4.65
6	compromising of design quality	4.76
7	lack of support from professionals	5.15
8	lack of suitable projects	5.29

Most architects rate compromising of design quality as the most important factor that could lead to the rejection of D & B, whereas most builders rate first confused definition of D & B.

* mean = weighted average

Lack of support from professionals and lack of control over variations during construction are felt to have least negative impact by the architects, with a low ranking for both factors. For the builders, lack of support from professionals and lack of suitable projects have the lowest ranking as factors that could have prevented D & B from being adopted.

For the factors that were meant to be specific to the situation of Hong Kong, both disciplines rank lack of experienced D & B contractors as having relatively higher impact and lack of support from professionals as having lower impact in preventing D & B from being considered. These results suggest that in order to gain more confidence on the use of D & B, more insight through experience for all parties concerned in the industry are necessary.

ADVANTAGES & DISADVANTAGES OF DESIGN & BUILD

The respondents were asked to give their further opinion on the D & B procurement route through rating a list of advantages and disadvantages measured on a scale of 5 (denoting great advantage/disadvantage) to 1 (denoting low advantage/disadvantage). The essence of this section is to investigate the perceptions of the local professionals on D & B in more detail through examination of the pros and cons of this mode.

Advantages

Table 5a. Ratings of the architects on the advantages of D & B

advantages	*mean* *
faster project time with incorporation of the design process into the construction programme	3.85
a single point of responsibility for the client	3.73
contractors in best position to reconcile time with materials/specification/construction method	3.47
stronger emphasis on budget/cost control	3.39
increased buildability of design	3.24
better provision for alternative solutions to engineering problems	3.22
improved communication on the project	3.10
reduction in variations and monetary claims	3.09
reduction in the number of points of conflict	3.08
fewer reasons for extension of time	3.02
setting of clear objectives at start of project	3.00
accommodation for speedier design changes	2.90
competitive prices for both design and construction parts of a project	2.80
contractor's in-house ability to buy in materials of equal quality at lower prices	2.75

* mean = weighted average

Table 5b. Ratings of the builders on the advantages of D & B

advantages	*mean* *
faster project time with incorporation of the design process into construction programme	4.50
contractors in best position to reconcile time with materials/specification/construction method	4.48
a single point of responsibility for the client	4.00
better provision for alternative solutions to engineering problems	4.00
increased buildability of design	3.96
accommodation for speedier design changes	3.93
setting of clear objectives at start of project	3.59
reduction in variations and monetary claims	3.56
improved communication on the project	3.54
reduction in the no. of points of conflict	3.52
fewer reasons for extension of time	3.50
stronger emphasis on budget/cost control	3.48
competitive prices for both design and construction parts of a project	3.33
contractor's in-house ability to buy in materials of equal quality at lower prices	3.26

Both architects and builders are supportive of faster project time, single point of responsibility and contractor's being in the best position to reconcile time with materials/specification/construction method, considering them to be comparatively higher advantages, and competitive prices and contractor's in-house ability to buy in materials of equal quality at lower prices as being of low advantage. The items that the two disciplines have significantly different opinions about include accommodation for speedier design changes and stronger emphasis on budget/cost control. From the overall perspective, the means generated from the builders' ratings skew high, again suggesting their higher confidence and support for the D & B mode of procurement.

Disadvantages

Table 6a. Ratings of the architects on the disadvantages of D & B

disadvantages	*mean* *
limitation for client in choice of design team	3.77
lower guarantee for client on design quality	3.59
a lack of design change flexibility during the project	3.49
lack of checks and balances among client, consultants and contractor	3.43
complication of the communication/decision-making process between client, consultants and contractor	3.25
increased risk for client with single point of responsibility	3.14
limited flexibility to project management	3.10

* mean = weighted average

Table 6b. Ratings of the builders on the disadvantages of D & B

disadvantages	*mean* *
increased risk for client with single point of responsibility	3.11
a lack of design change flexibility during the project	2.96
complication of the communication/decision-making process between client, consultants and contractor	2.93
lack of checks and balances among client, consultants and contractor	2.93
limited flexibility to project management	2.74
limitation for client in choice of design team	2.63
lower guarantee for client on design quality	2.56

The resulting ranking for lack of design change flexibility and lack of checks and balances among client, consultants and contractor is similar for both disciplines. However, the architects have distinctly different opinions from the builders in that they regard limitation for the client in the choice of design team as a greater disadvantage and increased risk for the client with single point of responsibility as a lower disadvantage. Consistent with the result for the advantages, the means of the builders' ratings tend to be lower when compared to those of the architects. It can be deduced that the architects are not so much in favour of the D & B mode, their main concern lies with the safe-guarding of design quality. As stated by Smith (1996): "No matter how honourably conscientious the builder is to build a quality building, he is driven by the perfectly reasonable commercial objective to build as economically and expediently as possible to the benefit of his own bottom line."

FACTORS CONTRIBUTING TO THE SUCCESS OF A DESIGN & BUILD PROJECT

There are several factors that have been considered as important in contributing to the success of a D & B project: quality of client's brief, experience in D & B on the part of client and contractor, proper channels of communication and good working relationships. The respondents were requested to prioritise them in terms of their importance. The results are tabulated below:

Table 7. Importance of factors contributing to the success of a D & B project

ranking in descending order of importance	*factors*	*architects' mean* *	*builders' mean* *
1	quality of client's brief	1.53	1.96
2	experience in D & B for client and contractor	2.15	2.04
3	good working relationship	3.18	2.93
4	proper channel of communication	3.29	3.20

The order of ranking is the same for both architects and builders. Quality of client's brief is regarded as the most important factor in contributing to the success of a D & B project. Indeed, since the contractor works from the employer's requirements in pricing his work, any

* mean = weighted average

uncertainty or ambiguity will only lead to future arguments. This is especially important with D & B projects, since the contract is inclusive of both design and build, and a third party consultant is normally not available to safeguard the interests of the client.

FUTURE OF DESIGN & BUILD IN HONG KONG

In order to project the prospect of the D & B mode of procurement in Hong Kong, the respondents were asked to give their opinion on its potential development on a scale of 5 (high potential) to 1 (low potential). Most of the respondents think there is some potential that more projects will adopt the mode of D & B in the future, although not a very big percentage has opted for high potential (see Table 8). The result also indicates that the builders are more optimistic than the architects in viewing the future of D & B in the local industry.

Table 8. Potential of D & B in Hong Kong

scale from high to low potential	*% of respondents*	
	architects	*builders*
5	5	14
4	29	37
3	29	37
2	17	11
1	13	0

In addition, the respondents were asked to indicate the types of projects for which they think there will be an increased use of D & B in the future in Hong Kong. 68% of the architects and 77% of the builders rate public works while only 19% and 37% respectively rate private works. These figures tally with the fact that there are more initiatives from the government sector in adopting D & B mode as mentioned earlier.

Table 9. % of respondents on the potential of D & B for specific types of projects

project types	*architects (%)*	*builders (%)*
commercial (offices, retails, hotels)	33	48
residential (housing)	37	51
industrial (factories)	49	44
educational (schools)	23	40
clinical (hospitals, clinics, nursing homes)	25	33
social (community centres, stadiums)	21	40
infrastructure	58	44

Table 9 lists the percentage of respondents on the potential development of D & B in specific types of projects. Regarding the types of projects for which D & B is suitable, the architects have responded more favourably for industrial and infrastructure developments for the potential use of D & B. The builders' response is more even, with slightly higher percentages for commercial and residential types of projects. The percentages of respondents for

educational, clinical and social building types are comparatively low for both disciplines, confirming the general view that D & B is not that suitable for user-oriented projects.

CONCLUSIONS

Despite the divergence in opinions between the architects and the builders, some main points can be drawn from the survey:

- D & B has some time and cost advantages;
- there is concern that D & B provides a lower guarantee for design quality, and lacks control and flexibility for the clients;
- a clear and comprehensive client's brief is of paramount importance for the success of a D & B project;
- there is some potential that D & B will be more frequently adopted for future projects in the local industry.

The most significant issue is that the builders are generally more supportive of D & B than the architects. This is largely because the architects believe that with D & B, quality of design would be compromised. It is often thought that D & B projects are contractor-led, so the consultants lose their identity as individual adviser to the client. In fact, D & B could be architect-led, providing the consultants better control over the design and construction process. However, care must be taken by the architects to avoid conflict of interests due to connection with any business that is inconsistent with his professional obligations, as governed by the Hong Kong Institute of Architects' Code.

The survey also reveals a general perception that D & B is more applicable to simple and standardised building projects. In particular, both the architects and the builders opined that it is more suitable for industrial type of buildings. On the contrary, most projects that are using D & B presently in the local industry are rather complex and specialised in nature. To reduce the concern associated with design quality, novation D & B is one method which could be considered for more sophisticated buildings. Modifications to the D & B method may be made to suit the situation best. There could be wider use of the D & B mode if the techniques can be applied with more flexibility.

Although the survey may not have provided a conclusive and complete picture of the views of architects and builders, it serves to give some insight into the professionals' opinions and expectations on D & B and the trend of this procurement mode. This, in turn, may be useful for parties concerned in formulating more appropriate procurement methods for the future.

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CORE BUSINESS MOTIVATIONS AND THE STRUCTURE OF THE BUILDING PROCUREMENT PROCESS

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Abstract

A survey of procurement literature shows a consistent emphasis on the causal relationship between the building owner (i.e. the purchasing side) and the functioning/ structuring of the building industry (i.e. the delivery side), with the owner as the source of all strategic decision making. In addition, industry's response in terms of performance, effectiveness, technology and all other product-related concerns is seen as directly dependent upon how the procurement side frames its strategic parameters. The burden of success and failure of projects, and, cumulatively, the effectiveness and productivity of the entire construction industry, is made a function of the owners' decisions. The delivery side, is portrayed as reactive, taking its cues from the procurement side, insisting that the owners remain the strategic decision makers in the building process.

However, owners' motivations have changed very significantly in recent years. Rapid growth of technology along with its associated rapid obsolescence of functional requirements, organizational downsizing and the consequent concentration on *core business*, is leading influential owners to measure their decisions against the yardstick of how these activities contribute to their core business. In this emerging environment, where facilities are seen as means and rarely as ends in themselves, the owners are increasingly reticent to be *influential partners* in the building process. The traditional causal relationship between procurement and delivery, especially with reference to innovation, effectiveness and productivity, is rapidly disappearing. The onus for quick and continuous innovation, identifying ever changing demands, and delivering appropriate products is rapidly shifting towards the delivery side.

Procurement; Delivery; Core Business; Obsolescence; Strategic Decision Making

INTRODUCTION

Two pioneering documents, 'Building Procurement: Proceedings of a Workshop' (Glover, 1974) and 'Project Delivery Approaches: An AIA Guide' (Haviland, 1976), more than any others, were instrumental in focusing on what might be called the two sides of the building industry 'coin', namely, the initiation, organization and management of the building process from the building owner's point of view (i.e., the purchasing

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side's view), and that from the building industry's perspective (i.e., the delivery side's view). The proceedings of the workshop, however, went further by suggesting as their core contention that a causal relationship between the building owner's procurement decisions and the structure/ performance of the building industry exists, and that it is in the interest of both the client and the building industry to exploit this causality. Specifically, it was suggested that "the way building owners arrange to purchase the building they need directly influences the way industry responds" and that "- if the owner wants better value for money, thanks to technological innovation - he can effectively encourage or inhibit that innovation through his procurement strategies"(Glover, 1974, 1976; Norsa, 1976).

Over the years, at least three corollaries emanating from the above propositions have become the main orthodoxies of procurement research. They are:

(1) The owner plays the key role, not only by being the originator of demand and establishing the scope of the project (i.e.,formulating of the purchasing side's strategic decisions), but also by being the catalytic agent responsible for organizing the building process.

(2) The Owner's procurement strategies are determining factors in the technological innovation by the building industry.[2]

(3) Overall performance of a building project is a function of the goodness of fit between the building owner's requirements and constraints and the selected delivery approach.[3]

It is quite possible to explain and defend the above hypotheses and corollaries in their context of the seventies and the then prevalent agenda of furthering industrialization in the building industry. In essence, the seventies marked a shift from the closed systems approach to industrialization - as represented by the Operation Breakthrough - to the open systems approach to industrialization with emphasis on sub-systems, construction management, formation of consortia, etc, - as successfully demonstrated by the SCSD program. It is important to note, that while the motivating force behind both approaches was the same, namely, to increase the productivity in building and thereby to avail the best value for money to the owners, the two approaches were radically different in how

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2. The sequel to 'Building Procurement - Proceedings of a Workshop', namely 'Answers for the Building Community: Optimizing the Choices' (Norsa, 1976) concludes that, "the three illusions held by the building team since the sixties - that (a) hardware will solve the problem, (b) manufacturers would become the dominant team members, and • the building team would straighten out the process - have now been dispelled. The reality is that the owner is the only agency which could solve the building problem; the main question therefore is how does one motivate an owner to act."

2. "The owner's procurement strategies most definitely affect the response of the building industry. Furthermore, if industrialization of the building process is to be encouraged, then the building owner must adopt certain procedures" (Glover, 1976)

they achieved their objectives. While the closed systems approach was hardware oriented and manufacturer centered, the open systems approach took a process oriented and owner centered route. The rational for this later strategy was firmly rooted in the twin considerations that not only was it in the interest of the building owner to seek the best value for money through increased productivity in the building process, but as the initiator/organizer of the building process it was in his power to facilitate it as well. As Ezra Ehrenkrantz pointed out, "Many of the changes that do take place in construction are "crisis oriented". It is generally an owner who, for one reason or another, either *initiates* the framework within which the changes do take place, or accepts the reasoning and logic of his architect or contractor who presents some ideas for change to him. For example, we could never have put together the group of school districts of SCSD program, if they had not felt that, within the then existing budget context, they could no longer meet their (user) requirements"(Norsa (ed.), 1976, pp.8).

The question that concerns us now, however, is whether this framework for studying procurement issues is still valid today? More specifically, we question whether the building owner can still be considered as spearheading the procurement process and, through his involvement in the building process, affecting the scope for innovation as suggested in one of the hypotheses of this very conference ("the procurement strategy adopted by any one building owner, particularly if he/she is a major player, directly affects the scope for innovation in the response by the building industry, in design, manufacture and construction; collectively, improved procurement enables major innovations to occur ")?

We would argue in this paper that while such a causality was a justifiable consideration when the first procurement workshops were held in the seventies, it started to dissipate in the eighties and now, in the nineties, all evidence points at the building owners completely divesting themselves from being "influential partners" in the building process, and seeking procurement of facilities "without becoming involved in the complicated interrelationships among the parties to building..." (Haviland, 1995).

Furthermore, we will take the position that barring the speculative building sector, building owners as clients are central to building. Not only do they initiate the building process, but also pay for the resulting facility. The extent of these owners'/clients' involvement in the building process, however, is highly dependent upon their motivations, which in turn are predicated by a host of complex social, economic, and technological considerations. As these societal conditions are almost always in flux, some times at very rapid rates, the motivations of building clients and owners also change in close synchronization. Accordingly, it may be useful for our present purpose to begin by outlining the evolution of the present-day client.

The Client as Patron

Except for Greek antiquity where the decision to build was made by the city council or assembly, or by a finance board in the case of a religious center, and where these

governing bodies set the budget for the projected building, authorized the expenditure of funds, and appointed the building commission to coordinate and supervise the building process (Kostof, 1977), much of the building activity during the last two millennia is dominated by the patrons of buildings who came from as diverse ranks as kings, princes, churchmen, and more recently corporate and civic executives. The patrons, even those who were motivated by humanist ideals, maintained procurement/delivery systems that reflected their personal values and supported their volatility and whims. A rational demarcation of the extent and the scope of the patron's involvement in the procurement/delivery process rarely happened (Wilkinson, 1977), and thus alternate ways of catering for the owner's/client's strategic demands could not materialize, that is, until Philip Bobrow declared that "the Patron is dead, and his replacement has resulted in a major shift in values and objectives. The sponsor is here, and the old structures of the client/architect/contractor are no longer effective in either serving the sponsor or the public at large." (Bobrow, 1974).

The Organizational Client

But, what were these major shifts in values and objectives of this new client/sponsor? What new structures were replacing the old ones? What was the profile of this sponsor, the new building owner/client in the post-patron ara?

To begin with, as the successor of the traditional patron, who was a single individual, the sponsor represented an industrial or commercial organization, a hospital management committee, a school board or some other form of organization. He was a complex client and came to the building industry with socially, economically and functionally accountable building-related needs (as opposed to personal desires, egos and whims of the classical patron) and sought facilities to satisfy those needs. On the delivery side, it faced a building industry that was fraught with a host of problems, begining with its fragmented structure, its vague division of responsibility, its artificial separation of design and construction functions, its lack of overall management, its abysmally low productivity, and so on. Furthermore, the building industry expected the client to structure and integrate it through designing the building process sequence, through establishing roles and responsibilities of the various delivery professionals, and through overall coordination of the building process. The building industry also expected the client to bear all the risks and responsibilities of the final product because of its traditional reactive mode that gave rise to the most influential procurement proposition of the period, namely, that "the way building owners arrange to purchase the building they need directly influences the way building industry responds"(Glover, 1974).

It is interesting to note, that this new sponsor's profile not only looks remarkably similar to the commissions of antiquity in terms of his composition, but also echos, in terms of mandates and jurisdictions, the early modernist/rationalist ideals of project organization by seeking a more defined scope of the client's participation in the building process, along with clearly prescribed domains and guidelines for interactions for the various

participants in the delivery process (Delorme, 1567).[4]

In the modern context, obviously, this idealized profile of the client ('naive client') is a similar construct as the 'rational man' of economics, and its utility, similarly, lies in developing theoretical procurement models than in addressing the real situations. In the real world, even of the seventies, however, neither the organizational client nor his objectives or his expectations from the building procurement process, were naive, yet, this abstract construct has remained at the very center of the procurement theory.

Robert Gutman (1988) alludes to the fact that while overwhelming majority of projects may be for small clients, increasingly it is the very large clients such as bureaucratically managed public and private agencies and organizations that set the standards according to which purchasing and delivery of buildings is organized. Considering the central role of these big organizational clients in the building procurement process, it is essential to profile them accurately and this can be best achieved by understanding how they view the acquisition of facilities. Gutman suggests that the most significant characteristic of the organizational clients is their disposition to view the acquisition of facilities from a purely rational and instrumental perspective. "This means that the organization clients regard buildings as capital assets, which should be managed like every other potential source of productivity, income, and profit. As a result, plans for new buildings and for the renovation of old buildings are judged in terms of their initial and maintenance costs, their resale value, their implications for corporate income, their usability as working environments and their possible effects on organizational efficiency and employee morale." Furthermore, "the instrumental view of buildings is most pronounced among business clients, including industrial and service corporations and developers, and other clients who are subject to careful budget review, such as departments and agencies of federal, state and municipal governments. These are the clients whose entire operation is evaluated in terms of economic value. It is not surprising that they would emphasize the cost of buildings, economic return they offer, or their impact on blue- and white-collar productivity and morale" (Gutman,1988).

The prevalence of the rational and instrumental world view guiding the procurement of buildings represents the culmination of the historical transformation of the relationship between the purchasing side (patron/client) and the delivery side (building industry), through a process that started during the middle of the nineteenth century and was firmly rooted in modernist thought and praxis. In practice, this world view has three salient components that were responsible for giving rise to the procurement orthodoxies referred to earlier.

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4. " In the preceding book we have sufficiently advised the architect and the Seigneur, or whoever would like to build, of their positions and duties as the two principal heads of the building enterprise. It remains in this second book to turn our pen to the third class of persons, without whom no building can be perfect. These are the master masons, the stone cutters, and the workmen ... who as well must not be deprived of our labor and instruction here, since it pleased God for us to give it " (Philibert Delorme, 1564, Premier tome de l'architecture, Bk.II, Fol. 31, cf. Wilkinson,1977, pp.124)

1. The modernist world view saw the purchasing side represented by 'building committees', which had replaced the individual patron, taken over the assembly of the delivery team, assumed high level responsibility to define project parameters, and often also undertook the supervision of all facets of work affecting performance and quality.

2. The modernist world view assumed procurement and maintenance of facilities as a core mandate/function along with the central mission of the organization. The importance of this position among organizations is indicated by functional ''departments within organizations with names like real estate and facilities management; building and corporate services; facilities construction; worldwide plant engineering and construction; and real estate and construction''(Gutman, 1989).

3. It extended the organizational theory's dominant view that there is 'no one way to organize' to the procurement and delivery of buildings and thereby opened the door to instrumentalist tinkering with the traditional building process in search of enhanced efficiencies.

The postmodern Client

Fred Polak (1972) proposed several decades ago that the continuation of any society depends largely on the presence in the society of a sustaining and motivating image of its own collective future. For the past three decades, especially, the postmodern debates are instrumental in articulating the obsolescence of the modernist collective image and transforming it into a new image of our collective future. (See : Somervell, D.C. (ed.),1947, *A Study of History,* New York: Oxford University Press; Drucker, Peter, 1957, *The Landmarks of Tomorrow: A Report on the New Post-Modern World,*New York: Harper & Row; Miles, M.,1964, ''On Temporary Systems'', in M.Miles (ed.), *Innovation in Education,* New York: Teachers College Press; Bennis,W., and Slater, P.,1968, *The Temporary Society, New York: Harper Collins;* Bell, Daniel, 1973, *The Coming of Post-Industrial Society,*New York: Basic Books; Jencks, Charles, 1977, *The Language of Post-modern Architecture,*New York: Pantheon; Prigogine, I., and Stengers, I.,1984, *Order Out of Chaos,* New York: Bantam Books; Baudrillard, Jean, 1987, ''Modernity'', *Canadian Journal of Political and Social Theory, vol. 11, no. 3, pp. 63-73 ;* Lyotard, J.,1984, *The Postmodern Condition,* Minneapolis: University of Minnesota Press; Clegg, S., 1990, *Modern Organizations: Organizational Studies in the Postmodern World,* Newbury Park, Calif.: Sage ; Jamison, F., 1991, *Postmodernism or the Cultural Logic of Late Capitalism,*Durham, N.C.: Duke University Press ; Best, Steven, and Kellner, Douglas, 1991, *Postmodern Theory,* New York: The Guildford Press; Bergquist, William, 1993, *The Postmodern Organization,* San Francisco: Jossey-Bass)

The issue of an image of collective future is particulary important to the procurement and delivery of buildings because how the building process is organized and managed, is contingent not only upon the physical requirements of the project, but also, as we saw earlier, on the valuational dimensions of this prevailing/emerging image. Accordingly, tracing the shifts in the valuational system of the organizational client due to the emerging postmodern condition is essential for effective delivery of buildings in the future.

Even though Somervell (1947) suggested that a 'postmodern' break with the modern age began in 1875, the emergence of the postmodern client is a much recent phenomenon and may be attributed to the eighties' recession and ensuing restructuring led by the computer and information technology. Initially, the change manifested itself in terms of how organizational clients went about procuring the projects they needed. The traditional practice of beginning the process by appointing an architect began to disappear. ''A survey in 1978 of a random sample of building owners reported that one-fifth preferred to hire the construction manager before choosing an architect''(cf Gutman, 1988). Building Process case studies of projects initiated in the eighties show further that many building clients instituted a 'building incubation phase' instead of the traditional architect directed project definition phase enabling them to develop, articulate and assess a host of strategic decisions before initiating any formal building process (Mohsini,1996). This particular change, though not affecting the procurement orthodoxies, nevertheless posed challenges to both the procurement as well as the delivery side to develop integrated processes that incorporate the front-end incubation phase. Some processes such as 'partnering 'novation' have been developed to facilitate such integration, but a systematic investigation of these approaches within the emerging postmodern framework is not yet done.

More recently, two more consideration have emerged. Firstly, the organization clients have started to question the wisdom of considering facilities procurement and their management as a part of their core business.''Today, owners are more interested in what results from the process than in the intricacies of the process itself. Increasingly, influential owners - those commercial and institutional owners who require and maintain an extensive investment in constructed facilities - are focusing on their 'core businesses' and measuring everything they do against the yardstick of how these activities contribute to the core business. In this environment, new and renovated facilities are seen as means to more important ends and rarely as ends themselves''(Haviland, 1995).

Secondly, the very rapid obsolescence of technology and its associated obsolescent effect upon the functional requirements of building clients, is bringing the need for rapid mobilization of cutting-edge technologies, or for their innovation, to the forefront as the single most important strategic consideration affecting building procurement.

The first condition, namely, the removal of facilities from the 'core business' by the postmodern clients is a highly significant move as it leads to important challenges to the procurement orthodoxies, especially concerning (a) the involvement of the client in the

procurement process and (b) innovation as a function of the client's strategic decisions. "As they [owners/clients] focus on what they need and look to venders to supply the rest, many owners are not interested in becoming involved in the complicated interrelationships among parties to building,... These owners want results - on time, within budget, and at agreed quality and scope"(Haviland, 1995). This emerging focus on core business and the resulting reluctance to be a participant in the building process is a serious blow to the most central proposition of all procurement research, namely, that the client through his role as the organizer of the building process and his strategic decisions concerning the scope of the project, is the catalyst for innovation and industrialization in the building industry.

By removing the procurement and maintenance of facilities from its core business, the postmodern client has placed the whole bag of responsibilities that it traditionally assumed (or was expected to carry), i.e., of organizing and managing the building procurement process, of assuming and underwriting all risks and of facilitating technological innovation, squarely in the building industry's lap. If the very rapid rise in the use of design-build as the preferred building procurement method in recent years is any indication (in the US, in 1994, over 29% of ENR's top 400 contractors' revenues come from design-build projects, while in the UK during the same year nearly 35% of the construction industry's work load was contributed by the design-build procurement method), then the postmodern client is clearly signaling a complete divestment of his role as the influential partner in the building procurement process and showing a preference for becoming a one-stop customer.

The second consideration, rapid technological change and its obsolescent effect on the functional requirements of the client, on the other hand, is creating a new demand for parallel change and innovation in the facilities sector. Furthermore, the most significant aspect of this new demand lies in the realization that the time span within which the present-day (and future) building clients will return to the delivery side for technological/innovative fix up is getting ever shorter. The way things are moving, the question of innovation is no more an option that can be predicated with "if the building client wants...."; it is rapidly becoming an imperative for the delivery side.

Jointly, the withdrawal of the client from the building process, and the emerging shorter cycles of obsolescence-innovation, are placing the responsibility for finding solutions for the client's building-related needs - both in terms of mobilizing and structuring the building industry as well as coming up with the required innovation - entirely with the delivery side. The real problem facing the building industry in general, and procurement research in particular, therefore, is to find ways of (a) developing delivery processes without the traditional role of the building client as the catalyst, and (b) devising mechanisms for sustained innovations that are in step with the general level of technological changes and can be offered to the client on a continuous basis.

Conclusions

In this article we question the continued relevance of some of the central propositions of the procurement field. Specifically, our concern lies with the trend to maintaining a causal relationship between the strategic decision of the client, on the one side, and the functioning/ structuring of the building industry - in particular its ability to innovate - on the other. We suggest that while encouraging such a causality may have been an essential consideration when, for example, the 1974-1976 procurement workshops were held, and improving the productivity of the building delivery process, and thereby achieving a 'better value for money' for the building client, was viewed as exclusively depending upon the client's strategic choice of the building procurement process and his influencing/organizing acumen in structuring the building delivery process, now, in the nineties, with building owners refusing to play the role of 'influential partners' in the building process, it does not stand up to scrutiny (see Footnote No.2).

Notice that we are not suggesting that the building owners are disappearing or stopping to invest in buildings. Quite the contrary. The rapid technological change and its associated obsolescent effect upon the functional requirements of most building clients is increasing the frequency at which they are coming to the building industry and asking it to deliver more updated products. They are, however, increasingly reticent to be active partners in the development of these products, and thereby leaving the building industry on its own to deliver updated products (i.e. to innovate) to meet this novel demand.

What is absolutely essential to understand is that the traditional link - real or postulated - between the purchasing side and the delivery side, so succinctly articulated in the 1974 procurement workshop, has snapped. The onus for quick and continuous 'innovation' is now entirely on the building industry. It is the building industry that is now required to convince the building client - entirely through its own resourcefulness - that it is indeed capable of taking care of the clients' rapidly changing functional requirements.

We believe that the field is very rapidly shifting from 'procurement' to 'delivery'. A very significant consequence of this shift is that most traditional, client centered delivery structures are becoming incompatible with the emerging motivations of clients in general, and with the ever shortening time-span for the replacement/upgrading of technologies, both hard and soft, in particular.

Some partial solutions to these emerging demands are already appearing in the form of delivery approaches such as 'design-build', 'partnering' and 'novation' contracts. Others may lie in the building industry getting out of the business of inventing technologies and processes altogether and instead, focusing on rapidly scanning, evaluating, adapting and applying cutting-edge technologies brought in from other industries that can deliver them on a shorter life-cycle and on a continuous basis. More comprehensive solutions, however, will require the forging of new strategic alliances within the building industry, as well as with other relevant industries - such as finance, information and technology - on short- and long-term bases.

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Procurement Improvement and Innovation- The Case of the National Health Service

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Abstract

Since 1979, the United Kingdom has been governed by the Conservative Party. A cornerstone of the political ideology has been the drive for efficiency, the use of the market as a regulator and a reduction in public expenditure. The National Health Service (NHS), the provider of universal medical care, did not escape the application of these ideals. The NHS underwent major restructuring which had a serious influence on the capital development programme on one of the largest public sector construction procurers.

This paper sets out to outline some of the experiences and issues that arose during the period of restructuring within the NHS. It addresses the factors that influenced the outcome of projects and lessons that could be used in the client's procurement process. It also examines the changes introduced to the procurement process, to respond to the new structure of the organisation and to the introduction of commercial principles in public sector bodies.

This paper concludes on how a major client organisation is responding to changes in its structure, to outside political pressures and to the demand to be more commercial.

Introduction - Changing Times

In 1979 the Conservative Party came into government in the United Kingdom. They have reshaped the public sector by privatising public corporations, utilities, deregulating transport and reshaping local government. The motivation behind these changes has been the drive to improve efficiency, to give greater priority to the needs of customers rather than producers and to bring in market disciplines or proxies for them. A central theme within the administration has been the break up of large organisations into smaller units. It was therefore certain the National Health Service (NHS) would also be affected.

The National Health Service was the largest single employer in western Europe and arguably the client with the largest ongoing building programme. In the 1980's the government sought to improve managerial efficiency by implementing the recommendations of the Griffiths report (NHS Management Inquiry, 1983) and introducing market driven influences through competitive tendering. The National Health Service and Community Care Act 1990 set in train more fundamental changes. Its key feature is the separation of the purchasing of health care by district health authorities (DHA) or general practitioners, from the provision

of health care carried out by hospitals. The hospitals were granted a degree of autonomy on financial matters. They were granted budgets and had to compete in this internal market.
The major consequence of these actions saw the disappearance of regional and district health authorities that controlled the procurement of hospital facilities. The procurement of construction services devolved to the individual hospitals or groups of hospitals, called trusts. The procurement of hospitals had undergone a dramatic change. By 1994 the majority of the NHS hospitals had moved to trust status. However, further changes were to take place in 1994 with the introduction of the government's Private Finance Initiative. This policy attempts to increase private sector funding of public sector projects through concessions, franchises, etc. This initiative now required all capital projects in the NHS be tested for private sector finance.

In 1994, the Latham report, a wide ranging commentary on the state of the construction industry, commissioned by the government, was published. It recommended far reaching changes to the industry.

By 1995, the National Health Service Executive Estates Department remained as the only centralised, construction group for the health service. They published a guidance Capital Investment Manual for the service in 1994, which was about to be implemented. Due to the publication of the Latham report and the changes that had taken place, the NHS estates decided to undertake a study of the state of capital investment projects, the potential influence of the Latham report and their new Capital Investment manual.

The generic aims of the research described in the paper were to establish what happens during the procurement of health care buildings and how improvements could be achieved. This was done through an examination of six completed and three current hospital projects. This paper highlights the key findings of this research project.

The Research Methodology, Data Collection and Analysis

The projects were all health care facilities but with variations on specific uses. Comparison of project performance was needed and an adaptation of the model presented in Morris and Hough (1989) was adopted. Consequently the following areas were identified as being crucial in assisting project success and forms the basis for comparison:

Project Definition.
External Environment of the Project.
Organisational and Contract Strategy.
Finance.
Schedule/Programme.
Communication and controls.
Resources/management.
Human Qualities and Attitudes.

The data for the comparison was collected in three stages; (i) initial face to face interviews, (ii) questionnaires, and (iii) follow up interviews. Initial face to face interviews consisted of asking what key participants thought about the particular project; what were the good things to emerge from their experience, what where the bad things to emerge, what had they learnt from it, how would they avoid making the same mistakes again, and so on. To provide a measure of reliability, all parties representing the Client Team, Consultants, M&E specialists, and the Contractor where forwarded a questionnaire. The intention was to build a picture based on reflecting all facets of a project.

Once questionnaires were returned, several issues, previously unobserved surfaced. These were addressed by focused interviewing of particular participants. Each project was considered in isolation to develop an explanation of what had occurred. Once all the single case studies were presented, a process of explanation building commenced across all the case studies to form a multiple case study analysis. Typical questions were; why has one project been successful and another has not? what contractual relationships existed? why was that particular standard form of contract selected? who carried the risk at the start of the project, and was that risk passed on to commercially weaker parties who might not necessarily have had the best resources to deal with it? and so on.

It was from this case study base that the initial findings were developed. The second stage of the research strategy used an action research methodology to implement the findings on on-going projects. The vehicle for this participative involvement was Value Management workshops.

Review of the Critical Project Issues on Completed Projects

This part of the paper focuses on the issues that were raised during the survey, the case study development and subsequent analysis of completed projects.

The External Environment.

The influence of the external environment was extensive. Clear evidence emerged as to the number of substantial changes that have taken place during the life of the projects investigated. The source of the major changes was government driven as the Health Service underwent significant restructuring. Much of the environmental change was generated from within the client organisation. The concept of the Internal Market, the introduction of the Patient's Charter, changes in treatment patterns and the introduction of a security conscious philosophy resulted in a major restructuring of hospital design and procurement. The period during which the projects were constructed can be best described as turbulent.

Local issues have a great deal of significance on projects as they determine need through local social and welfare circumstances. Local influences at a political and economic level also impinged on investigated projects. The need to comply with EU directives has an influence on technical specifications and procurement policy. The general economic

environment also had an impact on the projects, particularly on the contractors and consultants.

Project Reasoning

The actual trigger for the researched project's birth was difficult to identify but tended towards an epidemiological approach, based on consensus building. The projects raison d'être tended to be strategically driven Information on the early strategic development of projects proved very difficult to access as many of the relevant personnel had either retired or had left the Health Service. The majority of Clients felt that they had bid for money to build a facility that would meet local needs. The demand seems to be identified by 'throughput' and 'waiting lists'. The actual objective of meeting local needs fades in significance as the project moves into the pre-contract stage and the need to achieve accountability drives the project.

The Project Concept and Brief.

The development of a project concept was driven by factors that have been identified earlier in this paper. The data gathered indicated that the 'strategic' facility requirements were the principle drivers for each project.

Flexibility and Rigidity
The main problem identified during the concept and briefing stage was the trade off between detailed strategies that may be compromised by 'changes' and strategies that retain flexibility. On a number of projects a clear and focused project brief was lacking; these project briefs have been interpreted by the consultants and the contractors as lacking clarity and being poorly defined.

The important role that Users (clinicians, nurses, operators) play during briefing and design became evident. Users make a significant contribution to the relational and process features of each facility. A number of problems emanated from this interface. The principal problem is that the length of the pre-contract stage meant that opinions changed as key users were either promoted or left the Health Service. This led to new users with new ideas. On a similar theme it emerged in some cases that surgical consultants changed the specifications as described on room data sheets. The explanation given was that they were not appropriate to the evolving practical demands of surgical practice. Best procurement practice would require these data sheets to frozen and 'signed off' on completion of the briefing.

Changes in the Client Organisation
One case study saw the introduction of Trust status some twenty months into a twenty-nine month project, essentially a new Client for the project. Moving from the previous health system towards Trusts and the Internal Market has evidently removed a large amount of in-house experience from the Clients. The reduction in the size of regional authorities, coupled with, in one case in particular, the Trust's sense of isolation as a self governing body, has had

negative impact on some projects. The lack of continuity created problems in a number of cases because clinical users could not visualise, nor communicate effectively with the design teams. One case showed that there was insufficient knowledge of non-standard or new facilities outside the scope of the client team's experience. In a number of cases, visits to other existing facilities were undertaken to address this inadequacy.

The absence of continuity of personnel was identified as a factor that had a major influence on the outcome of the sample projects. The relevance of this issue is made more significant if continuity is broken at briefing stage when proper communication of the brief is not transferred through the life of the project. On one case study no single person had seen the project through from start to finish. The implication of this is that new project members would be continually re-entering the learning curve, denying the benefits accrued from project knowledge, team development and experience and may also have allowed previously made decisions to become re-negotiable

Environmental Changes
Another case study saw the introduction of EU legislation affecting the concept design (for Entonox gas storage and delivery) during on-site construction. Social variables were also seen as a source of uncertainty that could affect the concept. An example of this was the snatching of a baby from a maternity ward, an incident that meant one case study group had to completely rethink the idea of providing a secure environment for patients.

The Role of the Client's Project Manager
The role of the client's project manager was identified as being of key importance during the briefing stage as well as throughout the rest of the project life cycle. The project manager has an important role to play acting as a facilitator between the client and the design team. The development of the a cohesive project team is a critical function of the project manager.

The implications of flexible briefing can be traced through the life cycle of a number of projects.

Financial issues.

The research data indicated that the preliminary budget acted as a major driver for each of the projects. It acted as the point of reference for the entire project. The system of cost control was well founded but still had to consider and cope with an inordinate number of variations and claims.

There are large numbers of variations on projects despite cost limits and attempts to have fixed briefs. One case study is still dealing with a claim that runs into millions. This was due in part to client variations caused by, for example, EU. Directives and problems of security, but the size of the claim exceeded their preliminary expectations.

The Mechanical and Electrical (M&E) on that project was not measured in a Bill of Quantities issued as part of the tender documentation. This meant that all subsequent claims had to be negotiated leaving the client in a vulnerable position. Most case studies showed that increased costs were generally a corollary of changes in the brief, changes in technical specifications particularly in the M&E, and the late delivery of information from the design team to the contractor. In addition, funding restrictions often meant that functional requirements were cost driven and variations for additional items were introduced late in the project.

It became evident from the data that problems exist with the design integration and cost control of the mechanical and electrical work. A number of respondents felt that the M&E was viewed as not being integral to the project and that its cost control was outside the influence of the main cost plan. Respondents felt that the M&E should be more tightly integrated into the overall design earlier and its cost control brought closer into the main cost plan to reduce problems.

Client Project Organisation.

The case studies mentioned previously show that the client's organisation has to respond to a flow of continual change. Detrimental effects were felt on those projects that changed their status to 'Trust' during the life of the projects. A major consequence of this was the inability of consultants and contractors to develop long term working relationships with the client due to the lack of continuity that developed on some projects.

One project showed that the problems were exaggerated, in the eyes of the consultants and contractor, as a consequence of a client project manager not having the appropriate Health Service experience. His inexperience, caused negative feelings as his presence seemed to create, in the words of the architect; "a barrier between the users and the design team" and an erosion of client team credibility.

A good project manager can create a positive cohesive project team. It also emerged from the data that a project team that took 'ownership' of the project and worked as a unit felt that the project outcomes were better. The role of project leadership and good team philosophy was vital.

A common view that emerged was that the Mechanical and Electrical work on the projects were viewed as entities in their right and not integrated adequately into the schemes. Most case studies showed that contractors, client representatives and architects anticipated problems with M&E and yet very few brought in-house the appropriate knowledge at the outset to deal with this problem. Most tried to manage this issue through the contract. Some case studies brought in specialist M&E consultants whose performance ranged from adequate to poor.

The most successful project organisation was on a Design and Build project followed by a Management Contract project. The research team discussed why this might be so at length. The conclusion was that the client team's organisation was not as important as with other contract strategies. That is, this project allowed the contractor to take most of the responsibility, and the task of the client's teams then became one of helping the contractor to realise the client's objectives through monitoring and control. The initial creation of a comprehensive brief ensured that what the contractor was to achieve, was clearly understood, and could be evaluated.

Schedule Management.

The main causes of delay were variations, poor co-ordination and changes which in particular affected, and were affected by, the M&E. The research team felt that the duration of the projects combined with poor briefs were the main cause of these issues.

Monitoring was by contractor's bar charts updated for monthly and sometimes fortnightly meetings. It was at these meetings that scheduling problems were resolved. Only one project set a number of milestones in the programme that were used to gauge progress. Schedule management tended to be the responsibility of the contractors

Project Control.

Project control was by monthly meetings, where programme and cost issues were discussed in the wider framework of the project. Capricode and Concise were the guiding documents used.

What did emerge from the data was the lack of continuity, in the employment of key personnel, in positions of control. This spanned all parties from the client to the M&E specialists.

No client team or consultant knew about the criteria, or systems the contractor used in selecting domestic sub-contractors. No client teams, consultants, and in fact only only a few contractors knew how the sub-contractors recruited their operatives and whether their competencies had been tested in any way.

Key findings from the completed Projects

The synthesis of the surveys has highlighted a number of points that have either helped deliver a successful project or have had a negative impact on the outcome. Positive project influences were, good project management, cohesive project teams, continuity of client and consultant teams from inception, good client-consultant-contractor relationships. These points were seen to contribute to better projects outcomes.

There were also a number of factors that created negative influences on projects. These include: fluid, flexible and incomplete briefing; changes in the client organisation; lack of continuity through project life cycle; poor project leadership and fragmented project teams; inadequate integration of the Mechanical and Electrical design; high numbers of variation orders and late design changes.

The lessons from the completed projects indicated that a well-developed system of health care provision can unravel fairly quickly when externalities have their impact.

Ongoing projects and the impact of changes

The second stage of the research project concentrated on an examination of current ongoing projects. The primary focus here was on the progress in applying the capital investment manual, adoption of ideas from the Latham report and impact of the Private Finance Initiative (PFI). A slight variation in the research method was adopted. In addition to the procedure mentioned above, project review meetings were conducted using Value Management workshops. This approach gave a deeper insight into the workings of a project team and decision making.

The results of the second phase of the work showed that little had changed despite the reduction in the uncertainty and the completion of the majority of changes in the health service. The reality suggested that the trusts that were reviewed were experiencing the impact of a steep learning curve. The resource and skill levels available have been severely curtailed. Experience on large scale capital development was absent at all levels, from the new trust managers to the construction professionals charged with delivery. New construction business case guidelines increased the involvement of non-construction decision makers. The case studies suggest that construction could now be judged as a conflict between value for money and cost reduction.. This view would certainly be regarded as at variance with the Latham recommendations.

The most far reaching impact on the current hospital procurement is the impact of PFI. It has added a number of problems to project delivery. The first problem is that it adds uncertainty to project funding, as approval is not guaranteed. The PFI approval process also adds considerably to the time for overall project delivery. This has a significant influence on ensuring sound briefing and meeting user requirements, as the increased time to implement projects is likely to increase the influence of staff turnover.

The application of the Capital Investment Manual was being accepted fairly slowly. The manual outlines the phases in the procurement process within the health service. The purpose of the manual is to provide guidance for managers. The manual has not been in use for a sufficient time for its full impact to be assessed. The chief criticism from the cases suggested that the manual was far too prescriptive. It provided adequate guidance at a

strategic project level but not enough guidance for a detailed analysis of issues such as PFI guidance.

Conclusions

The Health Service has undergone a dramatic change in its structure and operations. A well-established organisation and procurement system was changed to introduce market efficiencies.

The introduction of commercial principles, primarily internal markets, has moved the focus towards the financial deliverables rather than the facilities' perspective. The innovation and attempts at improvements intended, by internal markets and private sector funding, have not delivered the procurement velocity as intended. The sector is bogged down by the number of projects awaiting treasury approval for private funding and by competition between facilities and duplication of services that are financially lucrative. The reduction in unit size has meant that in-house expertise has disappeared on a fairly dramatic scale.

The structure of health service facilities' provision from a post approval perspective remains relatively unchanged. The impact of changes and variations during detailed design and construction can have a far wider ranging impact. Health Services are expected to operate within their budgets and cost overruns mean cutting of services elsewhere. Greater financial discipline is required and this is also evident where private sector finance or operations are present.

The National Health Service in the UK has undergone fairly dramatic changes over the last decade. It has attempted to improve the service it provides. The built facilities part of its operations has also felt these 'winds of change'. Its ability to be a more dynamic as a client is stifled by its continued presence in the public sector. Public sector rules and regulations for competition and procurement mean that innovation will tend to be tempered.

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PROCUREMENT AND THE PRIVATE FINANCE INITIATIVE

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Abstract

Montreal Symposium "Procurement - A Key to Innovation"
Building procurement under the United Kingdom Government Private Finance Initiative ("the PFI") illustrates the veracity of the first working hypothesis and demonstrates that in the counter hypothesis the words "and is independent of procurement strategies" constitute a non sequitur. The conceptual breakthrough which leads to this conclusion is the de-coupling of building ownership from accommodation procurement.
Traditionally if a UK Government Department wished to procure accommodation for its own use it would either take a lease from a developer or would purchase a site and then employ a professional team and a contractor to build the building. Capital constraints stifled innovation.
Under the PFI the Government does not acquire a substantive interest in real estate. Instead it procures an accommodation service in return for a payment over the life of the contract. All the responsibilities and risks associated with ownership of the building rests with the provider of the accommodation. An emphasis on total service provision and value for money over the contract period encourage the provider to look at the most cost effective solution over the whole life of the contract - for instance an innovative approach to energy use may involve greater initial capital outlay but may produce long term savings through greater efficiency. That innovative approach will have emerged as a result of the PFI procurement strategy.

INTRODUCTION

Two alternative hypotheses have been postulated:-

1 "the procurement strategy adopted by any one building owner particularly if he/she is a major player directly affects the scope for innovation in the response by the building industry in design manufacture and construction; collectively improved procurement enables major innovations to occur".

2. "Contemporary building owners are only concerned with the quality and effectiveness of the building being acquired and do not wish to be involved in the building process in any way; consequently innovation is the responsibility of designers, manufacturers and builders (ie of the "industry") and is independent of procurement strategies".

This paper seeks to demonstrate that building procurement under the UK Government's Private Finance Initiative leads as a result of the procurement strategy to a position where:-

1. the user of the accommodation is not concerned with the building or design process; but

2. the owner of the building is so concerned.

Traditional Route to Procurement of Government Accommodation

The starting point was that the cost of funds provided by HM Treasury will always be cheaper than the cost of funds to the private sector. It followed therefore that the preferred method of government accommodation procurement was to use capital funds to build and then own the required facility. In exceptional circumstances, a building might be leased (for instance if the requirement was only short term) but generally this would be regarded as a disguised form of borrowing; and since Treasury funds were always cheaper, borrowing and therefore leasing were unacceptable. Because scarce capital was being expended, there was pressure to keep initial build costs to a minimum. The consequence of that short term approach was that life cycle maintenance costs were likely to be high. But those costs were dealt with out of revenue rather than capital and in future financial years. The problem was simply deferred.

Procurement of Government Accommodation under the UK Government's Private Finance Initiative ("PFI")

The UK Government is concerned at a political level: (a) to keep the Public Sector Borrowing Requirement as low as possible by taking the procurement of capital projects off balance sheet and (b) to mitigate the effects of the so-called pension "time bomb." arising from the vast numbers of direct employees with occupational pension rights. For instance in the National Health Service alone, there are over a million employees. If PFI is successfully implemented, many of those not involved in the core clinical services will be transferred to the private sector, along with their pension rights.

The Chancellor of the Exchequer launched the PFI in October 1993 with the objective of reducing the Government's capital commitments by encouraging the private sector to create capital asset, be they buildings, IT systems or whatever, using private sector capital. The Government would make use of these assets in return for annual revenue payments.

How does this approach fit with the basic principle that Government funds are always cheaper than private sector funds? The key lies in the words: transfer of risk, value for money - and innovation.

Transfer of Risk

This one of the principal tenets of PFI. The Government performs various functions for the benefit of the population. It is not in the real estate business. Why therefore should it take on itself the risks associated with building construction and ownership?

Under PFI the Government will produce an output specification and service requirement. In other words it will specify such matters as the number of staff to be accommodated, the ambient temperature required, how many meetings a day need to be catered for and the like. It will also specify what services it requires; certainly building maintenance but possibly a whole range of other services such as IT, telephones, catering and security.

But the Government will not specify how those outputs are to be achieved. It is for the private sector supplier to carry out the detailed design work and then to construct the facility and install the services so that the Government's employees can simply walk in and carry out their work. Not until they can do so will the Government pay any money. Payment will take the form of a single unitary payment for the serviced facility. It will not be a rent but will simply be the figure bid by the private sector supplier to cover its debt servicing costs, out of pocket costs and profit margin. The payment will be subject to reduction for poor performance.

The term "transfer of risk" is used but in fact some risks can properly remain with the Government. The concept is really "appropriate allocation of risk". Each party should be responsible for the risks it can manage best. There is no point in the Government insisting on the transfer of risks which it can manage better than the private sector. That will simply be priced into the bid and result in poor value for money. The concept is succinctly summarised by the Treasury (HM Treasury 1995]:

> "As a general rule value for money can be expected to increase initially as risk is transferred to the private sector until the optimum point is reached at which all risks have been allocated to the partner best able to manage them."

Typically, therefore, the Government will retain the risk of supervening discriminatory legislation; it will guarantee a certain level of occupancy so that it keeps the occupancy risk. If it wants a degree of flexibility, an element of occupancy risk can be passed over to

the private sector but there will be a cost attached to this. There is always a price for transfer of risk.

But the private sector will take on a much wider range of risks including:

Design
Construction
Cost - the bid is fixed
Interest rates
Availability
Operational performance
Residual value - ie the unitary payment should not involve in effect paying for the whole capital cost of the land and the building paying for the whole capital cost of the land and the building over that part of its useful life covered by the contract.

Value for Money

As we have indicated, a price attaches to transfer of risk. It is critical to the evaluation of bids to decide whether, taking into account the risks transferred, the payment represents value for money in comparison with the traditional procurement route. The higher cost of private sector funding should be off set by risk transfer and efficiencies and economies provided by the private sector. How can these efficiencies and economies be achieved? Primarily through innovation.

Innovation

Innovation provides a key to value for money.

- Life cycle maintenance costs can be minimised by innovative initial design, even if that is at a greater initial capital cost.

- The cost of occupancy flexibility can be minimised by innovative design allowing discrete areas to be remarketed.

- The cost of residual value risk can be minimised by designing a building which is likely to be usable for a range of purposes at the end of the contract period.

PFI in Practice

Achievements

(i) Infrastructure Projects

The UK Government first adopted the PFI to procure infrastructure. These projects had,

in common with accommodation projects, been prone to problems of poor quality, high cost and overrun. By passing the responsibility for Design Building Financing and Operating of roads bridges and tunnels to the private sector, the Government was able to ensure that the private sector had a long term commitment to maintaining quality and delivering on time. The PFI approach has indeed been successful in the provision of major capital items such as roads and bridges. Projects have been delivered. Consortia have signed up to 30 year contracts to build and maintain roads. One of the main innovations has been the concept of shadow tolling. Road providers are being paid according to the volume of use of the road as monitored by the Government. The Government claims that £4,991m of transport related projects have been agreed to. This, however, includes the £3,000m project to build a rail link to the Channel Tunnel.

(ii) Prisons

Among the first building procurement projects under the PFI were contracts for the provision of prisons. These have been signed and prisons are already under construction. Payment made by government is related to the number of prisoner places available per day and so does not represent a major risk transfer. In addition, the ownership of the prison, on the expiry of the contract, will revert to the Government. This also represents a less than perfect deal in terms of PFI theory. As we have mentioned, the key to innovation under the PFI is transfer of risk to the private sector.

(iii) Hospitals

The Hospital sector is where there has been the most activity in the PFI and it is the area that has received the most criticism. The National Health Service Trusts, who run public hospitals in the United Kingdom, have been encouraged by central government to procure new facilities using the PFI. In the order of 60 projects amounting to approximately £500m have already been agreed to and many schemes are in the pipe-line. There are, however, fundamental problems relating to the funding of health sector projects which are preventing these deals from being signed. These problems will be discussed later below.

(iv) Offices

HM Treasury, the driving force behind the PFI, has been amongst the first government departments and agencies to procure offices under the PFI. Faced with the prospect of refurbishing historically important buildings in central London, the Treasury put the project out to tender under the PFI. They have now selected their preferred bidder and are in detailed negotiations relating to estimated £200m project to provide new accommodation. The Department of Social Security has selected a preferred bidder to provide over 100,000m² of accommodation in the north of England. This contract will require the private sector provider to take on all existing properties and associated liabilities, and build

and maintain new accommodation, whilst accepting that the Government's requirement for space may decline over the contract period. Preferred bidders have also been selected for similar projects involving HM Customs & Excise, The Inland Revenue and the Post Office.

The largest office-related PFI project to date involves the transfer to the private sector of over 800 properties and interests in property, currently occupied by the Department of Social Security. The Department wishes to reduce its occupation costs by 30% over the next three years and has a portfolio of expensive and poorly maintained buildings in unfavourable locations. The winning bidder will provide a complete property service for the next 20 years. This is the first of a number of "big bang" projects through which the Government is planning to sort out its acute estate management problems. If the private sector fail to be innovative, they will also fail to maximise their returns from these schemes.

(v) Other Government Accommodation Projects

PFI in government accommodation has not been restricted to the conventional office sector. The British Museum, The Tate Gallery, The BBC World Service and even Stonehenge are all in the process of procuring new accommodation and services through the PFI. The Foreign and Commonwealth Office, not renowned for being unconventional, has taken up with the PFI and is currently procuring new embassy accommodation in locations as diverse as Berlin and Beirut. The Lord Chancellor's department is procuring courts and the education sector is now using the PFI to procure schools, colleges and universities. Even the police are using the PFI to provide new accommodation, with forty projects under consideration at the moment.

A Procurement Revolution

In October 1996, new legislation was enacted to allow local government to use the PFI to provide buildings and services. This now means that the whole of government accommodation in the United Kingdom is open to PFI solutions. This constitutes not just an opportunity to bring greater innovation into the procurement of property, but a revolution in the whole approach to the occupation of buildings. Government occupiers are now buying into property services, rather than buildings. New companies are being formed to provide these services often with the encouragement of the banks. Once established, these companies would be in a strong position to offer the same service to major private sector occupiers. The larger corporate occupiers are already considering using quasi-PFI procurement for the provision of accommodation.

Problems

It would be painting a false picture to suggest that the PFI has been a flawless innovation that has been proven to deliver innovative solutions. Although all the signs are encouraging, it is too early yet to say whether the solutions produced will be truly innovative.

As has been indicated earlier, there have been problems associated with the PFI. Contractors have been very critical of the time it has taken to sign contracts. This is a result of inexperience in both the public and private sector camps. A good knowledge of the PFI is still concentrated in very few hands.

One of the main causes of delay has been a mismatch of expectations. The 'theology' of PFI encourages the public sector to transfer risks to the private sector. This has been adopted with enthusiasm, but often with little or no appreciation of the consequent costs. As a result, purchasers have gone through the tendering process, selected their preferred bidders and then discovered that the project was not affordable. This problem has been compounded by central government advice that the purchaser should not try to "second guess" the cost of the PFI solution. This has resulted in several hospital projects being stopped at a very late stage.

Health projects have also failed because of a lack of attention to funding. In early projects, both sides in the process seem to have failed to grasp the importance of ensuring that project finance can be obtained. Many in the property industry used to debt funding were unprepared for the different requirements. The main problem in the health sector has been the strength of the covenant of the NHS Trusts who run the hospitals. These trusts, although funded by central government, have no guarantees from Government. They could fail, without recourse to Government. This has proved, so far, to be an unresolvable problem, preventing the signing of any hospital contract. However, the covenant problem does not arise with other government occupiers.

Another criticism of the PFI has been the extremely high bid costs. This has particularly applied to hospital projects where detailed proposals have been prepared by short listed bidders. It is understandable that contractors should become frustrated when projects are abandoned.

Remedies

None of the problems that have arisen with the PFI in Government accommodation is insoluble.

The mis-match of expectations, described above, will be cured with continued education of government purchasers and the growing pool of PFI expertise. The notion that reducing risks incurs increased costs is starting to be accepted.
Attention to funding issues is also improving. Early projects were often contractor led. Recent projects, especially the larger ones are now being led by banks.

Purchasers are also now more inclined to consider the likely costs of projects and appraise affordability before projects become too advanced.

The above, coupled with a drive by government to streamline the process should lead to a faster, less expensive bidding process.

The Way Forward

One of the changes that has taken place in the PFI has been a change in the likely leaders of successful consortia. The earlier PFI projects in both the health and the office sectors were very much dominated by building contractors. This occurred because the PFI arose at a low point in the development cycle in the United Kingdom and presented itself as a potential solution. Since then, contractors have invested millions of pounds in bidding for property projects and very few have been signed. Even in the earlier days of the PFI, it became apparent that there was no need for a contractor to form part of a bidding consortium. Contractors could be brought in to deliver the buildings when required. Nor were many contracting companies well suited to becoming locked into long term contracts, often in excess of fifteen years in duration. It was thought that as the contracts were essentially service contracts, it would be facilities' management companies that would take the lead, putting together consortia and leading bids.

It turns out that, for the very largest PFI projects at least, it is the banks who are starting to lead the running. For example the Department of Social Security project, involving 800 properties, received three bids from consortia all led by banks; Nomura, Goldman Sachs and NationsBank. The logic now runs that just as a consortium only needs a contractor to deliver the building, services can be bought from service providers as they are needed. The consortium needs only to have procurement skills, the correct advisers and funding to ensure that it can deliver the service required.

This shift to funder-led bids is likely to encourage innovation. Contractors were essentially interested in a short term contracting profit. The banks are interested in the long term performance of the asset.

Conclusions

The United Kingdom may have decided to use the Private Finance Initiative for reasons relating to fiscal policy rather than innovation in property procurement, but in doing so it has started a revolution in property procurement. Unusually, the government has made the first move by introducing a paradigm shift in this area of thinking. Those property occupiers who have a strong enough covenant can demand quality service, reduced risks and innovation from providers in return for a secure income stream. It does not follow that all property procurement will go down this route but it presents an additional option for any occupier, whether in the public sector or the private sector, with a strong enough credit rating.

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International Owners' Perspective of Involvement with Constructor/Designer

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Abstract

Procurement strategies adopted by major owners in global construction are believed to directly affect innovation attempted by different participants throughout the building process. This paper is the result of an independent research effort undertaken to formulate one or more case studies that will help clarify an owner's strategy for fostering innovation during the procurement process.

The procurement strategies of three major US owners are examined. They have all been extensively involved in global construction projects for several years and each has formed a myriad of relationships (alliances, joint ventures, partnerships, etc.) with several foreign entities. Along the way, these companies have had the opportunity to explore many procurement strategies that work well in some areas of the world but not in others.

Some owners choose to retain the responsibility for design within their own company. Others feel it is better to have an entity not connected with the owner "create" the project. It is believed that the most important factors in choosing one procurement strategy over another is imbedded in the culture of the company and the country in which the project is being built. The owners that get intimately involved in the construction of their projects and are aware of how to do business in a country need to pass this information on to the contractors, the designers and the suppliers.

Introduction

The emergence of many new markets around the globe in Eastern Europe and the Third World countries can be seen as the main reason behind the global competition present today. This global market created a new global competitive environment which has resulted in an increased number of US companies to go multinational and seek to procure construction projects beyond their territorial boundaries.

The nature of global construction projects is relatively complex due to several factors such as: the relatively large size of projects; remote geographical locations; involvement of unfamiliar participants; and other cultural, social and political issues that might impose additional risk to multinational owners (Khazanet, 1996). Thus, the procurement objectives

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of different owners in global construction are many and varied. Their main issues include cost reduction, construction and service innovation, quality and value, technology acquisition and risk transferring/sharing (Rajagopal and Bernard, 1994).

The procurement strategy that a multinational owner adopts in global construction is critical to the success of a project. It must incorporate how to work beneficially with the various participants to attain the project objectives.

Objective

The aims of this paper are twofold. First it presents procurement strategies of three major US owners involved in global procurement. Second, it discusses these strategies with the intent to provide a framework for developing a global procurement strategy from an owner's perspective.

Study Methodology

The purpose of this study was to investigate and formulate one or more case studies that will help clarify an owner's strategy for fostering innovation during the procurement process. The source of information included a questionnaire specifically designed to collect the appropriate data. The questionnaire was self-administered and e-mailed to all participants. It was designed to focus on the company's procurement strategy that would encourage innovation in the design and construction process. The five specific questions that relates to owners' procurement strategy asked were:

1. Since you are involved in projects on an international level, is there any specific procurement strategy (or strategies) you use to encourage innovation in the design and construction of your project?

2. Is your strategy different when dealing with a domestic company vs. a foreign entity? (you might wish to comment on labour issues, cultural issues, etc.)

3. Once a project has been conceived, who does the design? Is it handled in-house or do you contract it out?

4. If the design is contracted out, please answer the following:

   a. How much "guidance" is given to the designer?
   b. Do you set specific guidelines and limitations on the design? Or is the designer given more a less a "free reign" to exercise his/her creative powers, as long as the ultimate product meets your expectations in quality, performance and cost?
   c. Are periodic meetings held with the designer?
   d. If the answer to c. is yes, are the meetings held as an open forum that will allow for constructive debate between all involved?

5. If the design is accomplished within your organisation, please answer the following:
    a. What department in-house will do it?
    b. Does this group do the conceptual design only or do they do everything, i.e., the entire set of detailed working drawings?
    c. If the design is completed within your company, how much latitude is there for changes through such vehicles as value engineering

Participants

Four major US owners who are extensively involved in global construction projects were queried. Three of the companies contacted responded giving the case study a more broad spectrum of views. The authors felt that the companies' size and high level of involvement in global construction were most appropriate for this case study. The third company that participated in this case study, which is referred to as "Company Three" throughout this paper, wished to remain anonymous.

Company Responses

DuPont

DuPont sees itself as initiating and leading the facilities engineering process with their term "front-end loading," which means the business objectives are known and the facility and project objectives must match those business needs. They then allow the engineering and construction "contractor" to execute the project, overseen by DuPont. This company's strategy for executing projects is the same regardless of the geographical location. The "contractors" are looked upon to add value while delivering at lowest cost. DuPont drives four best practices for capital productivity during front end loading:

1. "Front-end loading" against business needs;
2. Invest in new technology;
3. Minimise non-value adding investment; and
4. Execution with a "no-change" philosophy.

Design and construction can be by the same firm or split among firms. The strategy also includes strategic acquisition agreements, long term alliances with selected full-service "Design Contractors", consortium benchmarking of the four best practices and project deliverables. Major projects are executed with a single, business led, integrated project team empowered to determine the contracting strategy and integrate business objectives with project objectives. When contracting outside the US, DuPont maintains relationships with "contractors" that are familiar with local customs, cultures, regulations, practices, and are committed to developing further in these areas.

Twenty-five percent of the design is generated during front-end loading by a combination of in-house and contract personnel. The 25 % includes process and instrument diagrams, single line electrical schematics, and, in some cases, specifications for special equipment or that requiring long lead times for delivery. The company believes that this initial 25% sufficiently defines the project to the point where a qualified "contractor" can complete with minimal guidance.

The production engineering of projects is carried out by "alliance engineering contractors". From experience it has been proven to the company that simply turning over a project to a builder brings less than optimum results. Thus, the "contractors" are also involved in the front-end loading in order for them to contribute to determining the strategy and to assure continuity in the process. DuPont feels that it is important for the "contractors" to understand why the strategy is what it is so that they do not try to adjust. The company also maintains regular meetings throughout the life of a project with everyone participating. This policy is focussed on developing team skills, identifying roles and responsibilities and establishing the process of managing change. Basically, DuPont innovates the process (and to a minor extent the contractor) and they want the "contractor" to be innovative on how to execute better, faster and cheaper.

Mr. Raul Hermosillo, with DuPont, believes that :

> "innovation is a product of the project team, business, engineering, maintenance, operations, construction, and contractors. They can be as innovative as they are willing to be held accountable for." He adds: "Our contractors are very innovative when provided with the right incentives. We believe the best measure of innovation is the percent of dollars the project spends on new technology. We benchmark it continuously."

Lucent Technologies (a Subsidiary of AT&T)

The procurement strategy that Lucent Technologies adopts involves having a contract with both a construction manager and a designer (either in-house or external) early in the project to maximise the value brought to any project. Teamwork alignment/partnering between the project manager, the client, designer and construction manager is emphasised in order to gain in quality, reduce the schedule, and achieve cost savings through constructability and value engineering analysis.

The company does not use a different strategy when dealing with a foreign designer/contractor. However, some differences arise when dealing with tax issues and legal differences between the US and the foreign country. To overcome labour and cultural differences, the company contracts with a local designer (at least for design input) and/or with a construction manager with local experience.

An in-house architectural and engineering group having full capabilities is available. However, due to the fact that the in-house design group has limited resources, some projects are designed by external A/E firms. A fair amount of guidance will be given to the external designer to ensure that the company's expectations are met. Lucent will not designate rigid specifications in order to promote creative thinking by everyone on the team. The goal is to maximise cost savings to the project and achieve high client satisfaction.

Depending on the project and their resources, the in-house group completes either the conceptual design, or both the conceptual design and the construction drawings. If only the conceptual design is accomplished in-house, schematics are also completed and then this package is passed to an external firm to complete the construction drawings and detailed specifications. In other cases, an external A/E firm will complete the entire design from

conceptual to construction drawings. When the design is accomplished in-house, much latitude is given to the designers for changes which will result in savings through value engineering and/or constructability. However, changes are weighed against other factors as well, such as schedule and impact on quality.

In either case, a designer will be provided with a set of space guidelines which dictate the sizes of individual offices and "square feet per person" targets for the entire company. Each project has a specific budget and the designer is not expected to just meet the budget; he/she is expected to be creative in meeting all client expectations such as cost, schedule, performance and quality in the most effective and cost efficient way possible.

The company believes that constructive debates can have a positive impact on a project in many ways if conducted in a proper and organised manner. Thus, open forum periodic meetings are held weekly or bi-weekly depending on the nature of the project. Such settings can produce positive impacts such as finding ways to achieve the same level of quality at a lower cost without delaying the schedule.

Company Three

Company Three doesn't have a company-wide procurement strategy that will encourage innovation in the design and construction of their projects. To ensure that all participants are aligned with project objectives, the company concentrates on partnering and team building.

As an owner who extensively deals with international projects, the company's procurement strategy does not differ significantly when dealing with a domestic versus a foreign entity. However, it acknowledges that considerable time and effort should be put into understanding the culture and "drivers" of a foreign company, especially one that Company Three is not familiar with.

In terms of adopting innovative technologies and introducing them into new projects, the company believes that it is best if the introduction took place during the early stages of the project. It also recognises the need for incorporating a significant contingency in both cost and schedule when evaluating the economic feasibility of incorporating a new technology.

Once a project has been conceived, the smaller ones are designed in-house. The concept and design basis for larger ones are also handled in-house; however, the details are contracted to an outside firm with various levels of owner's representatives integrated into the design team, depending on the working relationship between Company Three and the external designer. If the design is a duplicate of a previous project, then the designer/constructor is given a great deal of freedom. Otherwise, and also if the designer is an unknown, then Company Three will be closely involved. The guidance provided for the designers is generally in terms of performance expectations, a list of government regulations that must be complied with and sometimes equipment preferences, if they exist for the operating area. So as to optimise the project around the project objectives, the company holds periodic meetings, have full-time staff on site and holds monthly management reviews.

Review/Analysis of Research Findings

The factors that affect a company's global procurement strategy provided in this paper are of considerable interest in that they reveal some of the significant issues that some multinational owners consider when procuring globally. It is obvious that all three companies have implemented policies that tend to encourage participation of the contractors in the design effort.

DuPont expects the constructor to actively offer suggestions and participate in the early stages. As pointed out in their response, these constructors are referred to as alliance engineering constructors. Here, "Alliance" signifies a partnership built on trust and "engineering" implies in-house design capabilities within the construction firm. Without this type of relationship, as DuPont has learned from experience, less than optimum results are obtained. A standard owner-constructor relationship would obviously not encourage participation by the constructor in the design, and DuPont has found that the body of knowledge most constructors possess is based on experience.

This knowledge-based experience becomes invaluable when venturing into new and unfamiliar areas. It is the rationale behind the philosophy of defining the very basics of a project, such as the process and instrument diagrams, and allowing the constructor to design the method on how such a process can be implemented. In other words, only about 25% of the "project strategy" is known by the constructor and it is then up to him/her to adequately define the other 75%. He/she is also mandated by DuPont, as part of this overall procurement strategy, to ensure that value be added throughout the design/construction effort. This is apparent from their commitment to: 1) invest in new technology and 2) to minimise non-value adding investments.

Therefore, the real essence of innovation in design is essentially contained within the DuPont commitment to value at no extra cost. As mentioned above, DuPont encourages a contractor to offer innovative approaches with the idea that he/she will be held accountable. Although such an approach increases the risk factor, it includes the compensation for added risk. To some people, new technology implies an inherent risk; however, DuPont believes that the more new technology a project has, the higher the level of creativity during the design and, hopefully, the more value within the design. Thus, in our overall analysis of how owners implement strategies to encourage innovation, DuPont seems to have found the correct approach.

Lucent's strategy is also centred on the team concept and early constructor involvement. However, one of the perceived differences from DuPont's approach is that more responsibility is given to an in-house or independent designer for the design versus the constructor/designer concept. This is not to say that the constructor, through a construction manager, does not participate, because in fact, they do. But the emphasis seems to be more on a "designer" than on a "constructor /designer." One of the reasons is most likely that Lucent has an in-house architectural and engineering group who are fully capable to do many of their projects.

Even when the design is contracted to external firms, Lucent maintains control and furnishes guidance to the extent that company expectations are met. Concepts such as value engineering play an important role in assuring quality and value in the finished product. It seems that, independent of who does the design, Lucent encourages innovation as a way to achieve constructability at all levels of the design. What is interesting is the fact that this owner is so intimately involved in their project designs. As pointed out above from their response, they sometimes do the conceptual and schematic drawings and turn the detailed drawings over to an outside firm. If they have the resources for doing all of this in-house, they do it. In either case, the designers are given a fair amount of latitude during the creative phase and are not hampered by rigid specifications. Our interpretation of Lucent's approach to innovative design, while markedly different from DuPont's, is that it is a valid technique which has become a part of their overall corporate strategy.

Company Three is another case altogether. While DuPont focuses on encouraging design innovation within the constructor firms and Lucent maintains considerable design capabilities within their company, Company Three does neither. They do not have a "company wide procurement strategy that will encourage innovation in the design and construction of their projects." It seems that, after close analysis of Company Three's response, that they are not as intimately involved in the construction process as the other two companies. They know what they want and as long as the objectives are met, the designer and/or constructor are given free reign.

Company Three is reluctant to try new technologies without an appropriate "contingency" added, and usually during the early design stages. Their emphasis for innovation seems to be more on performance than on value added. Which, for their industry, is understandably justified. Risk is a big part of the petroleum industry and, in our opinion, much higher than in the chemical or communications industries. Why? First of all there is the risk during exploration. Secondly, the volatile nature of countries that produce much of the world's petroleum is seemingly always at a high level. It therefore seems logical from a financial point of view that introducing additional risk through the trial and error of new technologies would not be in their best interests.

However it would be incorrect to believe that Company Three, as an owner participating in the global market, is creatively stagnant. Their innovation is based more on establishing people relationships with the participants. They are focused on team building, partnering and understanding the cultures of the foreign countries they are active in. These concepts are undoubtedly "managerially" innovative and are becoming more of a necessity when dealing with international entities. Company Three's concept of frequent meetings enhances communications between all participants and more than likely encourages innovative ideas to surface.

Research Summary

The whole point of this research has been to find examples of how owners who operate in the global market encourage innovation in the design to assure that the end product has the quality they demand. It is more than just customer satisfaction that they seek; it is customer

enthusiasm. The three companies used in the case studies exemplify this attitude. As owners, they know what they want the end product to look like, whether it be a chemical processing plant, a communications facility or a petroleum refinery. Each has the foresight to know that they, as owners, are not the best equipped to define how to achieve these goals. So they have come up with various strategies that encourage innovation, rewarded with incentives and based on co-operative agreements.

They understand that the correct methods, materials and equipment used in one part of the world are not necessarily the same in another part. They also recognise the tremendous impact that culture has on global projects. Local rules, ordinances and customs directly affect the way something will get built. Constructors familiar with these local cultures best know how to cope with them. They also know when and when not to introduce new designs and technologies.

However there is one anomaly that the authors have detected in this analysis. That is the fact that none of the three companies interviewed had a different strategy for the domestic market versus the international market. It would seem that the complexities and nuances would be drastically different between the two markets. Perhaps it is due to the fact that a large share of their construction activities are overseas. We would speculate that there are companies in the US who would expand to the global market but are hesitant to do so because they fear the repercussions from realigning their overall corporate and business strategy. This might be an area for further study.

In conclusion, we leave the question of risk unanswered. Are the different strategies related to the amount of risk a company is willing to take? And is the risk related to the type of product that the owner builds? We touched on this briefly in our discussions on DuPont and Company Three, but do not have enough information to draw any factual conclusions. It does seem logical that such a relationship exists. Again, perhaps an area for future study.

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AN EXAMINATION OF DECISION-MAKING BY MANUFACTURING INDUSTRY FOR INVESTMENT IN NEW BUILDINGS.

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KEYWORDS: Investment, Manufacturing, Buildings, Motivation.

ABSTRACT:

This paper attempts to identify different investment behaviour patterns within manufacturing industry categorised by industrial classifications, establishments and/or enterprises. It seeks to differentiate between manufacturing sectors for their propensity to invest in new buildings and to determine whether enterprises invest in expectation of a profit (neo-classical model) or invest from reserves from previous profits (a practical model); whether investment expenditure is a function of profitability or rate of change of profitability. The paper also explores whether competitive threat is a motivation for investment and whether there have been shifts in capital spending away from buildings towards plant and equipment. The study eventually hopes to develop more sophisticated models of investment behaviour than simple demand models and examine the real underlying motives for investment in new buildings (using recent empirical evidence) and thereby to increase the market awareness of construction professionals.

INTRODUCTION

This paper develops a research initiative aimed at identifying construction demand from the manufacturing sector in an attempt to determine either different behaviour patterns by industrial classification or trends in activity. The study has commenced by looking at manufacturers' overall spending and that in particular on process plant, and whether it is evident that this expenditure is a consequence of primary demand. There is a need to look beyond this initial picture, however, to determine whether there are shifts within capital expenditure from say buildings (new build and existing stock) to plant and equipment. Other shifts might then be apparent in building expenditure per employee or building expenditure as a share of total expenditure.

Professor Ranko Bon (Bon 1992) has addressed the relationship between construction, industrialisation and urbanisation. As economic development proceeds, it is held that each country, or economy, experiences similar milestones of development. The decline of construction activity changes from relative to absolute decline at a particular milestone in development .

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One such milestone is defined by the S-curve relationship between the share of urban population in total population which first grows at an increasing rate and then at a decreasing rate as GNP per capita increases. This coincides with the inverted U-curve relationship between the share of construction activity in GNP and any growth in GNP/capita.

Table 1. Population, GNP per capita and % GDP in Manufacturing and Construction.

Country	Population (millions)	GNP per capita (US $)	%age GDP Manufacture	%age GDP in Construction 1991
China*	1,134,000	370	N/A	5.90
Germany 2	78,752	20,520	34.66	N/A
Hong Kong*	5,705	11,890	16.88	5.02
Japan*	124,000	25,840	31.11	9.50
Korea, S	42,869	5,440	32.75	9.64
UK 3	56,930	10,560	23.22	6.55
USA 3	244,000	18,480	20.91	4.80

Notes: *1990 data: 2 1989 data: 3 1987 data.

Source: World Tables 1993,
1991 Demographic Yearbook,
Statistical Yearbook for Asia and the Pacific (1992),
Harrington J.W. and Warf B.,1995.

Together these two relationships point to the direct derivation of construction demand from activity in manufacturing industry. Construction output is therefore hypothesised to grow and decline with that of manufacturing, the key component of construction's share of total economic activity.

INVESTMENT BEHAVIOUR DIFFERENTIATED BY MANUFACTURING SECTOR.

In the UK Process Industries Investment Forecasts 1995-1999, capital investment is examined in 9 major industry sectors. For the purposes of this paper, the author has chosen to examine **(1)The Chemical Industry, (2) The Water Industry and (3) the Food and Drink Processing Industry** because they appear to offer contrasting performance and behaviour. Another important factor in choosing these industries is that there exists a reasonable spread of consistent statistical data over time. The discussion about whether there exists sufficient quality of data for analysis of investment patterns must at present remain outside the remit of the paper.

The Chemical Industry

Basic data for capital investment in the Chemicals Industry are obtained from the Chemical Industries Association (CIA) annual survey and from the CIA's Investment Intentions Conference.

Table 2: Capital Expenditure Intentions by the Chemical Industry

	Actual			£million
	1991	**1992**	**1993**	**1994**
Total Expenditure	2194	2075	1971	1878
	(2104)	(1909)	(1746)	(1632)
Expenditure on Process Plant	1097	1038	986	939
	(1052)	(955)	(873)	(816)

Figs. in parenthesis are constant (1990) prices.

Source: UK Process Industries Investment Forecasts Volume 30 1995-1999.

Table 3: Purpose of Investments

	percentage share 1993-1995	percentage share 1994-96*	percentage share 1995-97*
Production extension:			
- existing products	24	22	21
- new products	11	15	18
Replace/modify existing facilities	17	17	13
Increased efficiency	9	12	22
R&D (pharmaceuticals)	22	22	16
Other	17	12	10
Total	***100***	***100***	***100***
Of Total: Energy saving	6	5	6
Health & Safety	7	6	6
Environmental Protection	17	16	14

* Forecast.

Source: UK Process Industries Investment Forecasts Volume 30 1995-1999.

This evidence of investment behaviour in the chemical industry has several points of interest and these include the following:-

1) There is a continued rise in the proportion of spending on new products
2) There is a decline in the share designated for modification to existing facilities.
3) There is a significant rise in the share aimed at increased efficiency.
4) There is a reduction in the proportion spent on R & D. This may reflect the completion of a major R & D pharmaceutical project (Glaxo).
5) Profit improvement has been identified as coming mainly from cost reductions, productivity gains and currency movements.
   There is a focus on cost-cutting and efficiency gains.

6) Investment intentions have included a commitment to keep any expansion modest, in the face of a demand upturn. This is to avoid over-peaking and any major subsequent capacity reduction in the inevitable ensuing downturn.

The Water Industry

Data on the capital investment of the water companies of England and Wales is available from the OFWAT annual report. Consider the comparison between Total Capital Expenditure with Process Plant Content,

Table 4: Capital Expenditure Intentions by the Water Industry

	Actual			£million
	1991	1992	1993	1994
Total Expenditure	2888	3116	3169	2863
	(2790)	(2912)	(2865)	(2556)
Expenditure on Process Plant	520	561	570	515
	(502)	(524)	(515)	(460)

Note: Figure in parenthesis are constant (1990) prices.

Source: UK Process Industries Investment Forecasts Volume 30 1995-1999.

Consider the purpose of investments as expressed by capital investment by outputs,

Table 5: Capital Investments by Outputs

£million 1994-95 prices

	1992-93	1994-95
Maintenance of underground assets	410	314
Maintenance of surface assets	810	660
Enhanced service levels	458	217
Supply/demand balance	422	288
Quality enhancement programmes	1118	993
Total	***3218***	***2472***

Source: UK Process Industries Investment Forecasts Volume 30 1995-1999.

Investment by the water industry follows two main strands of behaviour, firstly, recent merger and acquisition activity which has produced profit through efficiency gains and significant restructuring. The other strand has been in response to legislation and EU directives namely the EU Urban Waste Water Treatment Directive (UWWTD) which has had a major impact on some companies, river quality (sewerage) and water quality enhancement including chemical removal and distribution renovation programmes.

The Food and Drinks Processing Industry

The primary sources of data on this sector are the CSO Business Monitors and the Census of Production reports. Annual reports and accounts of the major companies can also be used.

Table 6: Capital Expenditure in the Food and Drinks Processing Industry

£million

	Actual	Estimates		Forecast(4th Qr 94 prices)		
	1992	1993	1994	1995	1996	1997
Capital Expenditure	2050	2130	2300	2357	2448	2525
	(1885)	(1873)	(1950)	(1998)	(2075)	(2141)
Expend. on Plant and Machinery:						
Food Processing	1167	1248	1357	1414	1469	1540
	(1081)	(1103)	(1130)	(1178)	(1223)	(1283)
Drink	322	312	322	342	348	354
	(291)	(269)	(276)	(293)	(298)	(303)

Note: Figure in parenthesis are constant (1990) prices.

Source: UK Process Industries Investment Forecasts Volume 30 1995-1999.

The food and beverages industry is one of the largest sectors in UK manufacturing and accounts for about 13% of output. Further it is a sector which behaves in a relatively stable way as the essential nature of many of its products are less affected by cyclical fluctuations. Nonetheless its proportionate share of consumers' expenditure has fallen.

There has been significant restructuring within the industry and plant closures have occurred. Increasing competition within the market, the growing purchasing power of supermarkets and price conscious consumers have cut margins.

It is necessary to differentiate between investment behaviour within the food sector and the drinks sector. Within the Food sector EU work practices and factory regulations have required costly upgrading of buildings and indeed led to some closures. Stiff competition from imports, especially in poultry, has also led to capacity cutting and lower margins.

Safety and hygiene requirements determined by legislation and multiple buyers act as motivation for investment, and general competitive pressures have caused manufacturers to invest in more technologically advanced processes.
A significant point to note here is that while capital expenditure in food processing and manufacture has grown over the five years to 1992, the total being 26% greater than that of 1988, expenditure on plant and equipment has grown by 25% over the same period. Investment in plant and machinery is estimated to have increased its share of total capital expenditure and to have grown at a faster rate than total expenditure in 1993 and 1994.

Major forces for investment identified include; implementing environmental policy, food hygiene legislation, to meet growing demand in niche markets e.g. chocolate confectionery

and biscuits in a specific attempt to improve competitiveness, and technological change in processing which is changing production patterns.

INVESTMENT FOR COMPETITION.

In examining investment behaviour, the Bank of England in its May 1994 Inflation report remarked that UK companies' capital spending plans and investment criteria did not appear to have taken into account the decline in UK inflation over recent years. By July 1994, the CBI Quarterly Industrial Trends survey had shown that Plant and Machinery investment was expected to rise only modestly over the year ahead with uncertainty about demand and an inadequate net return being the main factors limiting investment. Those respondents claiming demand uncertainty as a principal factor fell to 50% but those citing inadequate return as a constraint against investment remained at 47%, higher than in previous recovery stages, apparently reflecting a delay in companies' responses to lower and more stable inflation.
The CBI consequently conducted a special survey, targeted at finance directors within manufacturing industry, to investigate how the changes in the overall economic environment influenced the cost of capital and the decision making process used by manufacturing companies to evaluate new investment projects.

The survey asked these directors to compare quantitative and judgmental methods, and to consider how important a factor inflation was in their plans. They consistently assumed higher rates of inflation than the actual rates experienced. However, apart from inflation, the survey asked these directors to determine the most important factors in determining their required rates of return.

The impact on a company's profit growth was ranked as the most important factor, followed by the riskiness of the project and the opportunity cost of capital defined as the return available on alternative uses of funds. The cost of capital (interest rates) was seen as less important than the other factors in setting target rates of return.

The Opportunity Cost of Capital was assessed by a minority of companies in terms of the expected return on investing the funds in the stock market over the same period and with a similar risk and tax treatment. A large proportion of firms assessed the return on capital simply in terms of interest earned on short term deposit. Only one third of firms cited project risk as an influence on determining rates of return and most of those relied on subjective judgement.

But perhaps most importantly for the direction of this research, the prime factor in deciding whether or not a typical investment would in fact achieve its target rate of return was, perhaps not surprisingly, the expected level of demand for the company's products. This was cited by nine out of the ten respondents. Competition within the home market was the next most important, followed by the expected level of overall demand in the economy. Foreign competition was also an important factor and political risk was seen as being the least important.

The key therefore to tracking investment behaviour in UK industry would appear to lie in macro-economic performance, not least in the analysis of demand and growth patterns. The most recent economic cycles appear to have induced a more cautious mind-set in the manufacturing investor and perhaps the latest cycle has not merely been another sequence of peak followed by trough but more some form of long term correction.

Table 7. Manufacturers' Most important Investment Criteria, apart from Inflation

	%age of Respondents	Average Ranking
Opportunity cost	60	1.9
Riskiness	83	1.8
Cost of Finance	66	2.0
Impact on Profits	66	1.6
Other	5	1.7

Source: CBI Special Survey: Investment Appraisal, May 1994

Table 8: Factors Which Determine Whether Project Achieves Return

	%age of Respondents	Average Ranking
Expected overall demand in economy	43	2.6
Expected demand for own products	90	1.2
Competition within UK	55	2.4
Competition outside UK	49	2.8
Political Risk	31	3.5
Other	4	1.4

Source: CBI Special Survey: Investment Appraisal, May 1994

MODELS OF INVESTMENT BEHAVIOUR

The principle that construction demand is a secondary derived demand is well documented, but the author wishes to develop this within the manufacturing sector to produce a more sophisticated model. This would examine and incorporate the underlying motives for capital investment which directly impact on construction output.

If the most important motivation for investment is profitability, the key question may be posed whether investment expenditure is a function of profitability or rate of change of profitability. Assuming that enterprises continue to operate in the expectation of profit, do they invest in anticipation of profit or from reserves accumulated from previous profit?

Davidson (1991) has identified a post-Keynsian perspective for comprehending real world investment behaviour where decision-makers either avoid choosing between "real" alternatives because they haven't got a clue about the future, or follow their animal spirits for positive investment action. This nod in the direction of truly subjective decision-making appears to be borne out in part by the results of the CBI survey (CBI, 1994). Overwhelmingly, subjective

decision-making was used by all respondents in determining whether the rate of inflation was a significant influence in determining a required nominal rate of return and also in considering the riskiness of a project. Reassuringly perhaps, the vast majority of firms used some kind of quantitative assessment of their investment criteria but among smaller firms with under 200 employees just under one firm in five relied purely on subjective judgement.

A recent survey of 600 firms in the UK (Geroski and Gregg, 1993) cited by the Cabinet Office, (June 1996) showed a general shift towards intangible investments. Intangible investments may be said to include R & D, training, reorganisation, labour relations, joint ventures and software development. Although many firms had cancelled investment plans in plant and machinery and buildings during the recession, 185 had brought forward either research and development investment or product innovation during the recession, and 110 of these had also brought forward process innovations.

The second most significant motivation for investment appears to be competition. There is a need then to determine a relationship between the level of competition and the level of investment. How does the investment (in buildings) behaviour of competitors affect the investment behaviour of individual firms?

Current investment trends in the UK (Cambridge Econometrics, 1996) have indicated that manufacturing companies continue to reduce their investment in buildings, with the balance of those intending to do so having grown over the last two years. There has been a 20% decline in total investment by the utilities during 1995 which has been a major influence on the fall in investment in buildings and works. The fall reflects in part the 10% reduction in water industry investment from 1993/94 to 1994/95.

Total investment by manufacturing industry grew by 7% in 1995 with the strongest growth in the engineering sector and in chemicals. This strong investment *followed* rapid growth in manufacturing output in 1994 and reflected the increasing number of companies which were operating at full capacity. Is this an indication of an accelerator at work? By contrast, manufacturing output levelled off from the third quarter of 1995 and this has been associated with a decline in investment in the sector. The degree of spare capacity differs across industries with the Food, Drink and Tobacco, Chemicals and electronics reporting existing capacity being inadequate for forecast *future* demand. Recent industrial construction output has developed in the UK through inward investment in electronics, in *anticipation* of increasing European market share, and domestic investment projects by the cement industry *to improve productivity*.

The CBI survey has provided some significant evidence of the motivation for overall investment. Work has now begun to extend this inquiry down to the level of investment in new buildings. The author believes that this paper addresses a subject that is of importance to the building industry and should be of concern to those who study the interface between that industry and the demand for its services through procurement. Knowing about these investment trends and the motivation behind them provides the industry with good clues as to what clients want and to how they should go about about meeting those needs.

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CREATING A LEARNING ENVIRONMENT ON A PROJECT SITE- A CONTINUOUS IMPROVEMENT APPROACH

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Abstract

Training has increasingly become a key ingredient of companies striving to achieve best practice and competitive advantage. In the NSW construction industry however, training efforts have not been standardised, with many companies placing short-term project requirements above efforts to increase productivity through training. Yet there are clear benefits for companies who create a learning environment, especially when this is based on developing a continuous improvement culture.

This paper examines how one company has taken up the challenge of creating a learning organisation on a project site. Through a case study approach, the paper examines how management sought to place learning as a pre-requisite for increasing productivity, and improve worker competency levels within the site. The paper suggests that when management recognise the key characteristics of learning, they are better placed to match these with the core abilities and organisation behaviors required to continuously improve the workplace.

Introduction

The construction industry in Australia accounts for about five per cent of gross domestic product and employs more than half a million people. In New South Wales, annual capital investment programs are estimated at $6 billion or between 30% and 40% of the non-residential construction market.

Given that the industry has been criticised for its slowness to promote workplace change, this paper examines how one company in the non-residential construction sector has accepted the challenge of developing training programs to address the problem. The paper has two broad aims: firstly, to show how - despite political and economic restrictions - major players on a construction site can cooperate in the design and implementation of a major training program; and secondly, to explore how a construction company might improve the practical application of training, especially when this is based on a strong understanding of the continuous improvement (CI) process.

Background to a Cooperative Training Program

A report by the Construction Industry Training Advisory Board (CITAB, 1996), found that in the non-residential construction sector in NSW, there was a strong link between a forecast decline in employment trends and a current and predicted shortage of skills required for future projects.

Although on the one hand sub-contracting companies are tending towards fewer labor/trades ratios, the report notes that the majority of trade and skilled work is performed by this group. For major contractors such as Barclay Mowlem, skill audits for projects such as the Liverpool Hospital redevelopment scheme indicated considerable shortages in skilled trades. At Liverpool (NSW) for instance, finding construction workers was not so much the problem, rather, it was up to sub-contractors to prove that workers possessed the skills required to complete the tasks.

At Liverpool, the contractor was caught between the requirements to fill contractual obligations on the one hand, and finding the necessary skills represented mostly by sub-contracting staff on the other.

A Continuous Improvement Approach to Training

The Liverpool training initiative is an outcome of a much wider debate about training that has attracted much national attention in recent years (BCA 1991; Karpin 1995). For the most part, the debate has centred on Australia's inability to match the rest of the world in increasing factor skills in human resources.

The report by the Business Council of Australia in 1991 found that Australia had failed to upgrade its human resources through training or to use them effectively (BCA, 1991:57). The report found that sustainable competitive advantage in training was dependent not so much on specific industry assistance, but rather on those factors which shape the supply and quality of human resources (See Karpin, 1995; BCA, 1991:61).

Other reports and studies such as those by Garnaut (1990) and Pappas et al (1990) recognised that education and the quality of training have a major impact on productivity. Consistently, these reports appear to convey the same message: a best practice company views employees as investments, which, when properly supported and developed, yield a long-term stream of benefits to the organisation.

The key to the success of the following case study relates to CI innovation in the training process itself and the events which led to its implementation. For this reason, it is worthwhile exploring further the link between learning and continuous improvement before detailing the study. By this, we hope we can explicate the characteristics of learning and apply these to the evidence collected on the site.

In moving to continuous improvement, the concept has been defined by Bessant et al (1995) as continuous incremental innovation, more recently extended by these authors to mean "an organisation-wide process of focused and sustained incremental innovation" (Bessant et al ., 1996).

These authors regard innovation as not necessarily of the 'breakthrough' type, but consistent with claims by Mintzberg (1978) and Quinn (1981), more incremental in nature, formed and reformed over time, just as a potter turns his/her clay. The success of CI in the workplace depends on the level of sustainability and focus in implementation. The notion that CI applies only to the innovation of products, however, is false. In other work by Bessant et al, these authors note that the concept rests equally well with processes: the structure and systems embodied in CI as well as the supportive structures and underlying culture inherent in any organisation (see Bessant et al., 1993).

Focused and sustained incremental innovation can provide new meaning in the development of new products, formulating training processes, evolving international business structures, implementing advanced technology, advancing total quality management systems, designing lean manufacturing processes and almost any other organisational process. The key which harnesses most of these to success is the idea of high levels of participation (Bessant et al., 1996; Phillips 1996; Senge 1992), and the evidence of a learning process, which according to Gary Hamel, helps the organisation develop defensible competitive advantages (Hamel 1996:76). Such learning processes are often based on a hierarchy of imagination - where many people are involved in the process - rather than that which is contrived through experience only.

In the support of these notions of CI, Gilmore suggests that CI is brought about by identifying breakthroughs (process controls, improved raw materials, training, equipment improvements), that permit incremental changes in product or service performance, added value, and customer satisfaction (Gilmore, 1994:51). This implies that the process must add value from a customer perspective.

Other studies of UK companies by Bessant et al (1993, 1994, 1995), have found that organisations who have a degree of success in CI implementation, do so because of the existence of core abilities (levels of management maturity), and the existence of key behaviors; that is, those strategic management behaviors that underpin CI implementation (table 1). The more these abilities and behaviors are present, the more the organisation will be able to progress through different levels of CI. Different enablers (management mechanisms which speed the process along) also help to reinforce the process.

According to Caffyn and Bessant (1995), there are five levels that can be identified in the process. These include: level 1: natural CI, where there is evidence of some natural improvement but generally no core abilities or behaviors present; level 2: formal CI, where some evidence is occurring of enablers and key behaviors required: level 3: goal directed CI, where the organisation begins to master some abilities with the behaviors evident in the way these are supported: level 4: proactive, autonomous CI, where individuals and groups are proactive in seeking CI and seeing it through to completion, and level 5: strategic CI capability, where all core abilities and behaviors are present and established as a part of the culture (see Caffyn and Bessant, 1995).

Table 1: Abilities and Behaviors of Continuous Improvement

Core Abilities	Key Behaviors
A. The ability to link CI activity at all levels to the company strategy	1. Individuals and groups use the organisations strategic goals and objectives to focus and prioritise their improvement activities
B. The ability to strategically manage the development of the CI system within the organisations structure	2. The CI system is continually monitored and developed 3. Ongoing assessment ensures that the organisations structure/ infrastructure and the CI system consistently reinforce and support each other
C. The ability to generate sustained involvement in incremental innovation	4. Managers at all levels display active commitment to, and leadership of, CI 5. Proactive participation in incremental improvement

D. The ability to work effectively across internal and external divisions	6.Effective working by individuals and groups across internal and external divisions at all levels
E. The ability to enable learning to take place and to be captured and shared at all levels	7. Learning from own and others experiences, both positive and negative 8. The organisation articulates and deploys the learning of individuals and groups
F. The ability to articulate, demonstrate and communicate the CI values	9. People "live" the CI values

Modified from Caffyn and Bessant, (1995). University of Brighton, UK.

Considering the core abilities for a moment; collectively, these indicate much about the existence of the key behavioral characteristics in question. Indeed, these characteristics do not 'just happen'; to be achieved, the organisation must focus on a shift in learning which transforms the company from one with a predominant concern for controlling, to one with a predominant concern for learning.

Senge describes learning in the context of 'learning waves'. The first learning wave is based on quality management where the primary focus of management is front-line workers. Here, management's job is to champion continual improvement, remove impediments that disempower workers, and support new practices. The second wave is focused more on improving 'how we work' rather than on work processes. In this wave, what is needed is to foster ways of thinking that are conducive to continual learning about the dynamic, complex, conflictual issues that determine system wide performance (Senge, 1992:61). According to Senge, organisations need to be positioned in the second wave of learning even though many are still in the first.

This concept of learning described by Senge is similar to Rylatt's (1994) perspective of learning strategies needed to transform the workplace. In a world of uncertainty, workplace learning must be greater than change, and be systematic and interactive. Learning systems need to be well planned and based on team learning, benchmarking best practices, accelerative learning and total quality management. According to Rylatt, workplace learning must be geared to business outcomes and provide meaning, self-worth and sustainment for all employees (Rylatt, 1994:18-19). The latter is consistent with Senge's view that organisations need to build shared vision and a collective will to learn (Senge 1992:66). Individual commitment to learning will be important as well as the capability to visualise assumptions and challenge traditional mindsets.

When an organisation can create an organisational symphony approach to learning as Senge describes it (Senge, 1992:67), core abilities will be supported by organisation-wide

capabilities developed in concert with one another. These capabilities will be underpinned by the empowering of people around a common purpose and shared vision, and individual skills of communication such that confrontational issues can be addressed. A systems thinking approach that attacks standard ways of thinking will be evident, as well as a commitment by management to the long-term perspective

Description of the Training Program

The Liverpool Hospital redevelopment training initiative represents an example of learning and continuous improvement in practice.

The program was a competency based learning system intended to train apprentices from the ranks of the long-term unemployed. The training consisted of an accelerated learning program designed to give skills to apprentices, solve problems related to skill shortages, and provide employment in the construction industry.

The training program was part of an $80m broader project undertaken by Building Group South, a division of Barclay Mowlem Construction Limited, on behalf of the Department of Public Works and Services. The project was based in Liverpool, NSW and extended over a period of three years from 1994 through to 1996.

The parties contributing to the program included Barclay Mowlem Construction Limited (the principal contractor), the Department of Public Works and Services, the Department of Technical and Further Education (TAFE), the Commonwealth Employment Services (CES), the Department of Education, Employment and Training (DEET), the Builders Workers Assistance Centre, the apprentices and the sub-contractors working on site.

Designing the Training Program

At the program's inception, Barclay Mowlem established a steering committee to oversee the training program. The major players on the committee included representatives from the company, the training provider and the Commonwealth Employment Service. Out of these, the project manager and the training manager from Barclay Mowlem became program champions.

The key objectives established by the committee (table 2), meant that project participants would need to play cooperative and interlocking roles similar to company departments. To this end, a partnering charter helped to commit the parties to broader project commitments and establish future communication links.

Table 2: Training Program Objectives

• To create a program designed to link the training of long term unemployed to a construction site;
• To solve problems relating to a shortage of construction skills;
• To establish a training centre on site;
• To establish training links for flexible training delivery between the contractor and a recognised training provider;
• To increase cooperation and communication by creating a partnership charter between key project players;
• To pilot a mentoring system that would assist apprentices move into full employment;
• To locate sources of funding to assist in implementing the program;
• To advance the technical skills of both the contractor and sub-contractor; and
• To encourage suppliers to contribute materials to the project.

The role of each major player varied. Barclay Mowlem's role consisted of political lobbying, changing workplace culture, increasing communication links, negotiation, restructuring and team building. Significant political lobbying occurred to ensure funds were made available by DEET, to purchase the training off TAFE and fund the project.

It should be noted that the project was different from training procedures of the past. Existing procedures meant that apprentices were employed after completing two or three year trade courses in plastering, carpentry, or bricklaying. In some cases, they could be employed after partial completion of at least one year. This meant that trainees took much longer to acquire the necessary work skills to compete against established tradespeople.

The company recognised that considerable cultural shifts were required in workplace processes as well changing worker attitudes to recruits. The recruits were made to feel 'part' of the workforce and not 'just another' trainee. Each person was placed in a work team.

The company negotiated with the unions that recruits would enter the workforce on first year apprentice wages even though they were performing elements of second year tasks. More general task restructuring was necessary to provide the right work environment. The general foreman was brought back into the office for pre-planning and the work teams carried out the major project tasks. The perception of the Foreman's role had traditionally been that of a 'spy' or 'policeman'. This was changed instead to a position of 'mentor' or 'coach', with management playing the role of a supplier. For management, work groups became internal customers. Supplying critical resources was more important than 'telling' and' criticising', and work teams were encouraged to meet their own timetables for the completion of project tasks.

The sub-contractors' role by comparison consisted of providing long-term work for apprentices, flexible work arrangements and consistent monitoring of apprentices. All sub-contractors agreed to individual site-based enterprise agreements. These required them to support the training activities of the project, including the agreement to allow apprentices to come and go as training dictated, assign them to a work group and attend all site meetings. In essence, sub-contractors allowed apprentices to work 'on the job' under the supervision of a TAFE teacher, which helped solve concerns that existing staff would need to continually stop work in order to instruct apprentices on individual task competencies.

Since existing apprentice schemes meant that sub-contractors bore all the cost of training, Barclay Mowlem had negotiated with DEET (under a special job-subsidy program for the unemployed), for sub-contractors to be subsidised for employing the apprentices. The department of TAFE were responsible for most of the training role.

A number of concessions had to be made by TAFE. Firstly, they had to agree to run the courses outside their existing educational framework of one, two or three years. They had to construct courses that accelerated the skill acquisition of tradespeople which meant that elements of second or third year skills had to be included in the program. Next, they were involved in designing the program to suit the needs of the sub-contractor, while at the same time, meeting the time restraints of the builder.

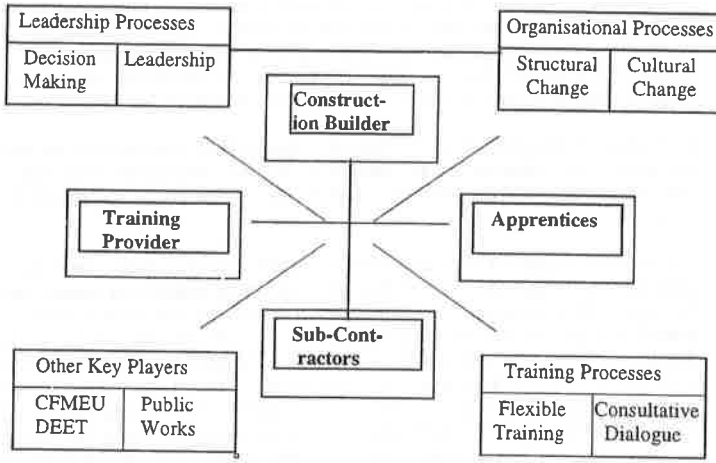


Figure 1: Relationship between parties in the training program

The course also had to be highly practical so that the apprentice could balance theory with skills applied on the job. This meant choosing modules of training relevant to practice and altering existing curriculum design. TAFE was required to provide a teacher on-site with the teacher/apprentice ratio of one teacher for every twelve to fifteen students. Generally,programs were conducted over six to eight weeks.

By the end of week six, apprentices could for example, lay bricks to a line, plaster sheath a wall and prepare and paint walls. These skills meant that apprentices could, almost immediately, contribute to the productivity of the project, while at the same time, receive advanced standing for a component of a more formal course. It should be noted that the accelerated courses did not replace the need for apprentices to continue their trade courses beyond the period of training.

Outcomes of the Training Program

Most training programs are designed to either increase knowledge and or increase and improve work competencies. The Liverpool Hospital redevelopment training program achieved both through the integration of learning into work processes for enhanced productivity.

Management noted that increased capabilities meant a much more focused and motivated workforce where competency based learning systems reduced the gap between knowledge and application. There was a duality of needs met from the perspective of both the apprentices and the employers. Although not entirely due to training, the oncology centre of the hospital was finished six months ahead of schedule. The problem of a shortage of skills was solved, not the least by a level of stakeholder cooperation not apparent in many other similar ventures.

A search for more creative solutions meant that work processes had to be redefined, and this contributed to the development of work teams, and a new method in organising work. Work teams, toolbox meetings, on-site training, the involvement of TAFE teachers, Government subsidies and workplace culture were, collectively, the means for enhancing productivity. Additionally, access to employment by an otherwise marginalised group (the unemployed), was a major outcome of the program. At the time of the case study enquiry, the program had recorded a ninety five percent success rate in progressing apprentices through to full employment.

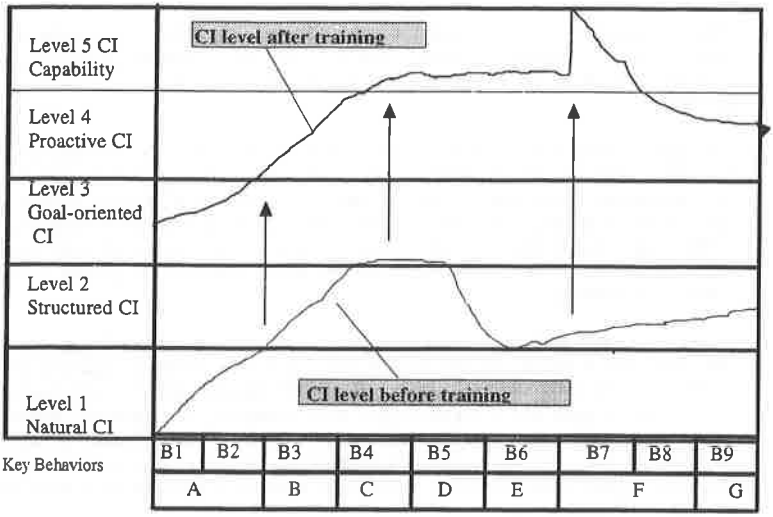
An Integrated Approach to Training, Learning and Continuous Improvement

The Liverpool Hospital redevelopment training initiative represents an example of how an organisation can use training to achieve best practice to rival world standards. What is unique about the case is the emphasis management placed on the organisational and

learning routines that brought about a change in worker attitudes. Additionally, a great deal of imagination was mobilised to help solve a critical skills shortage.

With an understanding of how learning occurs, the key behaviors necessary to progress CI implementation take on a different meaning. We notice from the Liverpool case that a commitment to learning underpinned the whole program. The characteristics of second wave learning described earlier were evident. These included the forging of new relations, a dedication to commitment and trust, the involvement of all parties in high levels of participation which challenged traditional mindsets about training, and the creation of a program that improved worker output and levels of job satisfaction.

The case confirms many of the behaviors evident in the Caffyn and Bessant (1995) model and these have been plotted in figure 2.



Adapted from Caffyn and Bessant (1995), A Capability-Based Model for Continuous Improvement, University of Brighton. UK

Figure 2: Profile of the Liverpool Hospital Redevelopment Training Program

The bottom line confirms the CI position prior to the existence of the program with the top line indicating the current position at the time of the case study analysis. The figure also

indicates the gap between each. This could be used by any company in recognising the extent of enablers and learning strategies required to move from one level of CI to the next.

At the start of the program, there was little evidence of the core abilities and key behaviors in respect of training as a holistic learning system. Training was often ad hoc and primarily on-the-job. Sub-contractors held a dim view of the benefits of training, however, and major contract work was structured along rigid time frames and cost projections such that there was little room to train apprentices on-the-job. Most parties to a project approached their task from an adversarial perspective since by tough negotiation on price and methods, contracts were either won or lost. The Liverpool training program was created out of management's recognition that change must occur for project and productivity measures to be met.

The top line in figure 2 stands in direct contrast to this. All parties to the project saw mutual benefit in supporting the training initiative and this promoted management's ability to work across internal and external divisions. The behaviors were reinforced by enablers such as committees, task forces, a mobile training centre, a training officer, toolbox meetings, enterprise development agreements, TAFE training, Government funding and partnering agreements.

Summary

The training initiative described in this paper shows a holistic learning approach to achieving continuous improvement where many organisation advantages were noted.

The training program demonstrates that competitive advantage can be achieved by combining the technological processes of producing the work - such as how to use machines and tools of construction - with a unique on-site learning system designed to create and enhance skill competencies on the job.

This was no better exemplified by human resource policies that promoted continuous 'double-loop learning,' where work problems were solved not only by pre-existing solutions of the past (single-loop), but by creative solutions underpinned by teamwork, participation, and flexibility (double-loop). Building owners may at least consider how these learning processes helped to change a culture from one which was indifferent to training on the one hand, to one where training was facilitated by all parties on the other. We believe such an approach should have universal attraction across the industry.

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PROCUREMENT PATHS - A CULTURAL/POLITICAL PERSPECTIVE

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Abstract

This paper extends the study of the use and abuse of power under different procurement paths originally reported by Newcombe 1994. The paper develops the theoretical perspective to present a more holistic view of projects from a cultural and political stance. The central argument is that culture acts as a centripetal force on projects whilst politics can be a centrifugal force. Both culture and politics can have positive and negative effects and the project manager's[1] role is to achieve a balance between these conflicting forces by establishing and maintaining a system of 'dynamic equilibrium'. Establishing such a system is likely to be easier under the Construction Management[2] procurement path than within the Traditional design-tender-build method. Innovation may be resisted or encouraged if the project has a strong culture; politics is usually a force for innovation.

INTRODUCTION

The view of projects as a coalition of powerful individuals and interest groups was explored in a previous paper (Newcombe 1994) and stems from the pioneering research of Cyert and March (1963). Their view of the organisation as a 'shifting multi-goal coalition' was novel at

[1] *Project management* is defined as the management of the project from inception to completion, regardless of which procurement path is used or who fulfils the role.

[2] *Construction Management* refers to the procurement approach in which the client has direct contracts with the designer, the Construction Manager and the trades contractors; the designer and CM are appointed at the same time and on the same conditions.

the time it was proposed but subsequent research by Mintzberg (1983), Johnson and Scholes (1993) and others (Bacharach and Lawler, 1980, Bass, 1990, Cohen and Bradford, 1990, Greiner and Schein, 1988) has confirmed that the power bases of the main actors and indeed the actors themselves 'shift' over time and that organisations, and especially project organisations, operate with a system of multiple and often conflicting objectives. The way in which the potential conflicts are handled through a system of sequential attention to conflicting objectives and the use of 'side payments' to 'buy off' opposition gives a very strong political flavour to the project process. Project strategy thus evolves through a bargaining process between the key actors or interest groups and dramatic changes in strategy may emerge as the power of the participants rise and wane over time (Tavistock, 1966). It was argued in the previous paper that the Traditional design-tender-build procurement path exhibits many of these characteristics.

In parallel with the growing trend in society towards greater participation in decision making there has been a parallel trend towards a wider view of people with an interest or 'stake' in projects - the stakeholders. Traditionally, the construction industry has seen stakeholders as the primary participants directly involved in the project, with others seen as secondary stakeholders. Stakeholders are groups or individuals who have a stake in, or expectation of, the project's performance and include clients, project managers, designers, subcontractors, suppliers, funding bodies and the community at large. Stakeholder analysis (Johnson and Scholes, 1993) has become a recognised technique for determining how stakeholders interact with the project and more specifically how they shape the commonly accepted strategy of the project.

Managing stakeholders, of course, has an ethical dimension. Do project managers operate as 'honest brokers' treating opposing interests impartially, or do they align themselves with the stakeholder group which most closely represents their own self-interest?

There is often a conflict between logical strategies and strategies which will be acceptable to the stakeholders. This is particularly true in public sector projects where a wider spectrum of stakeholders may express active interest in a project.

Alliances between stakeholders inside the project with powerful outside stakeholders are often used as a means of pushing through innovation strategies. For example, a project manager facing opposition within the project to a preferred strategy may elicit the support of the client in order to force the innovation through.

Mintzberg (1983) in his book, Power in and around organisations, identifies an external coalition which interacts with an internal coalition of stakeholders. Both coalitions are shown to be either passive or active, depending upon their level of power and interest in the project.

Power is the mechanism through which stakeholders influence the formulation of strategies for a project. This power can be used to retain the status quo or to enforce fundamental change. Innovation on projects is therefore dependent on stakeholders' attitudes and motives.

Stakeholders interact with the project in two primary arenas:

- The cultural arena - this is represented by the ideology or shared values of the project participants and may be used to shape or constrain innovation. Culture is a force for co-operation between project members.
- The political arena - this is the arena where powerful individuals and interest groups exercise power to achieve their objectives which often conflict with the objectives and expectations of other individuals and groups involved in the project.

Thus stakeholders interact with the project through two opposing forces, the centripetal force of co-operation through the culture and the centrifugal force of conflict and competition in the political arena. Unlike other forces which operate in organisations, for example, differentiation and integration which may create different organisation structures for different projects in a diffused way (Morris, 1972), cultural and political forces are infused into the whole project organisation.

Balancing these opposing forces is a major role of the project manager for any project. In this paper, we will firstly look at the nature and role of project culture followed by a discussion of project politics with a final examination how these apparently contradictory forces can be reconciled in the context of procurement methods.

PROJECT CULTURE

Culture is defined as "the deeper level of basic assumptions and beliefs that are shared by members of an organisation that operate unconsciously and define in a basic 'taken for granted' fashion, an organisation's view of itself and its environment" (Johnson and Scholes, 1993).

Two cultural frames of reference have a particularly strong influence on construction projects;

- The industry frame of reference, which is termed an *industry recipe*.
- The organisational frame of reference, which is termed the *organisational ideology or paradigm.*

The *industry recipe* is particularly strong in the construction industry, the flavour of which is captured in the perceived view of the traditional design-tender-build method of procurement, in which design is separated from construction and the system characterised by fragmentation, friction and mistrust. Newer forms of procurement, such as construction management and partnering, are being used as vehicles to change the industry recipe, albeit slowly.

This industry recipe contaminates the internal culture of organisations involved in construction activities, from clients to contractors to professional practices.

The *organisational ideology or paradigm* of construction firms tends to mirror the industry recipe and is coupled with lack of security and low levels of loyalty engendered by the temporary nature of projects and employment.

Again, some organisations are trying to break this mould by operating more democratic and participative organisations which encourage loyalty and commitment.

As discussed earlier, culture is the centripetal force which encourages co-operation and consensus amongst project members or stakeholders. The currency of culture is ideology. Culture is internal to the project but may be influenced by both internal and external stakeholders.

Where there is a strong project culture, project participants look inward to the culture paradigm or ideology for guidance when facing difficult decisions. Actions which are in line with the culture are acceptable; actions which do not match the culture are rejected.

Culture is sometimes seen as shield to protect the project from contradictory outside influences. This can have both positive and negative consequences for the organisation which we shall now discuss .

Positive Consequences of Culture

The positive effects for a project with a strong culture are:

- Project effectiveness is enhanced because people are enthusiastic about their job and its contribution to the project's objectives. Thus both efficiency of operations and the effectiveness of the project organisation as a whole are inspired by the shared values.
- Where different organisations come together for a project, e.g. design partnerships and contractors, then people who would naturally be in conflict can learn to live together because they share the values and beliefs of the project. The need for tight control in construction production can live along side the need for flexibility in design.
- Project members are less parochial about their particular role in the project and take a more holistic view of the project as a whole; a 'big picture' view thus emerges encouraged by a strong culture.
- It is possible to reconcile even apparently conflicting project strategies, such as, for example, the need to delay design decisions and the need to meet production schedules. A strong culture can enable a project to pursue both of these strategies concurrently because although project members recognise a contradiction, they do not see it as a basis for conflict.

- Even if one particular organisation is dominant within the project that doesn't preclude other organisations from influencing decisions if there is an open culture.
- A strong culture not only acts as a force for reconciliation between individuals and units but people in themselves are likely to be more comfortable when a single ideology dominates their thinking. Cultural schizophrenia can be devastating for the morale of all the participants to a project.

Projects can thus comprise a loose portfolio of contradictory firms and functions which are held together or integrated by the cultural 'glue'.

But a strong culture can also have negative consequences.

Negative consequences of culture

A strong culture is difficult to build and even more difficult to sustain, particularly for a large project. In new, young, small projects, a dynamic leader or project manager can establish a strong culture which expresses his or her vision for the project. However, as projects grow and become larger and more bureaucratic, it is frequently difficult to retain the early vision and enthusiasm as the ideology is defused by the growth in autonomous units and the proliferation of routines and controls.

However, once a strong culture is established, it may impose limitations on the project which eventually bring about its decline.

Some negative consequences of a strong ideology are:

- Because culture is not something an project *has* but something that an project *is*, it may be difficult to introduce necessary change into the project. The values, beliefs and assumptions of the project members are sometimes seen as immutable, particularly when they have been in place over a long period of time.
- We said, under the positive effects of culture, that it can act as a force for reconciliation between conflicting organisations; the opposite can also be true; culture can become a source of conflict between opposing forces within the project, particularly when people interpret the culture differently.
- Culture can actually impede efficiency; conservatism may restrain the need for innovation. The culture of mistrust often present in Traditional procurement paths may prevent the parties discussing obvious innovations.
- The effort to maintain the status quo within the project often breeds political activity between the stakeholders who want change and those who believe that things should remain as they are.
- The ultimate tragedy for an project with a strong culture is the paradox that as well as shielding the project from the extraneous external forces of fad and fashion, it may also have the effect of isolating the project from its environment. At best, this can result in 'projectitus', i.e. the project members becoming obsessed

with the project and losing sight of its objectives. At worst, the inward focus of project members may cause the project to implode! In this worst case, the project collapses in on itself because it has become irrelevant to the needs of its customers or clients.

Building a strong project culture is not a set of steps. A culture is built slowly by committed leaders with a strong vision or mission for the project. But when it becomes established as a part of the fabric of the project, it is equally difficult to dismantle.

PROJECT POLITICS

If project culture is a force for co-operation and consensus then politics in projects is often a force for conflict, competition and confrontation. If the currency of culture is ideology, then the currency of politics is power.

The view of organisations as a coalition of powerful individuals and interest groups stems from the pioneering research of Cyert and March (1963), which can be applied equally to projects as to companies. Decisions evolve through a bargaining process between the key actors or interest groups and dramatic changes in direction may emerge as the power of participants rise and wane over time.

Mintzberg (1983) makes the point that in contrast to other systems of influence in organisations, i.e. *authority, ideology,* and *expertise*, which are seen as legitimate, politics is seen as illegitimate in the means it uses and sometimes also in the ends it promotes. In this sense, political power in an organisation or project (unlike government) is not formally authorised, widely accepted or officially certified. This means that political activity is usually divisive and conflictive, pitting individuals or groups against the more legitimate systems of influence and, when those systems are weak, against each other.

The subject of politics in organisations has traditionally been a taboo subject in the management literature but in the last decade it has not only become an acceptable subject for study but even a fashionable topic. However, there is still virtually no serious research in the project context.

Politics exists in every organisation but it is a matter of degree. Politics may dominate a project so that the project becomes what Mintzberg calls a 'political arena'. Continual clash and conflict between competing individuals and interest groups are the norm in this type of project, with project strategies being constantly challenged and changed, often fundamentally. This type of totally politicised project is rare and usually temporary, as centrifugal forces eventually cause the project to explode!

The usual situation in projects is that politics exists as an overlay on more conventional systems of influence, acting as a challenge to the ruling power holders or the dominant ideology of culture. From a political perspective, the project is seen as a battle field in which the current power holders war amongst themselves or are in conflict with the rest of

the project participants, who are constantly seeking to combine their forces to challenge the power elite.

The importance of power as a currency within the political system merits special attention being paid to power as a facilitator of political activity during projects. This was dealt with in my previous paper (Newcombe 1994), where the power paradigm and its implications for procurement paths and project participants was discussed. Definitions and concepts of power are as follows:

> Most conceptions of power are based on Weber's (1947) classic definition that power is the probability that a person can carry out his or her own will despite resistance. Other definitions are, 'production of intended effects', 'ability to employ force', 'intended successful control of others', 'asymmetrical influence relation between the behaviour of two persons', 'the ability to get another person to do something he or she would not otherwise do', 'net dependence of one actor on another actor and/or interdependency among actors' (Bass, 1990, pp.225).
>
> Whilst a comprehensive review of the literature on power is outside the scope of this paper it is important to identify those concepts which are germane to the exploration of power within the project-based organisations .
>
> As already discussed, a key theme of the power literature is the view of organisations as *coalitions* of powerful individuals or interest groups which pursue *multiple goals* (Cyert and March, 1963; Thompson, 1967; Pfeffer and Salancik, 1978; Mintzberg, 1983; Kanter, 1983; Kotter, 1985).
>
> Arising from this is the idea of organisations as *interdependent* interest groups who control *resources* with which they *bargain* to achieve their own objectives (Cyert and March, 1963; Pfeffer and Salancik, 1978; Bacharach and Lawler, 1980).
>
> In addition to resources, other sources or bases of power available to managers in organisations are *reward* , *coercive* and *legitimate* power, categorised as *organisational* since they are directly linked to the individual's position in the organisation, and *expert* and *referent* power which are referred to as *personal* since they depend largely on the personal attributes of the individual, such as expertise and charisma (French and Raven,1959; Burke, 1986; Greiner and Schein, 1988; Gardner,1989).
>
> A recent theme is *empowerment* or *power equalisation* defined as 'the delegation of authority and the increased involvement of lower-level employees in the control and distribution of resources' (Burke, 1986). Peters (1987), and Kanter (1983), have also stressed this issue as consistent with the trend towards greater democracy and participation in contemporary organisations.
>
> A final relevant theme is that the existence of coalitions and the rise of empowerment has created a *power gap* resulting from a widening gap between the amount of

power granted by the position the individual holds and that actually required to get the job done (Kotter, 1986; Rudolph and Peluchette, 1993). The result of this power gap is that modern managers are required to exercise *influence without authority* through a system of *exchange* and *reciprocity* (Cohen and Bradford, 1990).

By its very nature, the political use of power often has negative consequences for the project.

Negative effects of politics

As stated already, it is a divisive force creating competition, conflict and confrontation. Competition may be beneficial in stimulating greater efforts between competing groups and is often deliberately used by organisations particularly in construction, where project 'league tables' may be compiled and compared. However, the potential for competition to degenerate into conflict is always present, the results of which are explained by Schien (1980).

The net effect of conflict is a win-lose situation in which the loser is not convinced that he lost, and that inter group tension is higher than before the competition began.

Another negative effect is that the ruling elite in a project, i.e. those who hold the power, may promote their own particular objectives for the project, developing strategies which are one-dimensional and unbalanced.

Conversely, professional organisations involved in projects may pursue strategies which enhance the status of their professional role. The result may be a constant power struggle between the current power holders and an aspiring majority of stakeholders within and outside the project.

Politics is a parochial force which stresses and pursues self-interest. Again this may be detrimental to the project as a whole.

The centrifugal forces generated by political activity may become so strong that the project explodes or disintegrates.

Having discussed the well-known negative effects of politics in projects, it is important to point out the positive effects of politics as well.

Positive consequences of organisational politics

Politics may act as an engine for change, challenging the status quo and the current project ideology or paradigm; in this sense, it may be seen to be in opposition to the current dominant culture in the project.

Where no charismatic leaders exist to push through fundamental change within the project, the system of politics may fill this role, enabling less charismatic individuals and groups to

bring about fundamental change. Thus innovation can be driven by political challenge, rather than by planning or executive action.

Project members often have to 'pull apart' before they can 'pull together'. This may mean that certain stakeholders leave the project and new stakeholders enter the political arena to create what Cyert and March call the 'shifting, multi-goal coalition'. The departure of key players and or the introduction of new stakeholders may have the effect of establishing a more acceptable ideology or culture whose beliefs and values the majority can now share.

Politics can act in a Darwinian way to ensure that the strongest members of the project organisation are brought into positions of leadership. This is in contrast to authority favours a single chain of command where weak leaders can suppress strong subordinates within the formal organisation structure and culture; this often happens under the Traditional approach to procurement. Politics, however, can provide a means for strong subordinates to unseat weak leaders and enable them to stage a *coup d'état* in which they emerge as the new leaders of the project. Survival of the fittest to manage is thus ensured and the long term survival and completion of the project is assured. The constant challenges to the power-elite in projects serve as a test to demonstrate their potential for leadership and whether they are still the 'fittest'.

Politics can act as a mechanism for ensuring that all points of view are taken into account in formulating project strategies rather than a single perspective being adopted. The dominant stakeholders in the project, its particular type of structure and its pervading culture may mean that strategies are essentially consensus strategies. We have seen already under the discussion on culture that the dominant paradigm or ideology may force the project towards specific strategies.

Because politics is a force which challenges existing conventions and cultures, key stakeholders are forced to justify their strategic stance in terms of the project as a whole rather than as an expression of the parochial needs of a particular group.

The use of the illegitimate system of politics is often essential to stimulate necessary changes that are blocked by the more legitimate systems of influence. Internal change may threaten the 'vested interests' in a project. The system of authority endemic in the contract concentrates power in the hands of those who were responsible for initiating the existing strategies in the first place, e.g. the architect, who will act to continue with these existing strategies through the exercise of established controls which are designed to sustain the status quo. Likewise, the system of ideology or culture, because it is rooted in the past, in tradition, acts a deterrent to change. In the face of these forces which are resisting change, the system of politics acts in a subversive way to bring about the necessary change.

Project politics are often used as a means of building strategic alliances with powerful stakeholders both inside and outside the project. A stakeholder mapping exercise may reveal the need to persuade key stakeholders to shift their position in respect of a particular strategy and it may be necessary to persuade, negotiate and build alliances to smooth the path for the decisions which the project manager wishes to make.

Thus the system of politics, whose *means* are by definition illegitimate, can be used to pursue *ends* which are legitimate and in the long term interests of the project.

Whilst strongly political organisations are uncomfortable to work in, this is often the only means of achieving a strategic change in direction within an established project and encouraging innovation.

COMBINING CULTURE AND POLITICS

Regardless of which procurement path is chosen, all projects operate within a paradox of cultural forces which are pulling members into closer co-operation and political forces which are pulling the project apart.

The secret of successful projects is achieving a balance between these contradictory forces of co-operation and conflict. Culture can act as a restraint on the wilder excesses of political manoeuvring to maintain the general strategic direction of the project. When necessary, political forces can challenge the values, beliefs and assumptions of the current culture, thus overcoming ideological insularity and preventing 'projectitus'. A system of 'dynamic equilibrium' can exist in projects where healthy competition occurs within a framework of continuing co-operation. Most of the time, the project team will pull together around a central ideology or culture so that the project can pursue its established strategic perspective with continuity and consistency; on occasions when fundamental change becomes necessary, the project team has to be able to pull apart through the competitive force of politics, and reassemble in a strategic posture which is more compatible with its environment and the needs of its stakeholders.

CULTURE, POWER AND PROCUREMENT PATHS

Newcombe (1994) argued that a comparison of two procurement paths - Traditional and Construction Management - revealed significant differences in the power structure:

> The Traditional System represents the old 'class-based' division between 'management' and 'workers' where position power based on a hierarchy of command is exercised by the project manager, i.e. the architect; this hierarchy is established by the process inherent in the Traditional System and by the form of contract used. The extent to which a hierarchy exists on a particular project depends on the individuals involved; position power or formal authority can be severely weakened by the need to bargain over changes arising from design inadequacies. However, the potential for establishing a hierarchy and the use of an authoritarian approach to managing are features of the system which has led to disastrous consequences on some well publicised projects.

> Construction Management is based on the modern management principle of empowerment or power equalisation and reflects the trend towards a more pluralistic society. Whilst ultimate authority rests with the client, as indeed it should, the encouragement of participation by all the parties in decision making coupled with the democratic distribution of power provides a radical new basis for conducting construction projects. Current management thinking (Peters, 1987;1992, Kanter; 1983, 1989; Morgan, 1993) suggests that this is the *only* way to run successful organisations now and in the future.

This paper has added a cultural dimension to this argument by stressing that power and politics can have negative consequences for projects unless the countervailing force of a strong project culture provides the necessary balance. A strong positive culture is more likely to be present in procurement paths that encourage empowerment and participation - Construction Management - than those that engender fragmentation and friction, e.g. the Traditional system.

SUMMARY

Stakeholders consist of anyone with an interest in a project, whether they are inside or outside the project.

Stakeholders vary in their ability to influence strategic decision making for the project depending on the power and interest they hold. Power, predictability and interest of stakeholders can be plotted by project managers in order to help them shape acceptable and realistic strategies.

Stakeholders interact with the organisation in two primary arenas - the *cultural* arena and the *political* arena.

Project culture is the shared values, beliefs and assumptions of the stakeholders involved in a project.

A strong culture has both positive and negative consequences.

Project politics is a force for competition, conflict and confrontation between stakeholders. The currency of politics is power, which may be used to promote the self-interest of individuals and groups in terms of strategic decisions. Conversely, politics may be used to force through necessary changes in strategy against the will of a conservative elite.

A balance of political and cultural forces exists in most successful projects through a system of 'dynamic equilibrium'.

A strong positive culture and the positive use of politics is more likely to occur under Construction Management than under the Traditional procurement path.

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Construction Joint Venture In Hong Kong

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The massive construction of the Mass Transit Railway in the 1970s was the starting point of construction joint ventures in Hong Kong and after its completion, there was a significant drop in the number of joint ventures. Nevertheless, the trend of joint ventures is picking up again in Hong Kong due to the construction of the new airport in 1990s. A recent survey indicates that construction joint venture is uncommon in public and private building works but it is widely used in civil engineering works especially in the Airport Core Programme (ACP) projects. A majority of the ACP contracts were awarded to joint venture companies because of the high financial risk due to their contract size and the competitive advantage of combining resources. As Hong Kong is undergoing a period of infrastructure development, it is worthwhile to study the current application of the construction joint venture in Hong Kong and to investigate its potential development in the near future. A case study based on one of the ACP projects is selected to illustrate the reasons for and benefits of joint ventures. Problems inherent in the joint venture project and factors for success are also discussed in the case study.

Keywords: construction joint venture; application; potential development; case study.

INTRODUCTION

The construction of the Mass Transit Railway (MTR) in the mid-1970s has been regarded as the starting point of construction joint ventures in Hong Kong. Since the 70s, Hong Kong has undergone an uninterrupted period of infrastructure development and the most recent mega sized project is the construction of the new airport. Local contractors were unwilling to take all the risks associated with such large projects and they lacked the resources or capital to carry of the works on its own. These large infrastructure projects are complex and require high technological skills which call for high level of collaboration between contractors. This has provided good opportunities for overseas contractors to enter Hong Kong's construction industry.

The impact of this influx of overseas contractors has effectively contributed to the need for the local contractors to consider forming joint ventures as a strategy to tackle keen competition in the construction market. Shui On (1987) listed the joint venture as one of the viable options for the local contractor to deal with the ever increasing competition in the industry and the joint venture is regarded as one of the most and practical solutions in providing the necessary financial and technological competence in large complex projects in Hong Kong.

DEFINITION AND TYPES OF JOINT VENTURE

Many authors have attempted to define 'Joint Venture" in construction. For example, Haley (1994) defines a Joint Venture as a " a contractual arrangement in which resources are combined by two or more participants with a view to carry out a common purpose" whilst the National Joint Consultative Commitee for Building NJCC (1985) provides for a construction definition of Joint Venture as "a partnership between two or more companies covering building, mechanical and electrical engineering or other specialist services for the purpose of tendering for, and executing a building or civil engineering contract, each of the participating companies have a joint and several liabilities for their contractual obligation to the employer".

From the various definitions including those from the business point of view (Young, 1977; Harrigan, 1986), it can be concluded that a joint venture provides an ideal vehicle by which two or more entities can join forces, capital, knowledge and/or expertise to form a single business entity with the particular resources, personnel, and capabilities required for the project at hand.

Joint ventures in Hong Kong are divide into three categories, namely, one-off, semi-permanent and permanent joint ventures (Lam, 1990). The most common arrangement adopted in Hong Kong is the one-off joint venture which is attributed to the fact that joint venture projects in Hong Kong are specific in nature and the contractors will not stay together every time as different projects vary according to size, complexity and technical skills required.
In semi-permanent and permanent joint ventures, the contractors who have worked together for previous project will team up for for any future similar projects. If there is a continous order of suitable jobs, the arrangement may becomes permanent.

The organisation structures of these joint ventures usually takes one of the following forms:-

Integrated Joint Venture - In this type of joint venture, all parties work together as an entity under a joint venture company which is formed solely for the execution of the construction project. All parties contribute their shares of capital, manpower, materials and equipment. When the project is completed, the profit or loss will be shared among parties according to the percentage agreed before project commencement. This integrated approach is clearly favoured where it is extremely difficult to split the work, or the project is so complex that it demands a highly structured and authoritative management (Armitt, 1984).

Non-integrated Joint Venture - Non-integrated joint ventures differs from the integrated ones in that they divide work into separate portions, usually delineated by work areas capable of clear demarcation. Each venturer is responsible for the construction as well as the profit or loss of its own section of work. The non-integrated approach is the situation where the partnership is formed to complement skills.This method can be further subdivided into Sectionalised Joint Ventures and Financing-Construction Joint Ventures. In Sectionalised Joint Ventures, each

partner is responsible for the management, execution of work and profit in accordance with the agreement which had been allocated to them before hand. In Financing-Construction Sectionalised Joint Ventures, one of the parties participates in the supply of finance, project estimating, profits and loss sharing while the other partner carries out the actual construction work.

WHY JOINT VENTURES?

Sharing of risk

A joint venture is said to be an effective vehicle for sharing risks of a huge commitment construction project (Chow, 1985). By using the joint venture approach, construction companies are able to reduce exposure on very large projects to more manageable proportions. The new airport project in Hong Kong is seen to be extremely complex and involves huge amount of financial commitment and it was envisaged that a single company would have difficulty to provide the necessary financial resources or the construction skills. Even if any one firm were to, the risk involved would be extremely high. As such, it is not surprising to note that nearly 70 % of the ACP projects employed joint ventures in construction.

Pooling of resources

According to Becker & Herzog (1992), joint venture contracting is one successful way for the contractors to combine their resources, expertise and skills to increase the credibility of a prequalification or a bid in large and complex projects. The joint venture provides the mechanism by allowing firms to concentrate resources in those areas where they possess the greatest strength (Harrigan, 1986). By combining their strengths they are multiplying their potentials to achieve the desired objectives more satisfactorily. Moreover, joint ventures give opportunities to small and medium size companies offering very specialised skills to increase the chances of success in tendering (Haley, 1994).

Entry into new markets

Joint ventures may be a means of entering new business or of expanding internationally (Harrigan, 1986). In an international joint venture between a foreign contractor and a local one, the foreign partner can gain the advantage of entry into the new market and the local one can learn the advanced technology from the foreign partner. It is an effective way of gaining the necessary government approval and overcoming the language and cultural barriers in the new market. Overseas contractors have formed joint ventures with local firms in Hong Kong in many of the large projects since the 1970s and after the completion of those projects, these overseas contractors have remained in Hong Kong and have actively engaged themselves in the civil engineering and building projects since.

Investing surplus capital and assets

Sometimes, the surplus capital such as surplus funds, construction plant and equipment can be used to undertake extra projects by establishing joint venture relationships with other contractors

(Wan, 1989). In such a way, the unemployed capital and remaining assets become productive. Hence, wastage of these resources can be avoided.

Political/Psychological Benefits
Joint ventures can offer political benefits through local contacts when the partner is represented locally. This is particularly useful in large infrastructure projects which involve government policies on autonomy and preferential treatment may be meted to joint ventures companies. In the Western Harbour Crossing project in Hong Kong, the successful consortium for the BOT project includes a very substantial investment from Chinese companies which serves to provide the political benefits for a project that straddles the political uncertainty of 1997.

PROBLEMS ENCOUNTERED IN JOINT VENTURES

Difficulties in making decisions
One of the problems involved in using the joint venture approach is the difficulty in making decisions. McCarthy (1992) points out that no single person has the ultimate right to make a final decision. It should be noted that joint control means joint decision making. The decision making powers of joint venture project have to be shared by the joint venturers (Chow, 1985). This means that an individual joint venture company's authority as well as the amount of control exercised by a parent company are reduced.

Cultural Diferences
A critical success factor for joint ventures has been the mutuality of objectives between partners (Swierczek, 1994). Objectives are difficult to achieve even in similar cultures and it is even more so in a multiple culture situation. Culture differences are regarded as one of the major source of failure for joint ventures where there is a lack of complementarity between partners (Selwyn, 1991).This lack of complementarity will affect the cooperation of the partners in the joint venture and results in conflicts between the partners.

Conflicts of Interest
Conflict of interest are often voiced as the main problem in establishing joint ventures. Besides conflict of interest over aspects of management, profit distribution among contractors is one problem in joint venture (Young, 1992). Conflicts of interest over earning is common because each partners believes it has contributed more in the project than other companies. Therefore the members within the management board of joint ventures may put their companies' benefits in the first place rather than the interests of the project itself.

Appointment of Personnel
In construction joint ventures, the appointment of the principal project personnel such as the Project Manager or the Financial Controller may in fact come from the ranks of one or more of the parties. These appointments obviously carry a measured amount of pivotal influence with respect to the business of the joint venture. Some reasonable means of allocating these

appointments among the parties will be necessary to provide each party with a certain level of representation and influence in the operational management of the joint venture.

JOINT VENTURES IN THE 90s - AIRPORT CORE PROGRAMME IN HONG KONG

In 1988, the Port and Airport Development Strategy (PADS) was initiated by the Hong Kong Government which was then distilled into the Airport Core Programme (ACP) in 1991. ACP consists of mainly ten core projects (Table 1) and they are critical to the future of Hong Kong construction industry because they involve a substantial amount of public money and some of these projects will span June 30th 1997 (the handover of Hong Kong to China). New development in undeveloped parts of Hong Kong and redevelopment of the existing old areas of Hong Kong will arise as a consequence of the ACP projects. The ACP projects create and sustain a large demand which cannot be met by local contractors alone and the Hong Kong government has specifically encouraged consortium bidding, in particular with overseas partners in joint venture arrangements (Liu and Ng, 1994).

Table 1 Contract Value of Joint Venture Projects in the ACP

ACP Core Projects	Total Awarded Contract Sum HK$	Contract Sum Awarded to JV HK$	% of Share of J.V. in each of the ACP Project
1. New Airport at Chek Lap Kok	31807.60M	17718.21M	55.70%
2. Tung Chung Development Phase 1	873.54M	817.91M	93.63%
3. North Lantau Expressway	5799.30M	5799.30M	100.00%
4. Lantau Fixed Crossing	10499.39M	9708.11M	92.46%
5. Route 3	3879.90M	2858.79M	73.68%
6. West Kowloon Reclamation	3641.69M	2555.15M	70.16%
7. West Kowloon Expressway	2196.11M	1233.61M	56.17%
8. Central Wanchai Reclamation	1696.06M	1696.06M	100.00%
9. Airport Railway	17755.88M	10470.88M	58.97%
10. Western Harbour Tunnel	N/A	N/A	N/A
* Utilities	1084.23M	840.68M	77.54%

* Utility works for water supply and water treatment
Source: Data extracted from Hong Kong Airport Core Programme-Contracts and Consultancies List Issue. No. 26 October 1995, New Airport Projects Co-ordination Office.

The new airport development has created an opportunity for both the local and foreign contractors to form joint ventures to gain market share. It was revealed that as of September 1995, 137 construction contracts have been awarded with a total value of HK $79.23 billion. Amongst those 137 ACP projects, 44 of them were Joint Ventures which worth HK$53.7 billion.

This accounts for nearly 70% of the contract value of the ACP projects being employed Joint Venture in Construction (New Airport Projects Co-ordination Office, 1995).
The percentage share in terms of contract value of joint venture in each of the ten core projects is as indicated in Table 1.

CASE STUDY - WEST KOWLOON RECLAMATION - NORTH AREA PHASE II

Project Particulars

The work is undertaken by Leighton, China State Construction Engineering Corporation, Van Oord - AZC and Lau Cheong Kee Joint Venture. The purpose of this project is to form reclaimed land for the West Kowloon Expressway, Government Dockyard facilities and for urban development. This is a lump sum contract with a contract value of HK $ 2555.15 million. Phase II of the West Kowloon Reclamation encompasses an area of 100 hectares from Yau Ma Tei Typhoon Shelter to Lai Chi Kok. The site is located between Kowloon Peninsular and Stonecutters Island. The works included dredging and removal of marine mud, deposition of sand to form reclamation, construction of seawall and piers for the dockyard and external works such as drainage culverts, roadworks, saltwater pipeline and pumphouse construction.

The reasons for joining into a joint venture in this project are as listed below:-

Combining different technical abilities of joint venturers
One of the main reasons for forming a joint venture in this project is to combine separate technical abilities from different contractors. For example: Lau Cheong Kee is a specialist contractor for mud removal from the sea bed; Van Oord - AZC specialises in sand filling to form reclamation and Leighton and China State Construction Corporation concentrate in construction and drainage works. Mutual benefits can be obtained by each venturer since no contractor possesss all technical expertise in construction and they must complement each other in order to perform the task efficiently.

Reduce Competition
It is sometimes advantageous for construction firms in the same field to work together on a specific project. This strategy can eliminate some competitors and increase the chance of winning the contract. In this case, both Leighton and Van Oord have special technical skills in drainage work. By forming a joint venture with each other in this project, which requires extensive drainage box culverts, the number of available competitors is reduced.

Spread of Commercial Risk
West Kowloon Reclamation - Phase II is the biggest contract in this Airport Core Programme. It is a protracted project (37 months) with huge financial commitment and it is risky for a sole contractor to undertake the project alone. By forming a joint venture, risk premiums such as

construction insurance and bankers' guarantees for this project are greatly reduced as they are shared amongst the four joint venturers .

More competitive price can be obtained
A more competitive price can be achieved by submitting a bid as a joint venture in West Kowloon Reclaimation. Since the risks such as performance guarantees and liquidated damages for delays are being shared by joint venturers under the joint venture agreement, they can submit a lower or a more competitive tender price in this project thus increasing the chances of winning the contract.

Organisation Structure of the Joint Venture

The type of joint venture in this project is based on the non-integrated type. This arrangement facilitates contractors undertaking their portions of work separately. It is often used by parties who have specialised areas of expertise or assigned work responsibilities. In this type of joint venture, each party is responsible for its own management, execution and profitability of the portion of work which has been allocated to it. Since the four venturers have special skills in this particular project, (LCK - mud removal, Van Oord AZC - sand filing, Leighton & China State - construction and drainage) a non-integrated joint venture is considered to be the most suitable arrangement in running this project.

The organisation structure is composed of two parts, the joint venture management board and the operation team. The management board consists of eight directors, two from each company. The board is responsible for policy formulation and making decision in the best interest of the joint venture parties. It also performs the task of mediation whenever dispute arises. The operation team is lead by joint venture project directors and they are responsible for supervising the project works which are undertaken by the different co-venturers. Further down the operation team, each contractor's project manager is responsible for the daily management and execution of the separate portion of work which is allocated to them.

There are several benefits which are obtained by this joint venture:-

- The chance of winning the contract increased as they pooled the resources together and combined their strength in order to tender for the work in a more competitive price.

- From the business point of view, this joint venture enables all the co-venturer to win the contract. Once the contract is awarded, joint venturers work together and profits are being shared among them so that the contractors' common goal of making money is fulfilled.

- A good relationship between co-venturers is built up as the joint venture has provided an opportunity for them to cooperate together and each of the venturers complement each other as they are specialised in different fields of construction.

- With respect to the project, each party is allowed to concentrate on their own portion of work. Hence, resources like labour and equipment can be concentrated on that particular portion so that the project can be on time despite the extremely tight schedule in this project.

Problems Encountered in the Project

Co-ordination of Works
The main problem encountered in this project is co-ordination. An extremely tight project and a complex construction schedule was set up by the directors. As reclamation has to be carried out in sequence by separate contractors, for example, mud removal must be done first by Lau Cheong Kee before sandfiling by Van Oord, the directors had to decide which contractors can come into the site and when. In this project, matching the construction programme by joint venture parties is the main problem. The contractors have to exert the best effort to accomodate the need for sectional handovers to the following contractors and to co-ordinate with each other in order to meet the extremely tight schedule set out in advance.

Technical Harmonisation
Lack of technical harmonisation is also another problem which needs to be addressed in such a massive project, and the operational staff has to overcome the barriers which occur in differences of language and cultural appreciation.

Several factors which are paramount to the success of the joint venture in this project are as follows:-

- Division of labour is highly visible in this project. Each contractor specialises in his own portion of the work and is able to use its technical skills to perform the construction effectively and efficiently.

- Good organisation structure and site co-ordination
  There is a need for careful planning before construction especially in site co-ordination and management. Each of the venturers needs to perform its tasks with close linkage to the others and an effective co-ordination is paramount in ensuring a well matched programme. Reasonable distribution of works and time allocation to each partner is important to ensure smooth progress of the works.

- Selection of suitable partner
  In joint ventures, the contractors need to consider their partners' complementary skills and resources and to ensure that the parties should have the same objective in forming the joint venture. A sufficiently strong financial status of the partners to maintain the joint venture is also essential in this project. A good working relationship is fostered by mutual respect that exists between the partners in the joint venture. The joint venture has enabled the parties to

submit a competitive price which won them the contract and allows them to work to the best capacity of each partner.

CONCLUSION

The advantages of joint ventures in construction are significant. They provide a way to bring in specialised knowledge and abilities and to broaden the number and scope of projects that a contractor can bid for. High competition in the Hong Kong construction industry enhances the opportunities for overseas contractors to enter the market, and consortium bidding with joint venture companies formed by local and overseas partners is a distinct feature in Hong Kong accounting for nearly 70 % of the Airport Core Programme projects. The increasing cost and the high risk in large complex projects such as the ACP projects have made clients tend to favour the guarantee of several contractors undertaking such projects jointly and sharing the risk.

Hong Kong is now undergoing an unprecedent territory development and with such huge potential infrastructural projects being developed here, there is a role for joint venture in the Hong Kong construction industry.

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HOSPITAL PROCUREMENT BY DESIGN AND BUILD A CASE STUDY IN HONG KONG

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Hospital projects in Hong Kong have long been procured using the traditional method. However, in recent years, the Hospital Authority of Hong Kong has initiated a departure from the norm for the procurement of one of its hospitals, North District Hospital, by using the design and build procurement method. The design and build approach has been used in the United States and the United Kingdom for the procurement of hospital projects and is considered a popular choice. This may be due to the nature of hospital projects which are large in time scale and in costs. Technologically, hospitals are also likely to be highly complex, and the design and build procurement method allows flexibility and diversity in the design and construction process. Nevertheless, the first hospital to be constructed by using Design and Built in Hong Kong aroused enormous interest and questions. This paper will look into the issues relating to the procurement of North District Hospital and aims to address the applications of design and build for hospital in Hong Kong.

Keywords: hospital project; design and build; case study; Hong Kong.

INTRODUCTION

In Hong Kong, the overall management of public hospitals is carried out by the Hospital Authority of Hong Kong. This a statutory body responsible for improving and modernising the delivery of medical services in public hospitals. In terms of providing a building, the Hospital Authority intended to address the issues of procurement related to project size, space and environmental quality, including problems of the redistribution of space. The procurement of large public funded projects of high complexity with lengthy design and construction periods such as hospitals has led to the consideration of using more innovative methods of procurement than the traditional method. There is a shift to a more market driven and "customer" oriented approach to the provision of health care. The need for accountability in public health projects also serves to ensure that the procurement of the work is carried out in the most cost efficient manner.

In a departure from using the traditional procurement method, the Hospital Authority has adopted an "enhanced design and build" approach in the procurement of one of its new hospitals , the North District Hospital. This hospital contract was awarded on August 1994 with a 30 month contract period and scheduled to be completed in June 1997. It is the first public hospital to be constructed by the design and build method in Hong Kong and this paper is based on the issues relating to North District Hospital as a case study.

PROJECT DESCRIPTION

The North District Hospital will be a 618-bed general hospital with ambulatory care facilities including a 24-hour accident and emergency service, specialist out-patient clinics and 120 day places including day surgery, psychiatric day hospital and geriatric day hospital.There is a provision for an open air carpark and a helicopter pad. The site formation and piling contract was completed in advance before the award of the main contract. Even though such an approach limits the flexibility of the structural design, it has permitted an early start on site.

The Hospital Authority has set a limit of HK$1,299.3 Million which comprises of design, construction, supervision, commissioning, project management and furniture and equipment.The construction of the project is to be completed by the target date of June 1997. Given the intended programme, the Hospital Authority has adopted the "enhanced design and build" procurement method with which the primary strategy is to build a hospital of defined scope within budget and on time.

ENHANCED DESIGN & BUILD

The enhanced design and build has a lump sum basis of payment with no provision for fluctuation and is based on a clear brief, full project design and definition of standards to be adopted, and a full technical specification of products the Contractor is to incorporate in the project.The Contractor is responsible for the design development, detailing, documentation and construction of the project.The Client provided design information up to Stage D[1] of the RIBA Architect's Appointment Scale to ensure there is no ambiguity in the design intent. The design information incorporated requirements from various end users which were from the medical section and from non medical sections such as catering and the electrical and mechanical services division.

[1] Stage D is Scheme Design stage where 1:200 scale drawings were completed in this project.

Although bringing in the contractor in Stage D limits the Contractor's design input regarding buildability which gives economy to the construction method, it does however ensure that the design concept of the client becomes the key parameter on which the finished product will be based. This is especially true in the case of the North District Hospital where a substantial number of end users were involved in formulating the design requirements. The process and the parties involved in defining the project are as illustrated in Figure 1.

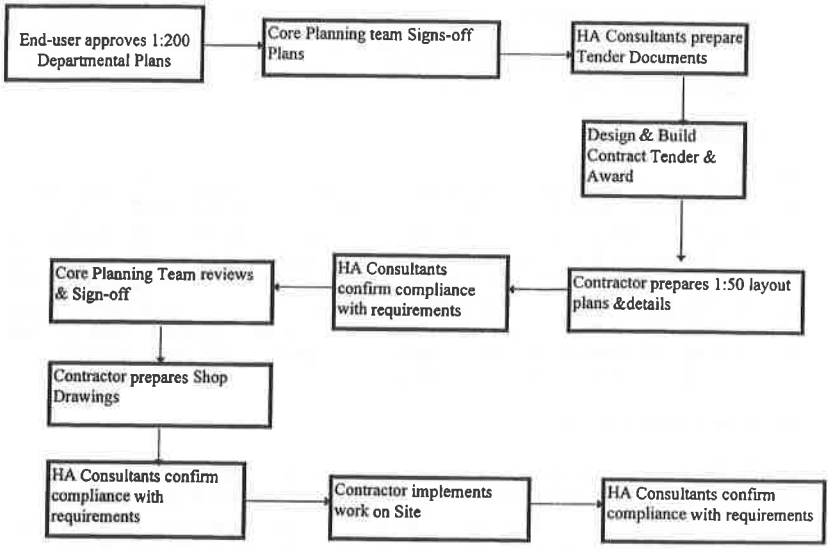

Figure 1: Project Definition
Source: North District Hospital, Hospital Authority (HA) Procedures Manual 1994

The enhanced design and build is effectively a develop and construct model and though not many contractors favour this system (Chevin, 1992; Akintoye, 1994), it is envisaged to provide more safeguards for the clients to ensure they get the building they want at a guaranteed lump sum. In this case, it was also considered to be more time and cost effective for the tenderers in putting up a bid for the project, as many contractors in Hong Kong do not possess sufficient experience and resources in going for a traditional design and build contract.

Previous studies (Griffith, 1989; Pain and Bennett, 1988) have indicated that design and build results in shorter total project duration than with the traditional approach. One of the reasons is that construction can overlap design; this was practised in this project where the Contractor had fast-tracked prior to the completion of the contract documentation. The Bills of Quantities were not used with the exception of the inclusion in the form of Provisional Sums of furniture and equipment which have building impact. The lump sum basis of payment is based on milestones negotiated between the contractor and the client.

FORM OF CONTRACT

The form of contract used is the standard Design and Build form developed by the Works Branch of the Hong Kong Government but modified to suit this project. The modifications generally strengthen the contract in aspects such as substantial completion and design responsibilities. In design responsibilities, it is stressed that no part of the approval procedures carried out by the Employer in ensuring the product meets the requirements with respect to design quality as well to construction quality relieves the responsibility of the Contractor to design and build the works. This is to further ensure the 'single point responsibility' of the Contractor. There are other provisions such as the milestone payment system and the use in the Conditions of Contract of a Dispute Resolution Advisor in the event of disputes.

ROLE OF CONSULTANTS

In order that the contractor gets a good start on the project, the civil and structural engineers are novated to the Contractor whilst the Contractor engages his own Architect and Building Services Engineers from the Government pre-approved list of consultants. In a novation contract, the civil and structural engineers are assigned to the contractor for whom the they produce any outstanding information which is necessary to construct the work. The engineers are paid by the contractor instead of the client as is traditionally the case.

Nevertheless, the other consultants engaged by the Hospital Authority to prepare the design proposals and the tender remained with the Hospital Authority to take on the watch-dog role, led by a Project Manager to maintain a tight control over time, cost and quality.

An independent consultant firm was appointed as the Project Manager in this project, and besides the management of the contract contingency provisions and programme, is also in charge of

policing changes during the design period.The use of a professional project manager was identified as an important contribution to the success of hospital procurement in a study by Smith & Wilkins (1995).

ORGANISATION CHART

A management structure which clearly defines appropriate procedures, roles and levels of authority for the implementation of the project is an important element for its success. In the North District Hospital, as illustrated in Fig. 2, the Project Management team or the Project Manager as the Supervising Officer, co-ordinates meetings to manage the design, construction and commissioning stages of the project. Each of these stages requires the interaction between the representatives from the Government, Hospital Authority, design team and construction teams. Since this is a publicly funded project, the Government is monitoring through a Steering Committee whose chairperson is the Secretary for Works. Reporting to the Steering Committee is a Building Committee chaired by the Director of the Architectural Services Department.

The Hospital Authority itself also set up a high level steering committee to control end-users. All requested changes must pass through this committee which is chaired by the Deputy Director of Operations. Reporting to the Steering Committee is a Core Planning Team representing about 90 end-users and chaired by the Senior Planning Manager for medical services within the Hospital Authority. The Planning Manager was the single point of contact that is essential in ensuring an effective flow of communication.

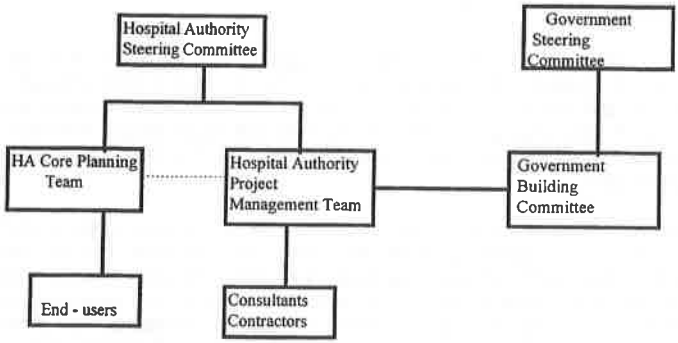

Figure 2: North District Hospital- Organisational Chart

INNOVATION IN DISPUTE RESOLUTION

In the North District Hospital, an innovative approach is used to defuse potential disputes by the application of partnering. This is a technique to organise the owner-contractor interface to maximise the benefits from a project team approach and minimise the impacts from the adversarial relationships in the project. "Partnering" workshops are conducted at key stages of the contract to remove the feeling of threat and to achieve a willingness from all parties to participate in an open forum, ultimately relying on trust and commitment by all. By participation of the Employer and the Contractor, a Partnering Charter is drawn up and was signed by both parties. Though the Partnering Charter has no contractual standing, it does demonstrate the determination of both parties to work together to ensure a successful project.

Meetings are conducted regularly with a monthly performance monitoring of the partnering. The partnering system is seen to be an effective process in improving performance efforts of members of the team by the Project Manager of North District Hospital and it is cited as a proven way of achieving an interdependent and productive relationship (Nielsen, 1996). Partnering is also reported to have increased savings in construction projects and reduced claims (Ryan, 1995). Nevertheless, there are problems in the system as there more parties involved than in a traditional method. There are two sets of consultants, one each for the Employer and the Contractor and as such there are more adversarial discussions than there would be in a traditional procurement method. However, the partnering system is seen as a strategy for resolution of issues in this project and even though the project is into 75% of its construction at the time of the preparation of this paper, there is no notice of dispute that has been issued to date.

VARIATION PROCESS

In a design and build contract, the client transfers a large part of risk to the contractor. Generally, the greater the risk assumed by the contractor, the greater his incentive to work efficiently and less is flexibility afforded by the contract. This reduces the ability of the client to change requirements as the project progresses. Cole (1994) states that client changes have been the single largest cause of time and cost overruns on health projects, and that the less flexibility there is for change the better.

In the North District Hospital, a stringent management structure was set up to control changes as illustrated in Figure 3. All changes requested by the end-users are evaluated by the Core Planning Team. If the Core Planning Team supports the change, it is referred through the Project Manager to the Contractor for investigation (Process 1). However, if a fundamental policy decision is required before an instruction can be given, it would be referred to the Steering Committee for direction (Process 2). Should the decision be to proceed, a formal "Variation Request" is forwarded to the Contractor for detail design and preparation of a quotation. If the requested change is considered justifiable, a "Contract Variation" is issued to the Contractor.

However, all changes need to be approved by the Government and as such, the Government Building Committee is required to approve the financial commitment before the issue of the "Contract Variation". Strict controls are placed on the ability of the end-users to introduce changes as the Core Planning Team, which serves to co-ordinate and manage the demands of the numerous end-users, exercises considerable control on the requests for changes.

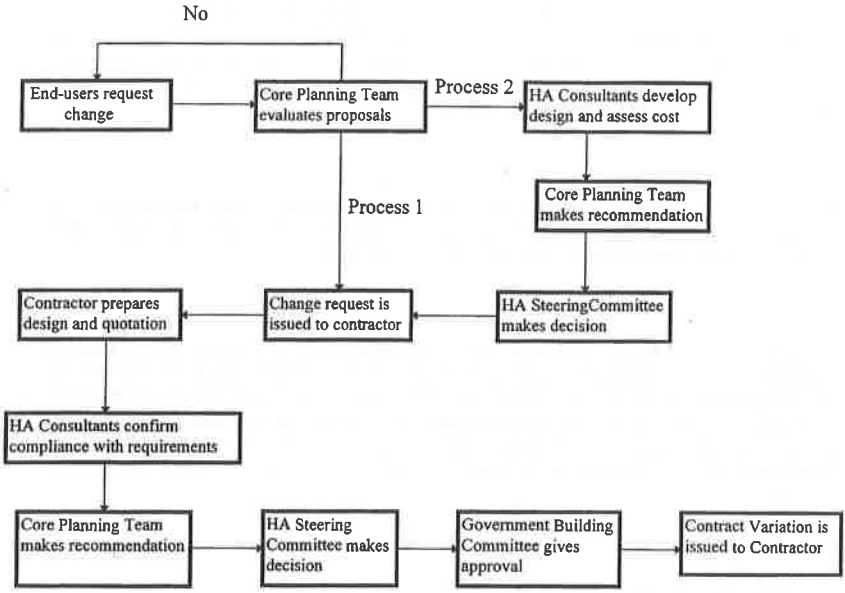

Figure 3: Change Process
Source: North District Hospital, Hospital Authority Procedures Manual 1994

TIME, COST AND QUALITY

TIME

There is a tight requirement on time since there is a political imperative that the project must be completed by June 1997. A contingency of four months has been built in at the outset of the project and at the time of this paper, three months have been used to settle time claims due to the delay by the end-users in finalising the design. It was reported that there was a time lag due to the difficulty in implementing the planned overlap in preparing the design to Stage D and when the contractor's consultants took over the design. Nevertheless, it was considered that in using the design and build procurement method, the Hospital Authority have saved up to a year from inception to completion if compared to a traditional method.

COST

In terms of cost, there is a healthy balance of contingency in the contract and the project is moving to use the contingencies to cover for additional facilities to the project. It was envisaged at this point of the project that the final cost will be within budget.

QUALITY

The quality of works are in conformance with the requirements and is satisfactory to the Hospital Authority. However, the hospital's representatives have to be involved in great detail in ensuring that the works are to the specified quality, due to the lack of experience from the contractor in managing works under a design and build contract. The contractor needs constant reminding that he has total responsibility for the design and construction process and that both design and construction are being managed and controlled by him to produce an end product acceptable to the employer.

CONCLUSION

The North District Hospital is due to be completed by June 1997 and there is another hospital (Tseung Kwan O Hospital) which is to be constructed by the design and build procurement method too. The develop and construct method used in the North District Hospital has been criticised as not reaping the benefit of buildability from the contractor and there was time lost during the stage of handing over the design to the contractor from the employer. However, the Hospital Authority is more concerned in maintaining a certain control over the design input and quality of the project which resulted in the use of this approach. It was recommended that in the other hospital the design shall be done until Stage C which is the stage for finalisation of outline proposal to allow for more design flexibility to the contractor but still effectively retain a develop and construct model. This develop and construct approach may be more appropriate considering

that most contractors in Hong Kong are new to design and build and would need more control from the clients.

Design and build finds favour with many clients due to the allocation of risk to the contractor and the assurance that the contractor assumes responsibility for completion on time and to an agreed cost. In the hospital project, there is an additional benefit of having the latest technology incorporated in the construction work especially in building services works and in the provision of special health equipment. The current progress of the project is good and the Project Management team is optimistic of a successful project completed within time, cost and quality.

There is not many design and build opportunities in Hong Kong at the moment and many contractors do not possess the relevant experience or know how to manage a design and build project. Projects which use design and build in Hong Kong are currently mostly publicly funded and if North District Hospital is completed successfully within time, cost and to the required quality, design and build procurement method may gain a foothold in the Hong Kong construction industry.

ACKNOWLEDGEMENT

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INFLUENCE OF CULTURE ON CONSTRUCTION PROCUREMENT

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Abstract

Application of information technology is constantly finding a place in the construction industry. This has led to the use of innovative procurement systems on the assumption that the traditional procurement system (TPS) is outdated and cannot cope with the complexities of the new demands. However, the new systems have often become transient mainly because they failed to take the cultural backgrounds of the stakeholders (clients, designers, construction team members and the public) into account.

A survey carried out in Southern African Development Community (SADC) member states found that the results of construction procurement system used for projects in which the stakeholders have similar cultural backgrounds are different from the ones in which they (stakeholders) are from different cultural backgrounds. The paper argues that the technical aspects of construction procurement systems cannot by themselves determine success of innovation in the systems. It concludes by emphasizing that innovation in construction procurement systems should take into account the culture of the stakeholders.

Keywords: Construction procurement, traditional procurement, stakeholders, culture.

INTRODUCTION

The primary goal of the project teams is to finish projects as specified, on schedule and within budget. Ritz (1990) refers to these goals as the project manager's creed. The project organizational structure, which is the collective action required to acquire the design, management and installation inputs is referred to as PROCUREMENT SYSTEM.

The procurement system selected for a project depends largely on the client's approach to developing its new facilities and the amount of human resources on its in-house staff. It is logical that a client will want to use its people, since they have experience in the client's business. However, most clients, especially government agencies, do not maintain large staffs of engineers and architects because of variations in workload. The heavy overhead charges of such organizations during periods of low project activity are hard to justify. Therefore clients contract with outside firms for most of their engineering, construction and project management services. Several types of procurement systems exist, and if a project is perceived by the client to have complied with the established standards set in the brief in terms of time, cost, quality and utility, then the procurement system utilized for the respective project has been successful.

One of the procurement systems commonly employed is the "traditional procurement system (TPS)". The essence of TPS is that construction work involving significant architectural input, is undertaken with the client contracting the architect as the principal design consultant. A separate contract is entered into between the client and the structural engineer. Later a separate contract is entered into by the client and the contractor (builder). In other words, the designer designs, and the builder builds. In order to achieve this, the architect must co-ordinate all the design input from the various technological design specialists, so that a single comprehensive set of documents can be put out to tender. In those projects involving mainly civil works, and where no architect is needed, the civil engineer is the designer and only two contracts are undertaken: between the client and the civil engineer, and between the client and the contractor/builder.

The client, the architect, the engineer and the contractor form the project team which operates in a dynamic and fragmented environment. These combinations of project participants are bound by mutual information dependence which can today be collected, processed and disseminated by integrated communication networks, advanced media technologies, etc. (Chang and Emsoff, 1988; Baldwin, 1990). However, the performance of the project team is influenced by several factors such as the organization framework, the structure of the temporary multi-organization (TMO), etc. (Shoesmith and Langford, 1991; Mohsini and Davidson, 1992; Bowen and Edwards, 1996). Inspite of the project manager's creed (Ritz, 1990), the contracts of employment used in construction projects provide very little incentive for project members to look for opportunities to benefit the client (NEDO, 1983). As a result, clients frequently complain of time and cost overruns (McGowan et al, 1991). Client dissatisfaction has led some researchers to blame the TPS as being out of date and not adequately reflective of an appropriate relationship between the client and the contractor (Dawson, 1988).

To improve the applicability of TPS, several innovative systems in the form of "TPS hybrid versions" have been put in use. To a large extent, these innovations have concentrated on the technical aspects of TPS and have not been successful because they have neglected to take cognisance of the project dynamics (Rwelamila and Ngowi, 1996). They have also paid very little attention on the relationships among the stakeholders of the projects, despite the fact that due to the necessity of international capital for large contracts, it has become likely that project participants come from any part of the globe and hence the existence of different cultures in a project.

Against this background, this paper discusses the influence of the cultural background of the project participants on the procurement system.

THE RESEARCH

A research project whose aim was to investigate the influence of the cultural backgrounds of project team members on their behavior towards key relationships during the project and how

this affected the performance of the project was carried out in Botswana. Ten projects, all of which were procured under the TPS were selected. In five of these projects the project team participants, i.e., the client, the architect, the engineer and the contractor were all from Botswana and shared the same culture. The remaining five projects had participants with different cultural backgrounds which included Europeans (British and Belgians), Chinese and Arabs. The client in all the projects was either a government ministry/department or a public institution.

Information about the behaviors of the project participants concerning their interactions with one another, communication, management of time, and conflict management was obtained through retrospective semi-structured interview techniques. Project managers and clerks of work were issued with notebooks in which they recorded weekly summaries of the behaviors of the project participants towards the key elements. These were selected because of the nature of their jobs which give them access to all other participants. The interviews were conducted on a face-to-face basis in the interviewees' own offices, and this made it possible for full explanations of the questions to be made. The length of each interview was 1 hour and a total number of 18 interviews were conducted: 8 with project managers and 10 with clerks of work. The notebooks were collected after a period of six months and the information was used to verify the results of the interviews. It was necessary to use retrospective interviews so as to obtain people's opinions about actual experiences of the said behaviors and how they affected the performance of the projects.

Interaction of Project Participants

In principle, the architect, the engineer and the contractor constitute different organizations in the TPS. Generally, the culture of the principal members will dictate the behaviors in the organization. In any case, members of different organizations are strangers to one another. Interaction of strangers is a novel situation for most people. According to Herman and Schield (1961), "the immediate psychological result of being in a new situation is lack of security. Ignorance of the potentialities inherent in the situation, of the means to reach a goal, and of the probable outcomes of extended action causes insecurity". Attempts to deal with the ambiguity of new situations involves a pattern of uncertainty and anxiety reduction (Ball-Rockeach, 1973).

The temporary nature of construction projects creates situations in which project members are constantly strangers to one another. In other words, the project members are constantly subjected to uncertainty and anxiety. While uncertainty results from peoples' inability to predict strangers' behaviors, anxiety stems from the anticipation of negative consequences. Stephan and Stephan (1985) noted that "people appear to fear at least four types of negative consequences: psychological or behavioral consequences for the self, and negative evaluations by members of the outgroup and ingroup". Under such conditions, project members become unwilling to try new approaches for project implementation, especially if they happen to be different from what is stated in project documents.

The research established that in those projects where the members of the different organizations shared the same culture, the degree of uncertainty and anxiety was much lower than in the ones where the members were from different cultural backgrounds. Project members were more eager to try innovative ways for project implementation in the former situation than in the later largely because inter-group interaction was easier.

Communication During Project Procurement Process

When people communicate, they attach meanings to the messages they construct and transmit to others. They also attach meanings to messages they receive from others. Rogers and Kincaid (1981) suggest that "mutual understanding is the goal of communication." Mutual understanding is the extent to which one person's estimate of the meaning another person attaches to a message actually matches the meaning the other persons attaches to a message. The communication can be through verbal or non-verbal processes. According to Samovar and Portar (1995), verbal process refers to use of verbal language and internal activity of thinking while non-verbal process involves all those stimuli in a communication setting that are generated using the environment.

Both verbal and non-verbal methods of communication are used at different stages of construction procurement and several messages are exchanged among the members of the different project organizations during the process. As construction projects are temporary in nature and the organizations have either not worked together before or are assembled from different countries and hence different cultures, misunderstandings can occur for a variety of reasons. Messages may not be encoded in a way that they can be understood by others, what is communicated may be misinterpreted, or both may occur simultaneously. According to Gumperz (1982), the greater the cultural and linguistic knowledge, and the more the beliefs of the people communicating overlap, the less the likelihood there will be misunderstanding. Lack of linguistic and cultural knowledge contributes to misunderstandings because according to Gumperz (1982), people "listen to speech, form a hypothesis about what routine is being enacted, and then rely on social background knowledge and co-occurance expectations to evaluate what is intended and what attitudes are conveyed." When strangers communicate with each other and base their interpretations on their own symbolic systems, ineffective communication usually occurs. In construction projects, ineffective communication translates into financial loss, which no party would like to shoulder. To minimize the occurrence of this problem, construction projects have tended to evolve fairly formal communication systems which are reinforced by the project hierarchy. However, formal communication does not create conditions conducive for innovation for two reasons: first, it denies project members the possibility of informal interactions where ideas can be discussed, as all such interactions have to be scheduled, and second, project members cannot experiment with undocumented procedures because they can not explain their actions through the formal channels.

The research noted that in the projects where the members of the different organizations share the same culture, communication was largely effective. Informal communication systems were frequently used and when members from different organizations identified innovative ways to carry out certain tasks, they were often allowed to implement them. In contrast, the projects

whose organizations had different cultural backgrounds, relied solely on formal communication systems. Any procedure which was not included in the contract documents, no matter how innovative it could be, was rarely implemented mainly because no party would like to formally shoulder the financial responsibilities of such actions.

It was also noted that language differences were the main cause of ineffective communication, especially where the parties involved did not have any idea of each other's language. Wrong pronunciations often led to misunderstandings.

Another important parameter in communication is the degree of context which predominates in the culture. A high-context communication or message, according to Hall (1976), is the one in which "most of the information is either in the physical context or internalized in the person, while very little is in the coded, explicit, transmitted part of the message". A low-context communication or message, in contrast, is one in which "the mass of information is vested in the explicit code" (Hall, 1976). The level of context influences all other aspects of communication. As noted by Hall (1976) "High-context cultures make greater distinction between insiders and outsiders than low-context cultures do. People raised in high-context systems expect more of others than do the participants in low-context systems. When talking about something that they have in their minds, a high-context individual will expect his interlocutor to know what is bothering him/her, so that he/she doesn't have to be specific. The result is that he/she will talk around and around the point, in effect putting all the pieces in place except the crucial one ..."

Organizations working on construction projects hardly stay together long enough for their members to know one another and establish appropriate modes of communication. As a result, everyone communicates based on one's own cultural background. This may lead to serious misunderstandings as everyone will communicate frankly to one's best knowledge and will have no reason to check whether the message was correctly interpreted, only to realize at a later stage that a misunderstanding took place. Again, this translates into financial loss.

The research noted that where the project organization is based on high-context culture (in this case the Chinese), it is very difficult to identify who has the final say in decision making as everything is referred back to the group for discussion before a decision is announced. And even then, the leader uses "we" instead of "I".

It was also noted that, in verbal communication, a negative reply to a request is not directly stated as "no". A reply will only dwell on the description of how difficult it is to implement such a request. An example was given by a "Motswana" sub-contractor for roadwork in a project whose main contractor was a Chinese Company. The subcontractor had requested to hire a grader which was lying idle at the site from the main contractor as all sub-contractor's graders were busy on another project. As a reply, the main contractor explained how difficult is was to get spare parts for that particular make of grader if something went wrong. To this, the sub-contractor confided that he had a reliable supplier of such parts. Then, the main contractor said that they were expecting a new project in which the grader would be required and went on to explain how difficult it would be if the grader was required at a short notice

while it was still hired out. Ultimately the sub-contractor gave up and made other arrangements. Although the word "No" was not used, the sub-contractor was given all the clues for him to realize that the reply was negative. The time wasted in communicating this information might have been saved if the cultural backgrounds of the two parties were the same. Moreover the cultural background of the subcontractor led him to believe that, as both parties were working on the same project, they both would put it before their individual interests.

Management of Time

The major dimension of cultural variability which can be used to explain the predisposition of people in the management of time and resources is individualism/collectivism. In individualistic cultures, emphasis is placed on individual's goals, while in collectivistic cultures, group goals have precedence over individual's goals. In individualistic cultures, according to Hofstede and Bond (1984) "people are supposed to look after themselves and their immediate family only", while in collectivistic cultures, "people belong to ingroups of collectivities which are supposed to look after them in exchange for loyalty".

The temporary nature of construction projects and the amount of risk allocated to each project organization influence the members to work as independent entities and encourage them to look after their individual interests whether or not they affect the performance of the other organizations. This is particularly so in the case of project organizations with individualistic cultural backgrounds, as they tend to be universalistic and apply the same value standard to everyone. In contrast, project organizations with collectivistic cultural backgrounds will tend to be particularistic and, therefore, apply different value standards for members of their ingroups and outgroups. Problems facing other project organizations are analyzed in that light and often receive sympathetic response.

Individualistic cultures are also very particular about efficiency and management of time. Since each group in this culture is expected to be independent, success is measured by how efficiently activities are carried out and how well time is managed. Like money, time is saved, wasted, given, taken, made, spent, run out of, and budgeted. Because time is so valuable, one must use it productively and divide it into intervals of efficient activity (Copeland and Griggs, 1985). Although all cultures are concerned about management of time, people from individualistic cultures have a tendency to stress getting things done, with emphasis on the end product rather than the means or the process. Extensions or postponements of activities receive very low tolerance because members have an eye to the future and would like to move on to the next activity. Cultures with a strong Islamic tradition, in contrast, because they believe that future events belong to Allah, also tend to perceive the present as a place where the past, present and future come together. They have little desire to chart out events that they believe are out of their control (Samovar and Porter, 1995).

Time in construction projects is normally planned and fixed through the "project programme" so as to enable coordination of the activities of all the participants. Often, scheduled times fall behind and catching up may be necessary from time to time through working during abnormal

hours. When activities require participation of the different organizations within the project, it may not always be possible to reach agreements to work during abnormal hours when the concept of time to these participants is different.

The research also found that, in the projects where the Chinese were involved, there were many disagreements with the other participants about working times, because the Chinese could work during the night and on holidays which other cultures could not practice. An example was given where a Chinese construction company had planned to carry out concrete work on Sunday but could not go ahead because the European structural engineer who was supposed to check and certify reinforcement work prior to concreting refused to work on a Sunday.

Conflict and its Management

Conflict between peoples of different cultural groups occur frequently in workplaces. While specific causes of intergroup conflict differ depending upon the situation, all incidents share one thing in common, namely "polarized communication". Arnett (1986) defines polarized communication as "the inability to believe or seriously consider one's view as wrong and other's opinion as truth." Polarized communication, therefore, exists when groups or individuals look out for their own interests and have little concern for others' interests (Gudykunst, 1991).

The contracts of employment used in construction projects, distribute risks distinctly between different project organizations. This in effect creates a series of highly independent control systems within the project, each associated with a specific organization. Each project organization, therefore, puts its interests first and foremost. Similarly a project organization will only put forward an innovation which will promote its interests. It will also undermine any innovation put forward by the other organizations within the project, if such an innovation threatens its interest.

Conflict itself, however, is not positive or negative. How conflicts are managed can have positive or negative consequences. Conflicts can arise from instrumental (i.e., differences in goals or practices) or expressive (i.e., tension, often generated from hostile feelings) sources (Olsen, 1978). Both instrumental and expressive conflicts arise in all cultures. There are, however, cultural differences in the sources people tend to perceive as the major "cause" of conflict. People in low-context individualistic cultures usually interpret the source of conflict as being instrumental in nature. Because the conflict is instrumentally based, people can argue over task-oriented issues and remain friends. People in high-context, collectivistic cultures, in contrast, tend to see conflict arising from expressive sources (Ting-Toomey, 1985). Because the person and issue are not separated, it is difficult to have open disagreement without one or both parties losing face. Ting-Toomey (1985) suggests that people in individualistic cultures prefer direct styles of dealing with conflict such as dominating, controlling and or solution oriented. People in collectivistic cultures, on the other hand, prefer indirect styles of dealing with conflict that allow all parties to preserve face.

In the project teams where informal communication systems were practiced, the research found that the frequency of conflicts was low compared to where only formal communication systems were used. This was said to be due to the fact that, as soon as tension or other sources of conflict were detected, informal discussions were quickly entered into, and often the tensions were released before escalating into conflicts. However, in some cases it was observed that resolving minor sources of conflict informally, only postponed problems and allowed them to build up to major conflicts.

It seems that, when a project is procured through TPS, and for this matter any type of procurement system (because of the assembly of strangers involved in all systems), conflicts are inevitable, especially if the cultural backgrounds of the different project organizations are different. Apparently, a conflict laden atmosphere is hardly conducive for innovation. Learning how to manage conflicts is, therefore, of paramount importance. In managing conflicts, Gibb (1961) emphasizes the importance of establishing a "supportive climate" which has six characteristics namely: description rather than evaluation, taking a problem orientation, being spontaneous rather than strategic, conveying empathy, communicating that the parties involved are equal and conveying provisionalism. Langer (1989) reinforces this approach through the notion of becoming mindful where people create new categories (which is necessary to be descriptive), be open to new information, and not to be "certain" that they already know the answers. The focus is on the process not the outcome.

CONCLUSIONS

The aim of this paper has been to discuss the influence of cultural backgrounds of project stakeholders on the outcome of construction procurement. Some important cultural attributes and how they influence the procurement process were discussed. It is, however, by no means an exhaustive list as the research upon which this paper is based is still on and may find other attributes in due course. Although the report concentrates on Botswana, preliminary correspondence indicates similar trends in the other SADC countries. The research will ultimately verify this.

More and more construction projects are attracting participants with different cultural backgrounds. The temporary nature of these projects means that participants from different cultures do not spend enough time together to learn how to get across to one another. As a result they rely on means of communication which are based on their cultures and often lead to misunderstandings. Misunderstandings may cause financial loss and breed suspicions and mistrust among project participants. Such conditions are not conducive for innovations.

For innovations in construction procurement to be successful the cultural diversity of the stakeholders should be taken into consideration.

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IMPROVING CONSTRUCTION PRODUCTIVITY IN SINGAPORE: ROLE OF PROJECT PROCUREMENT WITH SPECIAL REFERENCE TO CONTRACTUAL PROVISIONS

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Abstract

Faced with an acute shortage of workers, Singapore gives considerable attention to the formulation and implementation of programmes to enhance construction productivity, and, thereby, reduce the number of workers needed to undertake the projects required for the country's development. The national concern with raising levels of construction productivity in Singapore has concentrated on providing incentives, information and advice to construction firms to adopt appropriate techniques and equipment on their projects. Effort has also been made to promote the use of standard designs and prefabricated components. Thus, emphasis in the productivity enhancement drive has focused on the economics and technology of productivity and on measures to be taken by construction contractors.

This paper considers the role of both public and private clients in the effort to raise levels of construction productivity in Singapore. It discusses how clients can contribute to this effort in their normal procurement practices. It focuses on the implications of the provisions of the standard forms of construction contract in use in Singapore, for attempts to raise construction productivity. It argues that while appropriate drafting of some specific relevant clauses in the forms of contracts would help achieve success in the productivity drive, this would alter the present allocation of risks in building contracts. A new contractual arrangement is, therefore, necessary to allow for this change.

Keywords: productivity enhancement, client's involvement, procurement, contractual provision.

INTRODUCTION

Improving Construction Productivity

Construction productivity can be enhanced through the adoption of a wide range of measures separately or in combination. These viable measures include aspects of design considerations, statutory regulation, procurement methods, production and use of materials and components, site supervision, mechanisation, and motivation of personnel (Horner *et al*, 1987: 670). In the literature, emphasis is put on the measures which can be taken on site, as well as on actions which the contractor can take (Ofori, 1996).

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The construction industry in Singapore has been considered to be frustrating the efforts towards achieving the national policy intention to enhance productivity and increase value added in all sectors of the economy. Thus, particular efforts have been made to determine the reasons for the industry's low productivity, and to assist, encourage and provide incentives for construction enterprises to increase their productivity. The emphasis in Singapore has been similar to that in the literature, with a concentration on action on site, and on measures to be adopted by contractors. Of late, much attention has been paid to the design stage, with measures to encourage the adoption of buildable designs.

Construction Labour Situation

Since the late 1960s when jobs became abundant owing to the success of a rapid industrialisation programme, Singapore has faced a shortage of labour. In construction, the shortage has been acute owing to the poor social image of careers in construction, especially site work (*The Contractor*, 1992: 8-9).

Currently, the construction industry of Singapore relies heavily on foreign workers (Lim, 1985; Liew, 1995). Some 85 per cent of the workforce are foreign, with Thais, followed by Malaysians, constituting the largest proportion (CIDB, 1995). It is estimated that the construction industry takes up some 50 per cent of the total population of foreign workers in Singapore (by comparison, construction accounts for only 7 per cent of the GDP) (CIDB, 1995). This shortage of construction labour has been the key impetus of the construction productivity development programme in Singapore (TFCP, 1992). The aim is to raise productivity in order to reduce the industry's requirement for labour, and hence its reliance on foreign workers.

Productivity Programme in Singapore

In Singapore, the levels of productivity in construction have been of topical interest over the past decade. Studies have shown that construction productivity in Singapore is relatively low both in comparison with other sectors of the national economy, and with the construction industries of other countries at higher levels of development.

In the past two decades, increases in construction productivity (where productivity is measured in terms of value added per person employed) have been modest, at best, and in most years, have lagged behind the average for all sectors which has consistently increased each year (Ministry of Trade and Industry, 1987, 1993, 1995). Over the 15-year period, 1980-94, only in 1980, 1982-85 and 1992 was the rate of increase in construction productivity higher than in manufacturing and the national average.

The Task Force on Construction Productivity (TFCP) (1992) (see below) estimated that construction productivity in Singapore, measured in terms of mandays per square metre of total floor area completed, is 25 per cent below that in Japan, and 40 per cent below that in Finland. The main reason cited by the TFCP for these differences in productivity was the level of prefabrication, which was about 40 per cent in Finland, 15-20 per cent in Japan, and 7 per cent in Singapore. In the local construction industry, the TFCP (1992) found productivity in public-sector projects to be generally higher than that for private-sector projects, owing again to a difference in the level of application of prefabrication. The TFCP found that the public-housing sector had the highest level of productivity, owing to the larger proportion of prefabrication adopted, as standard designs are used. Ng (1996) reports that a CIDB study in 1995 found productivity levels on public residential

buildings to be over three times that on private residential buildings.

The genesis of Singapore's construction productivity development programme can be traced to the sixties when schemes were introduced by the Housing and Development Board (HDB) to help its contractors increase the pace of progress on their sites, in order to meet the physical targets for the completion of housing units. These schemes included: (i) guarantee of medium-term workload to a "core group" of contractors to enable them to plan, and invest; (ii) offering of interest-free loans to contractors for the purchase of equipment; (iii) specification of particular, faster techniques to be adopted (such as metal scaffolding and systems formwork); and (iv) an attempt, in 1973, soon abandoned, to introduce industrialised building methods.

The productivity development programme was intensified, and has been administered, by the Construction Industry Development Board (CIDB) since its formation in 1984 (Ofori, 1993). 1992 was a milestone: the report of the TFCP was published. The TFCP was appointed by the CIDB to compare Singapore's construction productivity with that of other countries, identify reasons for Singapore's low construction productivity, and recommend long-term programmes to increase construction productivity (TFCP, 1992).

Following the TFCP's recommendations, the productivity enhancement programme has focused on the promotion of buildable designs and application of prefabrication, with the public sector leading the way: the private sector has showed little interest in the productivity improvement programme. Ng (1996) observed that the private sector had lagged behind the public housing sector because: (i) conventional cast-in-situ methods are still economical; (ii) designers are not familiar with buildable design, and fear architectural monotony from the use of prefabrication; (iii) the contractor's construction expertise is not applied during the design stage of the design, bid, build approach commonly used in Singapore; and (iv) the country relies on a transient foreign workforce. He suggests that the best ways to increase productivity is through: (i) increasing training; (ii) further mechanisation; (iii) wider adoption of design-and-build; and (iv) utilisation of more buildable designs.

The Paper

This paper considers contractual issues relating to productivity in construction in Singapore. It addresses the extent to which both public and private sector clients are concerned about productivity on their projects, and how this concern is manifested in the contract documents. It focuses on the provisions of the main standard forms of contract used in Singapore in relation to productivity. It argues that much can be achieved by clients' awareness that they can contribute to the attainment of the national aim to enhance productivity by providing for, and monitoring the achievement of higher productivity on their projects, and supporting the efforts of their contractors to achieve such an objective. The paper starts by discussing key aspects of the national effort to improve construction productivity in Singapore, before considering the potential of procurement methods.

IMPROVING PRODUCTIVITY IN SINGAPORE

Incentive Schemes

The acute shortage of construction workers has provided a stimulus for Singapore's productivity development programme. Effort has been concentrated on the introduction

of techniques and the related equipment which will enable the construction enterprises to reduce their reliance on labour.

The programme to enhance productivity at the national level in Singapore was effectively intensified during the late 1970s when a concerted effort was made to restructure the economy to increase value added in all sectors by phasing out labour-dependent activities (Lim Chong Yah Associates, 1989). As part of national schemes administered by the Economic Development Board (EDB), construction enterprises have been encouraged, given financial incentives and given national awards to acquire productivity-enhancing equipment and adopt labour-saving techniques including structural steel construction, systems formwork, and metal scaffolding. The incentive schemes have been revised and fine-tuned over time. Three examples of the current schemes are now outlined.

Under the Investment Allowance Scheme (IAS), firms are given tax write-offs of up to 50 per cent of the investment when they purchase items (plant, equipment or computers) which are considered to help enhance productivity (CIDB, 1994a). The level of the tax rebate depends on the estimated extent of such potential productivity enhancement. The Product Development Assistance Scheme also offers grants of up to 50 per cent for development work on products or techniques. The incentive schemes are not limited to facilitating the acquisition of equipment and products. Under the Local Enterprise Technical Assistance Scheme (LETAS), dollar-to-dollar grants of up to S$25,000 are given to enable small and medium-sized construction firms to engage external consultants to assist them to upgrade their operations and set up management systems, especially those leading to improvements in productivity and quality.

Buildability

Soon after its formation, the CIDB promoted the adoption of standardisation of component sizes through modular co-ordination. The Board organised seminars, exhibitions and short training courses, published manuals and good-practice books, and instituted an advisory service to educate practitioners on the concepts.

The public client provided leadership in the implementation of prefabrication. Under a five-year programme launched in 1992, five major public client agencies including the HDB, Jurong Town Corporation, Port of Singapore Authority and Public Works Department, committed a large volume of work for application of buildable designs.

The CIDB considers buildability to have three principles: standardisation, simplicity, and the use of single integrated elements (Ng, 1996). The Buildable Design Appraisal System, developed by the CIDB, is "used to rate the labour efficiency of a construction method which is dictated by the design" (CIDB, 1994a: 56). The public agencies specify buildable score targets for the designers of their projects to meet either by their own in-house design team, or design-and-build contractors. The Best Buildable Design Awards, commenced in 1991, recognise companies which adopt labour-saving construction techniques. In 1994, 22 nominations were made; 7 awards and 6 certificates of merit were given (CIDB, 1994b: 23).

The promotion of buildable designs to the private sector has involved design workshops and seminars. But it has responded very slowly. Ng (1996) suggests that the reasons for this include: clients' perception of buildable designs as costly, and their resulting unwillingness to pay for it; and contractors' belief that such designs are more risky owing to their lack of exposure to them, given the low level of their utilisation.

Human Resource Development

The development of the industry's human resource is a major plank of the construction productivity enhancement programme, based on the truism that the better trained worker is a more productive worker. The construction labour shortage in Singapore is due to the industry's requirement for large numbers of workers owing to its reliance on 'conventional' labour-intensive technologies, with extensive use of wet trades, in particular, in-situ reinforced concrete. The unfavourable social perception has frustrated well-planned and well-resourced efforts towards attaining a national aim of developing a core of skilled construction workers. Wilkinson *et al* (1986) and Ofori (1993) outline Singapore's multi-pronged programme to reduce the industry's reliance on labour and develop a core construction workforce.

The CIDB has, since 1984, run multi-skill courses (on both full and part-time bases) and a trade certification programme for construction workers. It has trained over 40,000 workers in various trades, and in construction safety. Over 33,000 workers have taken the CIDB's trade tests. The Board has also trained some 3,700 supervisors since 1988.

The CIDB mounted a public education campaign in 1992 to address the industry's poor image, and interest Singaporeans in careers in construction. This comprised talks in schools, advertisements on television, radio and in the press, and a poster campaign. Despite this programme, the industry has been unable to replace its labour requirements significantly because of its continuing reliance on labour-intensive techniques.

If enterprises rely on cheap, numerous foreign workers, this would have a dampening effect on productivity improvement, among other negative effects (Liew, 1994). Thus, another aspect of the productivity enhancement programme is the control of foreign workers. The number of foreign workers in each sector of the Singapore economy is controlled via three measures (Toh, 1993; Ofori, 1996). First, under statutory provisions now expressed in the Employment of Foreign Workers Act 1991, all foreign workers require fixed-term work permits. These permits are valid for four years in total, and only for the specified trade or occupation, and employer. The Act provides for penalties against employers and employees infringing its provisions. All foreign workers must be recruited from approved countries.

The second control measure is the number of foreign construction workers employed in Singapore is the imposition of 'dependency levels' which indicate the number of foreign workers a company can employ per every Singaporean worker it has (currently, for construction it is 5:1 foreign: local workers) (Ministry of Labour, 1992). The third control measure on foreign construction workers is a government levy, introduced in 1980, intended to make employment of foreign workers relatively expensive (Teo, 1990; Toh, 1993). To encourage contractors to employ skilled workers, the flat levy was adjusted in 1990 (*Construction Focus*, 1990: 1). The two-tier levy is currently S$440 for an unskilled worker, and S$200 for a skilled worker.

POTENTIAL OF PROCUREMENT METHODS

The potential of using procurement methods to secure higher productivity lies in using them as tools to impose legal obligations on the contractors to achieve specified rates of production. As there are many routes to making it a legal obligation to achieve higher

productivity, careful considerations must be given to how these may rearrange the contractor's current legal position in respect of the risks undertaken for site operations and methods of construction in the traditional building contracts.

Common contractual provisions for factors affecting productivity

Every procurement method when translated into a contract apportions legal obligations between the developer and the contractor as regards the completion of the works. Inevitably, the contract, in providing for such apportionment, also makes provisions which may affect productivity indirectly. Such provisions are related to: (i) design; (ii) workmanship; (iii) materials; (iv) site operations; and (v) methods of construction.

In traditional building contracts, design, workmanship and materials are usually specified by the developer's consultants in the contract documents and any delay caused by matters arising from them would be considered as the consequences of the risks undertaken by the developer. However, under some forms of procurement such as design-and-build, the consequences of these risks for delay under the contract are borne by the contractor.

The design of a building affects productivity according to its buildability. All things being equal, a buildable design would result in higher productivity. Workmanship which requires a higher level of technical or artistic skill would, in general, slow down the completion of the works. However, where the workmanship required can be achieved by the use of the machines, the mechanisation of the work would improve the rate of productivity. In addition, if there is a lack of workers of a particular type or level of skill, a delay would be caused if the workmanship required can only be performed by this group of workers. The materials specified for use should have a good workability if a higher rate of productivity is required. In addition, where different materials are used next to each other, they should be compatible to facilitate any form of jointing required. All these considerations would determine the speed with which the works on a construction project may be completed (Oglesby *et al*, 1989).

The remaining two items above, site operations and methods of construction which concern the site operations and the methods of construction, are usually the responsibility of the contractor regardless of whether the traditional building contract or another form, such as the design-and-build contract, is utilised. Whilst most contracts may require the contractor to submit the works programme, it is usually provided that neither the developer nor the contractor is bound contractually by the deadlines set in the programme other than the contract period and hence completion date agreed to.

The obligation assumed for site operations would require the contractor to co-ordinate works on the site amongst all parties who are using the site including nominated and domestic sub-contractors as well as any developer's contractors, tradesmen or others allowed on site under the building contract. This would include the sequencing of works on site to ensure that all works would be completed within the contract period. If necessary the contractor may decide to accelerate the pace of the works at its own extra costs to avoid a delay in the completion date of the works. Another aspect of site operation concerns the layout of the site which should provide for, *inter alia*, storage and work areas. A congested site layout would inevitably slow down work carried out on the site.

The choice of the methods of construction is usually left to the contractor although the developer may specify some of the methods. Within the constraints of the design, workmanship and materials specified, the contractor may decide to mechanise the meth-

ods of construction and programme the work to complete within the contract period.

The legal implication of the contract period

In a building contract, the parties usually agree to a contract period for the contractor to complete all works, failing which, the developer is given a right to recover liquidated damages from the contractor to compensate for loss suffered as a result of late completion. If the parties fail to agree to such a contract period, which is rare, then the time for completion given by the common law is a reasonable time to complete the works.

Whether the building contract is a traditional one or of another form, such as a design-and-build contract, either party, that is, the developer or the contractor, may fix the contract period. The usual practice in Singapore is for the developer to fix the period. In this event, the developer is likely to stipulate a time period that would bring optimum returns from the development. The developer may, but is unlikely to, fix the contract period with a view of inducing higher productivity.

On the other hand, if the contractor is given a free hand in setting a contract period, he is likely to take into consideration his capacity to carry out works at his optimum rate of productivity. However, as he may be penalised for late completion, he may provide for a longer contract period in order to introduce a reasonable buffer to cushion off any unforeseen delay.

The current arrangements between the parties to complete the works do not give priority to setting a contract period that would induce high productivity. However, this arrangement does provide that the party responsible for any delay must bear the consequences of the delay. Thus, in the traditional contract, the developer is responsible for any delay caused by the late provision of the details of any design, workmanship and materials to the contractor without which he cannot proceed with the works. The contractor is responsible for any delay caused by the adoption of any inefficient site operation and methods of construction.

This being the case, this paper next examines the consequences of specifying rates of productivity in respect of design workmanship, materials, site operation and methods of construction.

Productivity specifications

In general, in Singapore, other than the global rate of productivity for the completion of a structure as indicated by the contract period, no rate of productivity (based on an attribute of the building such as floor area, or trade) is specified in building contracts (Suite, 1987). However, rates of productivity may be induced indirectly through the specifications in the five items discussed above.

In the traditional contracts where the developer's consultants are responsible for the specifications of design, workmanship and materials, they may, firstly, translate a buildable design into contractual requirements under the contract specifications drawings and bills of quantities, if applicable. Secondly, the consultants can state the nature of workmanship required after ensuring that it is possible to achieve such standards of workmanship in the light of the availability of the workers in possession of the required level of skill to achieve the specified workmanship. Thirdly, the type of materials to be specified should be easily workable and compatible with surrounding materials, especially

where jointing is necessary between any two materials.

In taking such steps, the consultants would not change *per se*, the legal obligations of the developer to ensure that there are no delays to the completion of the works caused by matters arising from the consultants' specification of design, workmanship and materials. Consequently, there is no real disincentive to induce the increase in productivity by this indirect means, However, this would be a futile effort as there is no incentive for the contractor to complete earlier than the specified completion date, unless rewarded by a bonus payment provision or it is in the interest of the contractor to do so after considering his optimum capacity to complete the works.

In traditional contracts, the responsibility for the site operation and the methods of construction is usually left with the contractor. Thus, when a contractor undertakes to carry out and complete the specified building works within a contract period, he is responsible for any late completion arising from any inefficient site operation or method of construction. If a developer decides to specify a particular site operation or method of construction, he is responsible for any delay caused if the contractor strictly complies with the specified site operation or method of construction. There is, therefore, a shift in the responsibility for delay in completion of the works from the contractor to the developer.

This would be an important consideration as to whether the developer would intervene in the present arrangement of the parties' responsibilities by stipulating the use of a particular site operation or method of construction which would induce a certain level of productivity. More importantly, even if the developer is prepared to intervene as such, there is still no real incentive to complete earlier if the contract does not provide for a bonus payment upon early completion.

DISCUSSION

In Singapore, enhancing construction productivity will remain a major national aim for the economy as a whole, and more so for the construction industry. The intention is to do more of what is currently being pursued. Over the next ten years the CIDB's objectives with respect to productivity are (CIDB, 1994a):

> ... the emphasis will be on integrating design disciplines using concurrent engineering and other information technology tools to raise efficiency. To improve productivity on construction sites, the Board will promote buildable designs and prefabrication to both the public and private sectors (p. 62).

A comprehensive programme has been implemented for the development of construction productivity in Singapore. The public client has sought to lead the industry by example, promoting and facilitating the use of materials and components, techniques, equipment, personnel and procedures which will lead to higher productivity on its projects. The Productivity Development Unit of the CIDB frequently benchmarks Singapore's productivity performance against those of other countries, and identifies ways and means of improving upon the situation.

The existing incentive schemes are frequently fine-tuned to make them relevant, and to address feedback from the industry. The list of equipment considered worthwhile for contractors to purchase is regularly updated. The CIDB's Productivity Development Unit is constantly on the look-out for new materials and techniques with a potential to increase

productivity. These, and projects on which they are used, are widely publicised in workshops and manuals and by an advisory service. In a week of activities culminating in the conferring of the annual Best Buildable Design awards, a conference, exhibitions, talks and competitions are organised by the CIDB.

The level of construction productivity in Singapore is attained in the light of several constraints. For example, there is a statutory limit on the amount of foreign labour a company may employ, and thus, the number of workers who may be available for a particular task.The rules relating to the employment of foreign workers, and sanctions against offenders have recently been made more stringent, and several sites have been raided, illegal workers arrested, and the contractors on whose sites they are found, heavily fined (*The Straits Times*, 1995, 1996).

The choice of both the manner in which the site operation is maintained and the methods of construction used would affect the time taken for the completion and therefore the rate of productivity. This choice is usually left to the contractor under the building contract, and is likely to be influenced by the contract period. Hence there is no incentive to plan for higher productivity, presumably at a higher cost, which would see an earlier completion date. To encourage higher productivity the parties must derive an economic benefit from this pursuit. It may be argued that if the developer has a stake in the contractor's performance, then it would be in the interest of the developer to encourage higher productivity. One option to create such a stake is to enter into a contractual arrangement of partnering.

CONCLUSION

The private sector has responded poorly to the intensive construction productivity development drive in Singapore. This is because developers have not encouraged contractors to attain higher productivity because of the tendency of any stipulation in the contractual provisions to alter the risk allocation on projects. Partnering appears to be a viable option by which clients can obtain a stake in the performance of the contractor, and hence an incentive to encourage the contractor to achieve higher productivity.

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RESPONDING TO MARKET CHANGE: PROCUREMENT AND MANAGEMENT OF PRIVATE-SECTOR RESIDENTIAL PROJECTS IN SINGAPORE

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Abstract

Since the late 1980s, the prices of real estate have substantially increased in Singapore. This is most evident in the case of private residential units. End purchasers have become better informed and more discerning. Among the client objectives of cost, time and quality, cost now receives least emphasis from private developers' firms. This has radically altered the previous preoccupation with cost minimisation, especially with attaining the lowest construction costs. With changes in various aspects of the property market, greater care is required not only in monitoring and supervising construction on site to ensure high quality of work, but also, in pre-design preparation and procurement practices.

This paper studies the current state of Singapore clients' project procurement and management practices, focusing on private residential development. It considers the nature of clients' present procurement and project management policies and procedures, as well as the evolution of these processes and accompanying influencing factors. It then maps out their future and proposes the best ways and means by which the firms can deal with their rapidly changing operating environments.

Keywords: **property market changes, developers' responses, procurement practices, forecasts.**

INTRODUCTION

Clients' Objectives

The project management literature suggests that construction clients have three objectives, and that these are often in the following order of priority: cost, time and quality (Bennett, 1985; Walker, 1989). Thus, it is suggested that most effort should be, and is, invested by project participants (clients, their consultants and contractors) in ensuring that projects are completed within the budget. The search for the most suitable procurement approach is motivated by, and aims to achieve, this project-objective order of priority.

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While meeting the time schedule is often a corollary of this fixation on costs, it is seldom the main concern, despite awareness, among project participants, of the time-sensitive nature of property development. Moreover, emphasis is put on the construction phase in the effort made to enhance so-called *value for client's money*. Even the attempts at managing the project which are made at the design stage are meant to plan for, and control, construction costs. This is true of the application of such traditional techniques as elemental cost planning and cost control, as well as the more recent ones such as *value management*.

Of late, quality has received much attention in construction (Kelly and Male, 1993). Clients are being advised, and some are taking measures, to place quality ahead of cost and time (Bennett, 1991). Ofori (1992) suggested that *the environment* should be the fourth construction project objective, although he did not propose a ranking order for the four objectives.

This paper considers the policies and practices currently adopted by private-sector clients in Singapore to procure and manage their construction projects. It focuses on residential development. It discusses the factors influencing the current procurement and project management policies and practices, and highlights their future. It identifies trends in the property market as one of the main factors. It also considers, as one of the main results of these policies and practices, private developers' increasing professionalism and greater attention to the strengthening of their organisations for administering their projects.

The paper starts by providing a brief introduction to Singapore's economy and residential market. It considers trends in property prices and the property market before focusing on clients' procurement and project management practices.

Singapore: Economic Background

With an area of 620 square kilometers and a population of a little over 3 million, Singapore has a high population density. Land prices are high and rising. After experiencing robust economic growth continuously for over a decade, and almost uninterrupted since independence in 1965, Singapore has a per capita income of S$34,500 (US$1 = S$1.40) (Ministry of Trade and Industry, 1996). The Singapore economy is export-led, with high-technology manufacturing and services being the largest sectors. Construction contributes 7 per cent of gross domestic product annually. The Property Market Consultative Committee (1986: 4) estimated that, together, the construction and real estate sector constituted 25 to 30 per cent of the GDP. The government recognises the importance of the sector, and pays attention to its well-being.

THE RESIDENTIAL MARKET IN SINGAPORE

Market Structure

The residential market in Singapore has a two-tier structure: (i) public housing which comprises, predominantly, flats in estates within integrated townships; and (ii) private housing of various types.

Public Housing

The provision of housing of a reasonable standard for the populace in Singapore was a

national objective in the early 1960s when the country faced a housing crisis. After an accelerated mass-housing programme administered by the Housing and Development Board (HDB), some 85 per cent of the population now live in public housing (HDB, 1995), having fallen from its peak of 87 per cent in 1993. Over 80 per cent of the public housing stock is owned by citizens (subject to guidelines on household income ceilings) on 99-year leases. The trend over time has been towards greater size and better quality.

Developments in issues relating to public housing reflect the social and economic progress of Singapore. The guidelines on eligibility (such as income ceilings) and on ownership have become increasingly less restrictive. Some recent developments in the public-housing programme are (Sim and Yu, 1996):
(i) introduction of the "design and build" scheme, where the private sector both designs and constructs the estates, thus providing variety in appearance, form and structure;
(ii) privatisation of some public housing estates, giving the leaseholders direct responsibility for the management and improvement of the estates;
(iii) upgrading of older blocks of flats (at little cost to the leaseholders) under a long-term programme, to provide additional space, and better aesthetics and common amenities; and
(iv) building of "executive condominiums", which are public housing estates with private-condominium features, with few ownership restrictions (see below).

These developments have closed the gap between public and private apartments in terms of size, aesthetics and amenities. But the gap in popular perceptions with regard to desirability persists. To "upgrade" from HDB flat to condominium apartment remains a personal aim of the typical Singaporean (as discussed below).

Private Housing

Private housing units in Singapore range from "landed properties" (detached, semi-detached and terraced houses), to apartment units, most of which are in "condominiums". With high land prices, houses are small in number and expensive. The condominium unit is more numerous, and is almost synonymous with "private housing" in Singapore.

In Singapore, condominiums are built in prime residential areas, as well as at important transport nodes or sites close to "good schools" in the "suburban areas". They are usually of high-rise form, and comprise housing units (apartments and/or town houses) and common amenities such as sports facilities, swimming pools and social halls. Condominium units range in size from studio flats (about $80m^2$ in floor area) to penthouses (exceeding $300m^2$ in floor area). A condominium may comprise under 50, or over 1,000 apartment units. Current unit construction costs of condominium units range from S$1,400 per m^2 to S$1,800 per m^2. Sale prices range from S$7000 per m^2 to S$15,000 per m^2 depending on location, quality of materials and services, and extent of facilities.

Some Key Features of the Singapore Market

Singapore has one of the highest home-ownership rates in the world. The financial system is geared towards supporting both the developer and the end purchaser. The bulk of the purchasers of private residential units recently (about 90 per cent in 1995) (Tay and Tan, 1996) have been the so-called "HDB upgraders", with significant capital gain from their units sold on the "open market" (subject to rules set by the HDB), as well as ample cash savings from their Central Provident Fund (CPF) accounts -- the Fund is a national savings scheme to which the employer and employee contribute equal proportions of the employee's earnings towards providing funds for the latter's retirement; part of the

balance can be used to purchase property. The CPF has been significant in facilitating the purchase of housing by Singaporeans.

The private housing sector in Singapore is well regulated, over and above the development and building control regime. For example, under the Housing Developers (Control and Licensing) Act (Revised 1985 Edition) and the Housing Developers' Rules (1990 Edition), all developers of four or more housing units must be licensed, and must follow prescribed guidelines with respect to the marketing of the properties and the drafting of sale agreements, among other things. It is pertinent to note that developers of commercial and industrial properties are not subject to such a requirement to be licensed.

While the regulatory measures are aimed at protecting the public from unfair practices, they offer certain benefits to developers. For example, under the provisions of the housing developers' Project Account Rules (1990 Edition), licensed developers can "launch" their projects and pre-sell their units, with purchasers paying specified proportions of the purchase price at various stages of completion of the project. This eases the developers' financial constraints considerably.

The Developers

Currently, private property developers in Singapore are of various sizes. Those undertaking condominiums are large and well-established. 20 real estate developers' companies are listed on the Stock Exchange of Singapore. The shares of these property companies have performed strongly in the 1990s on the back of the companies' large operating profits. In 1995, reflecting the robust property market, the share prices of these companies grew substantially, some in excess of 100 per cent. The prices of the shares have fallen back following the government's demand restraint measures (see below).

Many developers' companies are subsidiaries of companies with interests in various activities including banking and securities, manufacturing, trading and shipbuilding. Some of the larger construction contractors, both foreign and local, have also become prominent as developers. Most of the bigger developers have operations outside Singapore, in other countries in the South-East and North-East Asia regions, and a number have activities further afield, in Australasia, Europe (mainly the UK) and the US.

RECENT DEVELOPMENTS

Recent Trends in Property Prices

The prices of real property (including those of both private and public residential property) have increased considerably in Singapore in the past few years. The prices of residential property rose by 36 per cent in 1993, 42 per cent in 1994, and by a further 10 per cent in 1995 (*The Straits Times*, 1996a). For condominiums, the price rises in these three years were 25, 38 and 14 per cent respectively (Chua, 1997). The rise in property prices outstripped both the rate of growth of the economy (which has been over 8 per cent per annum during the past four years), and that of inflation (which was below 3 per cent over the period) (Department of Statistics, 1996). The factors considered to have fuelled property prices include (Chua, 1997): strong economic growth and good prospects; rise in wages; availability of funds; and demand for residential property by immigrants, would-be immigrants and investors from Hong Kong and Taiwan.

Recent attempts to moderate price rises -- a declared aim of the government (*The Straits Times*, 1996b) -- were at first indirect. They included statements by the government to allay fears among Singaporeans that the rise in prices would put private residential apartments beyond their reach. More state land has been released for residential development. Current data are published on the sale status of new projects (which, by late 1995, showed that, contrary to popular perception, many of the recently-launched units were unsold).

Later direct measures included moves to help first-time buyers sandwiched between the income with which they qualify for public housing, and that at which they can afford private units. Cash grants were made to first time buyers of public housing units on the "open market". The executive condominium programme was launched. To relieve inflationary overheating in property prices, most of the major banks adopted a loan ceiling of 80 per cent of the purchase price or valuation of the property (whichever is lower). In May 1996, the government introduced a number of demand-restraint measures which have successfully had a moderating effect on demand. The main ones are (Chua, 1997):
i. gains from property sold within three years of purchase will be taxed as income;
ii. stamp duty on all property sales will be payable upon signing of the sale and purchase agreement rather than on completion of the sale;
iii. vendors will pay stamp duty on property sold within three years of purchase;
iv. the quantum of loans for residential property is not to exceed 80 per cent of the valuation or purchase price;
v. foreigners and non-Singapore companies cannot be given Singapore dollar loans to purchase residential property.

Quality Shift

As the economy of Singapore has grown and disposable incomes have risen, affordability of private housing is not a major criterion for purchasers; they are no longer looking for a basic unit of accommodation. End purchasers are better informed and more discerning. Developers have had to respond to these market changes by incorporating increasingly greater and more sophisticated features in their buildings. These include higher levels of comfort in terms of space and internal physical environment, aesthetics (including attractive designs and top quality materials), and social amenities. A recent development is to incorporate in high-class residential developments, elaborate 'intelligent' features.

The above developments have resulted in a *quality shift*. Chow (1994) suggests that another contributory factor to this shift is the increase in land prices: as construction costs constitute a smaller proportion of total development costs, developers are willing to spend more on buildings to enhance their quality and increase their competitiveness.

Reduced Uncertainty

Several factors have contributed to the reduction of the amount of uncertainty in private property development in Singapore. This has made the pursuit of efficiency on projects more necessary. The development and building control regimes (such as guidelines on intensity of development and development and building control procedures) are continually improved to make them "business friendly". Changes to regulations or procedures are widely publicised well ahead of their effective dates, and phased in where practical.

Property market information is more easily available. Making accurate and timely information available was one of the main recommendations of the Property Market Consulta-

tive Committee (1986: 87), appointed by the government to study the property slump which started in 1985 (and eventually lasted for three years), and propose suitable courses of action. The published information which is currently available include:
i. quarterly data on the economy's performance, forecasts of business outlook; and annual data on leading economic indicators;
ii. quarterly data on property transactions and prices; medium-term forecasts of property supply and demand;
iii. quarterly data on projects for which planning permission has been given; and
iv. the medium-term programme for land to be released under the government's sale of sites programme and the volume of property each is expected to yield.

As a result of the above, developers have access to the information required for pre-investment analyses, leading to swift decision making. Developers are devoting greater attention to ascertaining user requirements prior to the design of their buildings, and seeking to design products meeting the aspirations of the potential end-users.

Contractors' Tendering Practice

Construction Industry Development Board (CIDB) tender price indices showed a decline of about 7 per cent between 1991 and 1994, despite a massive increase in the volume of demand for construction and in levels of activity, an 11 per cent escalation in the cost of labour over the period, and a decline of the materials cost index by 1 per cent (CIDB, 1996: 7-8). Owing to increased competition among contractors, tenders have become very keen (CIDB, 1996: 5). The high level of competition is due mainly to an increase in the number of both local and foreign contractors able to undertake large and complex construction projects, as most private-sector residential developments are. Contractors registered with the responsible public agency in the top financial category (able to bid for projects with "unlimited" contract value) increased in number from 54 in 1993 to 68 in 1995 (CIDB, 1996: 15). Local contractors in this category now outnumber foreign ones, reversing the situation which had prevailed since the early 1980s (Ofori, 1993).

In view of the above developments, contractors are seeking to differentiate their service by finding new ways to show that they can add value to the client's product. Clients have shifted emphasis from seeking the lowest tender, and from such previously common practices as engaging in post-bidding negotiation.

CLIENTS' PRACTICES

Need for Management

From the discussion so far, it can be seen that factors other than the traditional ones of construction cost, are exerting a prominent influence on operating policies and strategies of developers of private residential units.

There is less uncertainty concerning development and stability in construction costs (see below). The erstwhile strong demand has now considerably weakened. Thus, competition is even more intense. Moreover, the bases on which developers of private residential units compete have changed. A narrow cost focus is no longer appropriate. Management of all aspects of the project in an integrated manner is an important factor in corporate competitiveness in the real estate sector. The following sections consider measures being taken by the developers of private residential property in response to this situation.

Project Management

Developers have become more professional in their approach to the entire development process. Instead of being concentrated on the construction stage, the management of the project has become wider-embracing. The situation is dynamic, with each developer exploring different means of attaining the same ends. In the management of the construction phase of the project, emphasis is being placed on project planning and control to ensure high quality of work. One large developers' company has attained ISO 9000 certification, giving a pointed message to its consultants and contractors.

While they previously relied on external consultants under traditional project procurement and administrative systems, the larger developers have set up "project departments" staffed by qualified and experienced professionals. These departments typically act in a "project management" role, with the design being undertaken by consultants, and construction by (separate) contractors. Among factors which have contributed to the establishment of these project departments are:
(i) increasing complexity and size of projects, the full extent of which many of the developers' external consultants cannot cope with;
(ii) increasingly more demanding statutory provisions with which not all designers were familiar, leading to delays and increased costs in some cases; and
(iii) unsatisfactory performance of some consultants, requiring the "vetting" of their work.

A typical project department is headed by a Director of Projects, with Senior Project Managers in charge of various property types such as residential, commercial (office and hotel) and industrial, each of whom leads a team of professionals including engineers, architects and quantity surveyors. The project departments have established structured ways of feeding back experiences on current projects into the design and construction processes of future ones. Staff of the marketing units of the developers' companies are prominent members of the design development teams.

Procurement Approaches

Private developers of residential projects in Singapore have largely abandoned the traditional approach and are trying out various procurement systems, including some adapted from overseas. The private clients are developing their own procurement and project administration systems and applying them to distinct stages of the project. For example, some developers engage two or three architects to prepare the initial project scheme, under a form of "quasi-competition". The client's project manager is a major feature on their projects. The consultant project manager has not gained a foothold in Singapore as clients are not convinced that the "extra" fee of such a person is justified. The design and build arrangement has also been tried in a number of forms, although this is relatively rare where private residential property is concerned.

The approaches used by the public client in Singapore are also being tried out by private developers. These include the offer of tendering preferences to contractors with proven records for high quality of work. A variant of this approach is the award of bonuses, at pre-determined rates, to contractors attaining set levels of quality on their projects upon completion, as determined under the objective system used to assess the quality of public-sector projects, the Construction Quality Assessment System (see Ofori, 1993).

An innovative approach recently adopted by one developer was to commission designs for the structural, and the mechanical and electrical systems for a major development from three consultants in each case, paying a flat fee to each of them for this service. There was then a variant of the Value Management Workshop attended by the consultants and the client's representatives, at which the designs were presented and commented upon. The eventual design, prepared by the adjudged "winners" in each case, incorporated the suggestions for improvement made at the review session. The client saved on the cost of the structural frame and services, while attaining a higher quality for each system.

DISCUSSION

Project and Corporate Management

In their effort to build projects which would sell most quickly and at the highest possible prices in a market comprising knowledgeable buyers who are able to choose from an oversupply of property, developers have had to give due consideration to every aspect of their projects, and not only the construction stage.

With the changes in the planning parameters and guidelines, and developments in key aspects of the market, the nature of the condominium has undergone significant changes. Recent themes include: health-conscious living; resort-style living; and marina-style living. It has become important that the developer accurately forecasts the desirable product. In one approach to establishing user requirements, developers send out survey forms to a targeted sample of potential purchasers, with questions seeking to establish respondents' preferences with respect to features of the development.

Developers are making efforts to attain a desirable corporate image among the population. They are taking measures to differentiate their products. One of them has established a *brand name* for its condominiums. Having marketed itself and its products under this brand, accompanied by a reputation for quality, its housing units sell at a significant premium.

Developers in Singapore are forming strategic alliances with a variety of entities or persons, including banks. Recently, developers have formed joint ventures among themselves to undertake particular, larger projects. Other recent partners of developers include investment companies, owners of sites and design consultants.

Procurement

Developers have gained the confidence to relate to their professional consultants not even as equals, but as *their employers* (in the true sense of the word). Even where the traditional procurement approach is used, developers are no longer following *tradition* in terms of roles and responsibilities of the participants. Instead, they have sought ways by which they can best integrate the activities of the participants, for example, giving greater weight to the advice of the quantity surveyor, and streamlining communication and reporting channels on the project to facilitate the flow of information. Developers stress the importance of trust and goodwill in their dealings with both consultants and contractors. Most of the developers maintain long-term relationships with these practitioners.

As strategic alliances, in particular, joint project ventures, become common among, or with the involvement of, developers, managing the relationships among the partners will

assume as great an importance as the other aspects relating directly to the project. This will require a different skill on the part of the developers from that which they have used to manage their projects and their own companies in the past.

A small number of developers have set up their own construction units, which undertake all their projects. The developers believe that, in this way, they can better control the quality of their output. In a typical developer's organisation adopting such a practice, the relationship between the "client" and "contracting" sections are arms-length, the latter being engaged on a cost-plus basis for each project.

The Future

The trend towards professionalism among developers will continue. Greater exchange of ideas between the public and private sectors on procurement in both a formal and informal manner can be envisaged. Developers' project management units may offer procurement and project management services to newer and smaller developers. They may also be able to offer consultancy services to public clients, if the trend towards privatisation extends to the dismantling of the HDB and the Public Works Department (the public sector's "project management agency" -- responsible for projects other than housing and industrial buildings). On the other hand, these privatised public bodies may be able to offer project management services to the developers, making it unnecessary for at least some of the latter to maintain their separate project departments.

As the project units of the various companies compete among themselves and improve upon their expertise, a distinct Singaporean approach to *total project management* will emerge. This will pose major challenges to construction enterprises, as well as offer opportunities to them. It will provide the impetus for the enterprises to endeavour to enhance the quality of their services, and achieve their corporate growth.

CONCLUSION

The current state of Singapore clients' project procurement and management policies and practices for private residential construction manifests the results of responses by these companies to developments within the property market. Benefiting initially from a vibrant market and receiving a stimulus from a demanding clientele, and later, from competition among themselves in a softening market, the developers have become more professional in their approach to project management.

What used to be the innovative competitive strategies of a few developers are now a common occurrence. Clients' objectives on projects have been re-ordered in a fundamental manner in Singapore, and procurement and project management policies and practices are being implemented and continually refined to achieve these objectives.

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BUILD OPERATE TRANSFER PROCUREMENT TRAPS: EXAMPLES FROM TRANSPORTATION PROJECTS IN THAILAND

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Abstract

Many developing countries now see private financing as the solutions to their infrastructure problems. Consequently, there is increasing use of different forms of Build Operate Transfer (BOT) procurement in many countries. Promoters of BOT projects tend to focus, almost exclusively, on the commercial and technical aspects. However, experience in transportation projects in Thailand show that economic forecasts should be treated as what they are, "forecasts". The reality may be different if the contractual aspects of the project are neglected.

A major neglect is the credibility of the host government as a contract partner. If the host government dithers, or is unable to deliver what is promised, at any of the three stages (Build, Operate and Transfer) the sponsors (concessionaires) are left with a project that is unable to live up to economic promise. Worse still, they may be unable to redress the problem through the legal process.

In the Second State Expressway System, the concession company achieved a major technical break-through, the completion of the project using new technology, but disagreement with the local authority ruined the relationships. On the Elevated Tollway Project, the government was unable to meet its obligation under the contract promptly. As a result, the concession company is experiencing financial difficulties. To be successful, BOT projects in developing countries must focus more on the responsibilities of the host government and how to deal with government inabilities or unwillingness to meet contractual obligations.

Key Words: Build operate transfer, transportation projects, contracts, host government, concessionaire.

INTRODUCTION

The Build-Operate-Transfer (BOT) procurement system is being increasingly used for a variety of projects. A major reason is that developing countries are facing heavy debt burdens while development of infrastructures is still a social and economic necessity (Tiong, 1992; Setiadi, 1994; Asian Business, 1996). Private sector firms have found it necessary to

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participate in infrastructure schemes as a commercial necessity to remain competitive in a changing market place (Tiong, 1992; Setiadi, 1994). Asian booming infrastructure has been the focus of world attention since the 1980s but the progress in implementing BOT schemes Asia is rather slow (Asian Business, 1996).

The major attraction in using the BOT arrangement is that developing economies can meet their infrastructure needs without having to pay for the projects. As such, it is perceived in many quarters as a God sent solution to the infrastructure problems of the developing economies. However, a BOT project is a contract between two parties: the host government and the concession company. If any of the two parties should fail to fulfill its responsibilities under the contract, the expectations from the project will not be met. This paper uses the example of two transportation contracts in Thailand to show how Government breech of BOT agreements can sour relations and result in lost profits to concessionaires in developing countries.

RELATED LITERATURE

Projects requiring private finance have a long history in the construction industry. A number of infrastructure projects in the developed countries were built prior to the current popularity of the arrangement. However, the use of the term BOT probably started with the Turkish project in 1984 (Barrett, 1986).

Although many governments may wish to build much of their infrastructure through private financing, not all projects are suitable for privatization. Projects that are well suited for a BOT agreement should have the following characteristics:

1. The country in which the project is situated should have a stable political system.
2. The legal system in the country should be predictable and proven to be reasonable.
3. The economy should be promising in the long term with adequate local financial markets. The currency exchange risk associated with the project should be predictable. This is particularly necessary if expected income is to be paid in local currency.
4. The project itself should be in the public interest, with governmental support being available to it.
5. There should be long term demand for the service to be offered by the project.
6. There should be limited competition from other projects.
7. Profits from the project must be sufficient to attract investors.
8. The cash flow from the project must be attractive to lenders.
9. The risk scenarios should be predictable while still providing acceptable profit and cash flow. (Knoblach, 1992; Asian Business, 1996).

Private finance for public infrastructure is a risky venture. The major risks in BOT projects have been identified by several authors (McCarthy and Tiong, 1991; Tiong, 1992). BOT projects are susceptible to all normal risks facing any construction projects but are also faced

with additional risks of which political, legal and currency fluctuations are the most prominent.

Many infrastructure projects in Asia are still being held-up on the negotiation table. The reasons have been outlined by the World bank as: (Asian Business, 1996)

1. a wide gap between the expectations of the government and the private sector
2. lack of clarity about government objectives and commitment, and complex decision making
3. poorly defined sector policies (on pricing, competition, public monopolies) and inadequate legal and regulatory policies, including investment codes and dispute resolution mechanisms.
4. need to unbundle and manage risks and to raise credibility of government policies
5. inadequate domestic capital markets
6. lack of mechanisms to provide large amounts of long term finance from private sources at affordable rates
7. poor transparency and lack of competition.

It would seem from the favorable conditions outlined and the reasons for the slowdown in BOT approvals in Asia, that political climate, regulatory and legal policies and the transparency of government operations are very important in determining the success or failure of BOT schemes.

THE SECOND STAGE EXPRESSWAY SYSTEM (SES)

The SES was planned in 1982 with the objective of complimenting the successful First Stage Expressway System (FES) in creating a comprehensive road network for Bangkok residents. It was to supply six lanes which were to serve as short cuts between the inner city and the outer areas, hence reducing the heavy traffic in the city center (The Nation, Sept. 19, 1992).

The project involved the construction of a 25 kilometer expressway which linked the FES with other areas of the city. The Expressway and Rapid Transit Authority of Thailand (ETA) published the Terms of Reference (TOR) for investment proposals in 1987, inviting private-sector investors to submit proposals to design, build and finance the construction of the SES in return for the right to receive toll revenues and manage the operation of the SES for 30 years.

After a two-year competitive bidding process, the Bangkok Expressway Consortium, which later became the Bangkok Expressway company Limited (BECL), was awarded a contract on the terms and conditions agreed in the SES agreement (SESA), signed by BECL and the ETA in December 1988. The project was estimated to cost Bt. 27.5 billion (US$ 1.1 billion) and was expected to be completed in 1995 (Bangkok Post, May 26, 1993). The agreement was that the two systems (FES and SES) would be combined and managed by one company to prevent users having to pay tolls twice.

Under the ETA-BECL contract, toll-revenue will be shared by BECL and ETA at a ratio of 60%:40% in the first nine of the 27 years of toll sharing. Subsequently, the ratio will change to 40%:60% in the last nine years and 50%:50% between the middle nine years of the sharing period. However, these figures were subject to the condition that the toll rates would be Bt. 30 for 4-wheel vehicles, Bt. 50 for 6-10 wheel vehicles, and Bt. 70 for vehicles with more than 10 wheels when the SES was to become operational. A Bt. 15 toll was then being charged on every 4-wheel vehicle using the FES (Bangkok Post, May 28, 1993).

Problems faced By the BECL in the Contract

The concession company faced several problems on the contract. The major problems are now considered.

1. ***Toll Increment***

As previously stated, the ETA was required to raise the toll from Bt. 15 to Bt. 30 for 4-wheel vehicles on the combined FES and the SES system when the project was completed. However, the Government of Thailand decided to peg down the increase to Bt. 20 on April 6, 1993. Out of the Bt. 20 toll, BECL was expected to receive Bt. 18 while the ETA was to receive Bt. 2. BECL regarded the failure to increase the toll to Bt. 30 as a breach of obligation under the SESA. Investors in the project believed then that the Bt. 20 toll decision by the Thai government would have a negative impact on other privatised schemes in the country. This was because the international financing community viewed the SES as a precedent, being the first major BOT scheme in Thailand (The Nation, 1993).

2. ***Loans to BECL Suspended***

Foreign and local banks suspended loans to the BECL for the construction of the SES. One major reason given for suspending loan was that BECL defaulted on interest payments for the loans already given. Another reason was that the revenue sharing agreement between ETA and BECL was not clear. BECL had demanded an amendment to the contract since the toll was not increased to Bt. 30 as agreed. The amendment was to be approved by the BECL shareholders and the creditor banks. The banks preferred suspending loans until the amendment was made clear to all parties (Bangkok Post, May 28, 1993).

3. ***Right to Operate the project***

The ETA claimed that it had the right to operate the new expressway. It contended that there was no stipulation in the contract that BECL should operate the system for a period of 30 years under a revenue-sharing formula. BECL, on the other hand, argued that since the project was based on a standard build-operate-transfer arrangement, it had the right to operate the system and handle all financial matters (Bangkok Post, May 28, 1993).

4. ***Toll Sharing***

The BOT agreement required the ETA to acquire all land needed for the project and deliver it to BECL. At the time of contract negotiations, the ETA could not guarantee the delivery of land to BECL. Since the sharing of toll revenue on the combined FES and SES between the ETA and BECL was conditional upon the physical completion of the project rather than on the commercial opening, and since a section of the land needed could not be acquired by the ETA due to protests by the residents in the area, as such, the full project could not be completed. Consequently, the ETA suspended the sharing of toll revenue with the BECL until the firm had fully completed the project (Bangkok Post, May 28, 1993).

5. ***Cost Escalation***

The ETA was unable to deliver land for the project as per the agreement. Less than 1% of its original hand-over target was achieved by March 1, 1990 when site construction was to start. Also, the ETA was unable to deliver any site within the second phase of the SES, by the stipulated date of August 1, 1992. This poor performance by the authority meant that higher costs were incurred on the first phase of the project which affected the anticipated financial viability of the project. The contract provided that additional costs incurred on the project due to circumstances not caused by BECL, such as late delivery of land, changes in design, etc., were to be borne by the ETA. The Authority, however, refused to pay for any additional costs incurred due to late delivery of land (Bangkok Post, May 28, 1993).

6. ***Toll Collection***

The ETA argued that the project was a "joint venture" between the Authority and BECL, and as such, ETA could legitimately collect the toll revenue. ETA therefore insisted on supplying the workers to man the toll booths but BECL must pay their salaries and any other benefits (Bangkok Post, May 26, 27,1993).

When negotiations on the toll amount and the collection of tolls broke down, BECL and the ETA filed separate suits in Thai courts asserting their positions. Before the suits could be settled, the Thai Authority persuaded the court to invoke a long forgotten National Emergency Act to force the opening of the SES system despite protestations by BECL that the road was not yet finished. The leading venture company in the BECL, Kumagai Gumi of Japan was forced to sell its shares in the company, 65% of the equity, to a local company (Business Post, March 14, 15, 1994).

THE DON MUANG TOLLWAY

The Don Muang Tollway is an elevated road link between the central part of Bangkok and the Don Muang International Airport. At the end of 1988, the Ministry of Transport and Communication, via the Department of Highways, called tenders for the implementation of an elevated viaduct on the Viphavadi-Rangsit Highway. It was a functional tender with no details about the project given except a few guidelines for the design of the viaduct. Bidders were required to finance the project on a non recourse BOT scheme Each bidder had to establish his/her own feasibility study, investment cost and income study and take into account the risks involved.

Three proposals were received but the Don Muang Tollway Company Limited, comprising DYWIDAG (a German firm), Delta Construction (a Thai construction company) and GMI, (a French contracting company) was chosen. The project is an investment of Bt. 10 billion (US$ 400 million) and financed by 25% equity and 75% loan of which 50% is in Thai Baht and the rest is in US dollars.

The Tollway Company was granted a 25 year concession to build and operate the project. The Government also agreed to not to allow competing road facilities adjacent to the project. As such, it was agreed that the SES which was then being constructed would not be connected to the project. The Government also granted some privileges under the Board of Investment Rules.

Problems Encountered

1. ***Debt/Equity Ratio***

Originally, the company agreed to commit 20% equity in foreign currency and 80% loans in Thai Baht to the project. However, shortly after the concession agreement was concluded, the Thai Government changed the rules for foreign investment. Foreign investors were requested not only to provide equity in foreign currency but also to secure foreign loans for a substantial part of the investments. The project lenders were not very keen since the revenue was in Thai Baht and subject to exchange rate fluctuations throughout the concession period. The shareholders had to increase the equity to 25% and secure additional privileges from the Thai Government in order to persuade lenders to proceed with the project.

2. ***Competing Project***

Hopewell Corporation was granted the concession to build a combined tollway and train system less than 100 meters from the project. The Don Muang Tollway Company considered this a violation of the agreement not to build a competing project within the vicinity of its project.

3. ***Removal of Overpasses***

To ensure the financial viability of the Tollway, the Thai Authority agreed to dismantle two overpasses on the Viphavadi-Rangsit highway. The overpasses were directly under the elevated viaduct at two busy road intersections. It was necessary to demolish them to "persuade" road users to use the elevated tollway. By the time the tollway was being built, the Thai Government had changed several times. The new Government considered that dismantling the two overpasses would prove unpopular with the voters. The problem remained unsolved for nearly two years after the tollway was opened. As a result, the Tollway was reported to have lost Bt. 1 million daily for over two years. The company could not, therefore, meet loan repayment schedules.

DISCUSSION

The cases of the two transportation projects outlined above raise some interesting questions. Two of those questions are now addressed.

1. ***Why did a company with much experience in BOT negotiations encountered so much problems Thailand?***

The answer to the question is not easy to find but some explanations may be advanced. Tiong (1995) reported that the Kumagai Gumi organization has an impressive track record in BOT projects. The company was 'successful' in the Sydney Harbor Tunnel Project and Hong Kong's Eastern Harbor Crossing. It was also involved in the Tate's Cairn Tunnel, Very Fast Train project in Australia and the Florida High-Speed-Rail project bidding. In those projects, it was either successful in winning the concession and executing the project or knew when to get out of the bidding.

It would seem that a BOT arrangement works best in stable political systems. Australia and Hong Kong have very stable governments compared to Thailand. The average length of the last seven Thai governments is around one year. For a concession agreement lasting thirty years, there could be potentially up to thirty different governments. In addition, each elected Thai government is a fragile coalition of sometimes more than five political parties; each with its own agenda. A new government wanting to impress its constituents often sees contracts signed by previous governments as soft targets for attack. The government in office at the time the SES contract was signed by Kumagai was totally different from the one in government at the time the project was being completed. The company would, undoubtedly, have predicted changes in government. What may not have been easily predictable was the attitude of each succeeding government towards a concession agreement.

The American company, ENRON, also had problems in the Indian state of Maharashtra. When a new political party won election in the state, it canceled a power plant agreement between ENRON and the previous administration, claiming that the deal was 'against the interests of the state' and 'undermined the self-respect of its people and was senseless'.

Promoters of BOT projects need to be very careful in negotiating contracts in countries where the political system is not very stable. It is doubtful though if concession-seeking companies can be careful enough in the light of the unpredictability of political changes in many developing economies.

2. ***What can a company do to prevent such unpleasant experiences?***

Despite the problems encountered by the Kumagai company on the SES project, interest in BOT schemes in Thailand is still very strong. A major reason is that there is much potential profit from a successful BOT project. When the Kumagai company was having problems on its project in 1992, the manager of the Don Muang Tollway project was asked a question at a seminar, "How can you be sure that the Thai government will agree to demolish the two fly-overs needing to be demolished for your project to be viable"? His answer was that the company had signed an agreement with the Thai government, and as such, it expected the government to honor the agreement. Although he did not link his economic forecast with the potential contract problem, the prognosis for profit was very good since Traffic on the Viphavadi-Rangsit highway had been increasing by over ten percent every year for several years and the Thai economy was performing exceptionally well. It was the rosy forecasts that attracted investors. The Government took two years to permit the removal the two fly-overs that were crucial to the financial viability of the Don Muang Tollway. The tollway company was, therefore, mired in deep financial troubles. It is now being suggested that the foreign partners should consider selling their equity to local Thai companies.

Companies often concentrate too much on the financial aspects of BOT projects. However, political risks may render all financial forecasts unreliable. This is a problem that should be given due attention by companies wanting to enter into any BOT agreement.

A contract is an agreement between two parties. Traditionally there are various legal avenues for seeking redress if one party fails to meet its obligations under the agreement. Most BOT contracts in developing economies involve investors from another (usually developed) country. As such, a BOT agreement is usually, but not always, an international contract. As the SES case illustrates, the foreign concessionaire may be powerless if the host government violates the agreement. Moreover, public opinion will usually be against the 'foreigner'. The threat of chastisement in international financial circles may not be enough to prevent such contract violations. It may be that requiring all quarrels concerning BOTs to be settled in international courts may be a better form of guarantee for a foreign investor. The laws to be applied will be clear to the company seeking the BOT concession and most countries will want to prevent having court rulings against them in the international community. This arrangement is cumbersome, but it will persuade both parties to be more cautious during negotiations. Whereas this arrangement may be acceptable to countries desperately needing finance for BOT projects, the relatively well-off countries may not want to enter into such agreements. The unwillingness to operate in the "international environment" should be a pointer to would-be investors to exercise much caution when considering BOT agreements.

Transparency of the process of bidding for international BOT projects will also help in preventing accusations of wrong doing. The reason cited for the cancellation of the ENRON agreement with the state of Maharasthtra was that there was no open bidding for the project. Negotiated tenders provide ammunitions for 'self-righteous' government officials willing to gain political points. As such BOT schemes involving close negotiation should be approached with extreme caution.

CONCLUSIONS

BOT schemes continue to be an attractive option for financing infrastructure in many developing economies. However, the experience with BOTs has not been totally pleasant. The cases of two transportation projects have been reported in this paper. They serve as pointers to the fact that economic forecasts should not be the only dominant factor in entering BOT agreements. Countries with unstable political systems and unclear laws pose special problems to BOT concessionaires. As the experience in Thailand show, even seasoned actors in the international BOT scene may get caught. A BOT agreement, being a long term arrangement, necessarily has to be executed under different administrations. What is considered to be in the public interest by one government may be seen to be unreasonable and against the public interest by another government. A concession-seeking company is, therefore, well advised to consider very carefully the likelihood that political changes in the host country may have very negative impacts on the commercial success of BOT schemes.

In the developed countries, where the legal systems are well tested and proven to be very reliable, concession companies can undertake to carry most risks while receiving very little guarantees in return. However, in the developing economies, concessionaires are better off seeking government guarantees or even financial participation in projects as a risk-sharing strategy.

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THE RELATIONSHIP OF STAKEHOLDING TO SOFT SYSTEM CONSTRUCTION MANAGEMENT TECHNIQUES

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Abstract

Modern 'soft system' construction management techniques favour a holistic approach to problem solving, based on the involvement of stakeholders of the project. However although the techniques consider the importance of such involvement, there is not, to date, any real consideration of how this will be achieved. In partnering for example, although there is recognition of the need to include all partners with a stakeholding in the project, there is no means to overcome the fact that existing procurement arrangements do not allow for the appointment, and therefore inclusion, of sub-contractors until late in the project life. At such a stage, any benefit which may possibly be accrued from partnering may be lost.

This paper examines the role of the sub-contractor as a stakeholder in the construction project. It highlights how existing power differentials act as a barrier to the stakeholder concept and makes recommendations as to how these barriers can be overcome.

INTRODUCTION: CONSTRUCTION MANAGEMENT AND STAKEHOLDING

McGeorge and Palmer (1997) outlined that the construction management techniques that have appeared in the last 10 to 15 years favour a soft system holistic approach to the development and management of projects, which considers a wider spectrum of interests than traditionally was the case. Partnering for example is closely allied with stakeholder interests and is aimed at improving relationships among those involved in the construction process to the benefit of all. Value management by its team approach encourages the input of the users of the building as well as other interested parties. Constructability aims at achieving optimum integration of construction knowledge and at balancing the projects and their environmental constraints to achieve overall project objectives. Even the three process-oriented techniques of benchmarking, reengineering and total quality management recognise optimisation of the multitude of interests that exist on a construction project as a vital role of management.

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Benchmarking for example recognises that true organisational improvement rests in an external as opposed to an internal view of the organisation. Re-engineering requires the organisation to examine its fundamental reasons for existence. Finally TQM is not a stand alone system but an integrated part of high level strategy that involves all employees, top to bottom, and extends backwards and forwards to include supply chain and customer chain. (Rampsey and Roberts, 1992)

What these techniques have in common is that they are all based on the need for a cultural shift within the construction industry (or even within industry generally). The construction project can no longer be viewed as isolated, there to satisfy the objectives of a small group of financing individuals or companies. Modern techniques demand that the project be viewed holistically as part of the social, economic and political structure within which it exists. This idea is closely allied with the concept of stakeholding. Stakeholder theory recognises that the government and public contribute resources that allow organisations to operate. As a consequence, they are entitled to some return. (Adams and Hardwick, 1996; Ambler and Wilson, 1995) Nowhere is this more visible than with a construction project where land, infrastructure, energy, raw materials and labour are contributed from a multitude of sources. Stakeholder theory postulates that because of these contributions, various parties, including shareholders, creditors, managers, employees, customers, government and the general public, have legitimate claims on the modern organisation (or project). This legitimacy is established either through explicit obligations such as the construction contract or by unwritten implicit arrangements such as fair play. Stakeholder theory, contrary to the traditional view of the organisation, views that one of the major strategic objectives of management is to balance the conflicting claims of the stakeholders.(Stoner and Freeman, 1989)

It is easy to see how an organisation can have a stakeholder approach to management. It is not so simple to apply this notion to the construction project which typically is multi-organisational. The objectives of the organisations within the project may be different and not all will necessarily take a stakeholder approach. In addition, there is some evidence that the ability of an organisation to account for the interests of its stakeholders is possibly related to its size, profitability and leverage (the ratio of debt to assets) (Adams and Hardwick, 1996). On a typical construction project these three factors will vary depending on the organisation involved and, as a result, so will the ability to adopt the stakeholder approach. It may be much easier for a multi-national construction company with high profits and low debt to asset ratio to account for the interests of stakeholders than it is for the labour only sub-contractor paid cash on a weekly basis. The problem is that despite differences in the organisations involved, the stakeholders of the project as a whole remain the same. These stakeholders expect the same level of consideration from the labour only sub-contractor as they do from the main contractor. The problem for the construction industry is reconciling this.

DIVERGENCE BETWEEN SUB-CONTRACTORS', MAIN CONTRACTORS' AND CLIENT OBJECTIVES

Since stakeholders are those with an interest in the company or project or those whom the company or project has the capacity to benefit or harm (Nelson, 1992; Chryssides & Kaler, 1993), the sub-contractor is clearly a stakeholder of the project. Despite this, sub-contractor objectives on the construction project will usually be significantly different from the main contractor's and the client's. Stakeholder theory recognises that this differential exists (Hill and Jones, 1992). In order to make the project work efficiently, this divergence needs to be minimised and construction projects have built in mechanisms for doing this. These include:

Legal mechanisms

Certain legal mechanisms ensure that at least in some aspects client, main contractor and sub-contractor are working towards the same objectives. The most obvious two are the building regulations and the health and safety regulations.

Contractual mechanisms

The contract and contract documentation also limit divergence by providing uniformity of objective. The contract itself, the specification and the bills of quantities have the effect of limiting the differences between the parties.

Incentives

The construction project also has built in financial mechanisms that are aimed at narrowing divergence. Interim payments and the payments of materials on and off site act to reduce the differential between client, main contractor and sub-contractor. Implicitly the pricing of preliminaries encourages the main contractor to meet the client objective of speed of construction. The main contractor in turn passes this onto the sub-contractor, either directly with a similar pricing structure, or less directly through bonus payments. The efficacy of this type of divergence-narrowing mechanism is most clearly illustrated when it is absent. Daywork, which is used in the absence of any other pricing structure, is notorious for the disincentive it provides to finish work quickly.

THE PROBLEM OF SUB-CONTRACTING AND THE POWER DIFFERENTIAL

Divergence of interest therefore, can be narrowed by legal, contractual or financial means. However the size of divergence is not static. As a result, the divergence-narrowing mechanisms will also vary. The reason for the differences in the level of divergence is the existence of power differentials within the project, which are in a constant state of flux (Hill and Jones, 1992). The power differential between the main contractor and sub-contractor is governed by a variety of factors which include:

Ease of entry and exit

The ease of entry into a trade relates to the size of power differential. Where entry level into a trade is high, shortages that develop in the market (or on the project), are not easily met and power shifts towards the tradesman or sub-contractor. In recent years, the growth in sub-contracting has resulted in a decrease in apprenticeship and a dropping of entry level. This has possibly resulted in a shift of power away from the sub-contractor to the main contractor.

The level of skill

The level of skill operates in a similar way to the ease of entry and exit. High skill levels shift the balance of power towards the sub-contractor and away from the main contractor. It is argued that the level of stakeholding equates to the level of skill (Hill and Jones, 1992). An unskilled worker being easily replaceable, has a low stake in the firm, whereas a highly skilled employee has a much higher stake. This can perhaps be seen in the construction process where it often the higher skilled sub-contractors, such as mechanical and electrical, who are the best rewarded in terms of nomination.

Lack of stability in the market

Lack of stability in the market increases the state of flux of the power differentials. This has positive traits as it reminds the party holding the power that one day "the boot will be on the other foot." On the other hand it possibly means that problems are never really addressed and merely swing from one crisis to the next.

Organisational inertia

Some construction companies recognise that the sub-contractor problem needs to be addressed but the company systems and practices work in favour of keeping the status quo.

Withdrawal of resources

A construction company can withdraw work from a sub-contractor easily, particularly if it is a domestic sub-contractor. The effect of a sub-contractor withdrawing labour is directly related to ease of entry and current market conditions.

Voice

Voice is the collective ability of a group to express and protect its interests. To be legitimate, voice must be expressed by a recognised interest group. In some construction trades, there are recognised trade bodies that exercise a degree of influence, whereas in other trades such as painting, groundwork or bricklaying, there is not. When all trades were employed directly by the main contractor, employee voice was strong, since collective action would impact on the business of the main contractor. Diffusion of the trade function, brought about by the increase in sub-contracting, has reduced the ability of the trades to act collectively and has shifted power to the main contractor.

Deliberate shaping of the environment by one party

On construction projects there are often deliberate attempts to manipulate the power differential. Some recognised tactics are;

Dutch auctioning
Acceptance of low skill level which makes entry into the market easier.
Too long a list of tenderers
Unfair contract conditions
Pay when paid clauses
Bid rigging
Black listing
Delayed payment

AN EXAMPLE OF PARTNERING

If the presence of the stakeholder approach in modern construction management techniques is recognised, it is worth examining in detail how these techniques deal with the sub-contracting problem. For example, Stevens (1993) outlines that partnering:

> "attempts to establish working relationships among stakeholders through a mutually developed formal strategy of commitment and communication."

It is difficult to see how this could be achieved. Partnering is reputed to be most effective when carried out under a design and build procurement arrangement and herein lies its first conflict. Palmer (1996) recognised that the design and build procurement route is disadvantageous to the sub-contractor, in that it dispenses with nomination, the sub-contractor's greatest means of protection. It is of course possible for partnering to be carried out under a traditional procurement route. However, if this is the case, then the main contractor is not admitted to the proceedings until the design is complete. The sub-contractor is admitted even later. As such, and with the exception of mechanical and electrical, it is unlikely that sub-contractors will be admitted early enough to contribute anything to, or gain anything from, the partnering arrangement. Partnering therefore appears to do nothing to address the problem of the power differential which causes the divergence of interest between main contractor and sub-contractor.

It must be concluded that it would be difficult to make project partnering work on a one off basis because of the sub-contractor problem. It is our view that strategic partnering and project partnering cannot really be separated because only the strategic partnered company will have the long term relationships with sub-contractors necessary to make the arrangement work on a partnered project.[2]

[2] Project partnering is a partnering arrangement made for the duration of the project, whereas strategic partnering is a longer term commitment of organisations to work together over a series of projects.

CONCLUSION

In terms of construction, stakeholder refers to groups of constituents who have a legitimate claim on the project. This legitimacy is based on a relationship of some form. The sub-contractor's explicit relationship is largely with the main contractor, to whom he is a supplier of labour and/or materials. The exception to this occurs when the sub-contractor is nominated, in which case there is also an explicit contractual relationship with the client. The implicit relationships of the sub-contractor from a stakeholder viewpoint are much wider. Theoretically the stakeholders of the project, who may be the client shareholders as well as the general public, all have an explicit or implicit relationship with the main contractor and, as a result, all of his sub-contractors.

The problem that this creates is that although the sub-contractors may all take the same risk in terms of the obligation to the project stakeholders, their treatment under the project varies depending on the power differentials that are operating at any one time. Modern construction management techniques such as project partnering, which are based on the stakeholder approach, do little to rectify this. As such, it is difficult to see how such techniques will be successful in meeting their stated objectives.

Contrary to project partnering, the traditional system of procurements' ability to nominate sub-contractors *did,* in some cases, shift the balance of power in favour of the sub-contractor. However this only applied to work that was highly technical, such as mechanical and electrical, or work which formed a significant part of the contract sum. Labour only sub-contractors for example were never nominated. This system of nomination is in itself cognisant of the power differentials that are in force, in that it recognises the higher skill level of mechanical and electrical work and the greater barriers to entry and exit provided by the presence of Chartered Institute of Building Services Engineers and other trade bodies.

If a client decides to take a stakeholder approach, the concept of the domestic sub-contractor (that is a sub-contractor who only has a contractual relationship with the main contractor) is one that simply does not tie in, and the only way to redress the power imbalance is to nominate all sub-contractors. The alternative is for the contractors to address the problem themselves. This is achieved in Japan through a system of *keiretsu*. *Keiretsu* refers to company groupings and in the case of construction, may involve a sub-contractor working exclusively for one main contractor. This develops a long term relationship and degree of loyalty, plus an identification with the main contractor. Such a system reduces the sub-contractor's dependence on competitive tendering and produces a more mutually dependent relationship. The main contractor cannot easily admit new sub-contractors to the *keiretsu* and the sub-contractor cannot easily abandon one *keiretsu* in favour of another.

Possibly the biggest barrier to implementing a stakeholder system in the UK is competitive tendering. If work continues to be awarded on price alone, there will never be any incentive for the main contractor to take a fairer approach to sub-contracting. If on the other hand tenders were awarded based on quality, previous relationship or the adoption of stakeholder policy then an incentive would exist. This ties in with the views of Latham (1994), who in his report outlined that change in the construction industry must be client driven.

There can be little doubt that change is taking place in the construction industry. Soft systems, with their emphasis on the holistic approach, are becoming more prominent. In addition, Martin and Green (1995) have outlined early steps towards stakeholding on construction projects in the USA. Whether change will be implemented through new construction management techniques, or through stakeholding, or possibly through both, is not yet known. However, central to all of these ideas is the holistic approach which recognises that a project is only as good as its main contractor and that any main contractor is only as good as his worst sub-contractor.

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THE IMPLICATIONS OF ENVIRONMENTAL ISSUES ON CONSTRUCTION PROCUREMENT

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Abstract

This paper identifies the broad environmental issues and legislation affecting the construction industry in the UK. These are then classified in a framework that can be related to the construction process and represented graphically in a prototype decision making strategy for use in construction procurement. In conclusion, a way forward is proposed, highlighting the need for further research.

INTRODUCTION

I believe that environmental issues will be the major challenge confronting construction in the next century. Far from being an abstract concept, environmental issues are, and will continue to be, driven by legislation, Client and public demand and commercial benefits. Environmental issues already pervade every aspect of construction, only they often fail to be recognised as such. Consequently the term "environmental issues" conjures up a picture of highly specialised and technical knowledge, the domain of the mysterious "Environmental Consultant"

It is true, there are aspects of environmental concern which are and will always be outside and beyond the scope of practice for the typical construction professional. It is the intention of this paper to demonstrate, however, that many environmental matters are well within the existing brief of construction designers and builders, if not already established considerations for them. This is achieved by examining the decision making process required to deal with those issues which have environmental consequences and who, within the design and construction team, would be involved in that process.

The work described here has its origins in funded research undertaken as part of the RICS Environmental Research Programme (Pasquire, 1996) and is ongoing within the Department of Civil and Building Engineering at Loughborough University.

ENVIRONMENTAL ISSUES IN CONSTRUCTION

CIRIA (1993) have published a detailed and comprehensive classification of the environmental issues in construction. This work has been briefly summarised as :-

- Energy Use, Global Warming and Climatic Change : This revolves around the "greenhouse" effect and the need to reduce the emission of greenhouse gases into the atmosphere. In construction, these arise from the generation of energy for use in the manufacture of products and materials, during construction and during the use of the occupied building. They are also released during the chemical processes used for the manufacture of materials and products. The natural balance of the Earth's atmosphere has also been disrupted by deforestation, the construction industry being a substantial consumer of timber and paper products.

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- Resources, Waste and Recycling : This issue can be considered as a resource cycle. Vast quantities of natural resources are used in construction of buildings, roads and infrastructure, but their eventual demolition or redevelopment can produce waste which can be recycled on other projects. Unfortunately, the fragmented nature of construction development means that the practical extent of recycling is constrained. The issue of resource sustainability is of utmost importance; for example, the use of tropical timber, a potentially sustainable resource, is exploited in some parts of the world in an unreplenishable way. Recycling can be a cost effective option and according to CIRIA (1993) there is considerable potential within the construction sector for recycling and the reduction of over consumption of construction resources by a variety of means.

- Pollution and Hazardous Substances : Broadly speaking, pollution from the construction industry can be considered in four categories :-

  - atmospheric pollution caused by dust from demolition and the movements of vehicles, burning of waste releasing toxic gases and solvent releases from paint, strippers, degreasers etc.

  - water pollution caused by spillage or silt run-off as a result of earthworks.

  - noise and vibration pollution caused by the construction process itself and in particular piling, demolition, ground consolidation, blasting and the use of heavy plant and equipment. This type of pollution can lead to damage to buildings and sensitive equipment e.g. computers.

  - construction materials may themselves be hazardous; the hazard may also be caused by the process of installation, when the material s areworked, when they decay and when they are disposed of. The largest area of concern is currently land contaminated by hazardous materials left behind from industrial developments. Land may also be contaminated by naturally occurring geological phenomena and historic mining activity.

- Internal Environment : This includes such issues as Sick Building Syndrome (SBS), Legionella and radon gas, all of which place restraints upon the design and construction of buildings

- Planning, Land Use and Conservation : A wide range of environmental issues exist in connection with the interaction of the land use planning system and the construction industry. The two principle issues are improving the management of the building process and enhancing communications between the general public and the parties responsible for the development. Construction activity and subsequent building/land use impact heavily upon transport movements. Specific areas of environmental concern cover the impact of mineral extraction and development projects, infrastructure issues concerning the location of waste disposal/treatment facilities, dereliction and contamination, and the designation of areas for nature conservation and specialised habitats.

Much research into the environmental issues in construction has been undertaken and reported upon. Some of the commentators include CIRIA (1987); DTI (1994); DOE (1990); and Bright (1991).

It can be seen that there is a vast array of environmental issues that confront the construction industry. It is clear that businesses will have to become more aware of these issues in local, national and indeed global terms. In order to respond and manage these issues, a variety of skills are and will be provided in the form of environmental services to deal with and minimise

the problem. It must be recognised too, that although the issues can be identified and classified separately, in reality they are all interdependent and can't be considered in isolation.

ENVIRONMENTAL LEGISLATION AFFECTING THE UK CONSTRUCTION INDUSTRY

The legislation concerning environmental issues is broad and varied and there is no single statute governing the environment as a whole. It must not be forgotten that more legislation is emanating from Europe and that ultimately there will be global laws and conventions. In the UK, a legal definition of "environment" has been given in the Environmental Protection Act 1990 as "The environment consists of all, or any, of the following media, namely, air, water and land; and the medium of air includes the air within buildings and the air within other natural or man-made structures above or below ground".

An Outline Of Current UK Legislation

The main UK Acts of Parliament were listed by CIRIA (1994) as :-

- Alkali Works etc. Regulation Act 1906
- Building Act 1984, Building (Scotland) Act 1970 & Building Regulation 1994
- Clean Air Act 1993
- Control of Pollution Act 1974
- Environmental Protection Act 1990
- Environment Act 1995
- Health and Safety at Work etc. Act 1974
- Occupier's Liability Acts 1957 & 1984
- Planning (Hazardous Substances) Act 1990
- Town and Country Planning Act 1990; (Scotland) 1972, Planning and Compensation Act 1991, Planning (Consequential Provisions) Act 1990
- Water Resources Act 1991
- Water Industry Act 1991

Of these the most significant are :-

- Environmental Protection Act 1990 : governs a wide range of potential polluting processes; controls the disposal of waste on land and has modernised the law of "statutory nuisances" creating a duty on local authorities to register contaminated land.

- Water Resources Act 1991 : lays out the statutory system for the management of pollution of inland and coastal water by the National Rivers Authority. It also controls discharges to surface waters by a system of consents. Discharge of trade effluent to sewers, however, is regulated under the Water Industry Act 1991, also by consents.

- Health and Safety at Work Act 1974 : imposes duty on the employer to provide a safe working environment. See also Control of Substances Hazardous to Health Regulations 1988 (COSHH) which aim to protect against health risk from exposure to hazardous substances at work, and Construction (Design and Management) Regulations 1995 (CDM) detailing responsibility for health and safety in the construction industry.

- The Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 : although not fundamentally an environmental statute, introduced the initiative of Environmental Impact Assessments. Allows local authorities to exercise indirect controls over development by establishing environmental factors as "material" planning

considerations. How the actual construction is carried out is the subject of the Building Act 1984 supplemented by the Building Regulations and Approved Documents. Although limited in the environmental field, these have tended to concentrate on energy conservation and the use of environmentally friendly building materials.

- Environment Act 1995 : Creates an Environmental Protection Agency and brings together the NRA, the Water Resources Act and HM. Inspectorate of Pollution. Introduces extensive provisions relating to contaminated land and coal mines and dealing with countryside policy, minerals legislation and waste management.

An Outline Of European Policies

EU legislation is enacted mainly by directives or regulations. Directives have no effect until the member state has passed the relevant implementing legislation. Regulations on the other hand, are laws in their own right and do not require implementing legislation. They are effective immediately. On the whole, most environmental legislation is considered by directive e.g. landfill with waste, tax on CO_2 emissions, energy efficiency and the promotion of renewable energy and the green paper Remedying Environmental Damage 1993. Regulations have been used very sparingly with an exception in the phasing out of the use of CFC's. There is no institution which enforces EU environmental legislation. The only remedy is to take the Government of the member state to the European Court, if regulations are not implemented within an appropriate time scale or in a proper manner.

BS7750 Environmental Management

Although not legislative, this was developed by BSI as a shadow to the EU draft Eco-audit Regulations. It aims to protect the environment through a quality management approach and can be interpreted as a sort of "green badge" of acceptability for companies awarded the standard. The purpose of adopting an Environmental Management System (EMS) can include cost reduction, image enhancement, customer/client demand, investor's demand and insurance.

It can be seen that there is a fairly bewildering array of environmental legislation and regulation which affects the construction industry both directly and indirectly.

ENVIRONMENTAL SERVICES AND THEIR PROVISION TO THE CONSTRUCTION INDUSTRY

Undoubtedly, there is a fast growing band of specialised Environmental Consultants offering services to the construction industry. Some of the most common services were identified by Pasquire (1996) and are briefly outlined below :-

- Corporate Environmental Strategy : the definition of environmental objectives of a company for its employees, clients, shareholders and the public in the format of a comprehensive environmental policy.

- Environmental Auditing : a systematic, documented, periodic check on the environmental performance of an organisation, its management and equipment. It facilitates management control of environmental practices and evaluating compliance with policies or good practice guidance or legislation. See Wood (1993) and Town & Country Planning Regulations 1988.

- Environmental Impact Assessments : these were introduced into British law in 1988 as the result of an EU directive (RICS, 1993). It is a procedure whereby the likely effects on the wider environment, of proposed developments are contemplated as part of the planning and

design phases. Consideration may be extended through the construction phase and into the completed project phase, then represented by means of an environmental statement.

- Water Pollution : this is a highly complex area involving the assessment of the effects of developments on the aquatic environment in and around sites in a wide range of geological strata, during such operations as mineral extraction, landfill and the development of ground water supplies. In addition, the quality of the water maintained within the building should be monitored and consideration given to the disposal of aqueous waste, principally the characterisation of effluent and its treatment.

- Waste Management : becoming increasingly important and revolving around waste minimisation. On-site waste management comprises source reduction, re-use, recycling treatment and disposal. Primary methods of waste disposal in the UK are currently landfill. incineration and treatment.

- Contaminated Land : the investigation into contaminated land involves an examination of all matters relating to health and safety, pollution control, land drainage, compliance with legislation, environmental monitoring, geotechnical engineering, re-vegetation and re-development. Once the contamination problems are identified, alternative clean up technologies can be explored and a solution designed. This exploration process will include assessments of effectiveness and cost. See Hawkins (1993) and Baker (1993).

- Ecological and Land Management Surveys and Evaluations : assess the impact of proposed developments and include land use surveys, landscape design, visual amenity, impact prediction, migration measures, advice on both restoration and cost effectiveness after use.

It would appear that the type of services currently being offered centre on a very wide range of highly specialised and technical skills, and cover both the actual construction and use of a structure and the management of the organisations involved. What has been described so far bears little relationship to the day to day construction procurement processes we are so familiar with. This is probably because the issue of The Environment is largely defined and serviced by non-construction related parties and few construction professionals are contributing to or influencing the direction of environmental research. However, closer examination reveals that some construction professionals have been heavily involved in environmental issues for some time.

ENVIRONMENTAL ISSUES FOR CONSTRUCTION PROFESSIONALS

A classification of environmental issues with a more meaningful structure reveals the areas where construction professionals can and do make a significant contribution. There are three main categories for consideration :-

1. The overall effect the change of land use has on the immediate and surrounding environment - for example the loss of amenity, diversion of water course;
2. The consequences of the construction methods and materials used, both locally and in the latter case, globally - for example disposal of construction waste or use of timber from sustainable sources; and
3. The continuing environmental impact of the use of the structure after construction - for example energy efficiency, process effluent and emissions.

There will be overlaps in the type of problem e.g. noise may be produced during construction as well as by the use of the structure, but the impact of the problem will differ - noise from the construction process is temporary and will be different from noise produced by the operational

structure. These differences give rise to and are reflected within the definition of the categories. Therefore it is much more effective to consider the issues within a framework defined in this way than to try to tackle the whole problem of say, noise, at once as illustrated by the CIRIA definition.

Change of Land Use

It is under this category that most of the highly specialised services offered by Environmental Consultancies would be used. However, there are aspects that would fall into the remit of the design team. Some examples from the UK include :-

- Consideration of Previous Land Use : brown field sites will have had a previous use and this may have left anything from toxic contamination to derelict structures. Appropriate advice should be given regarding the commissioning of specialist site investigations and the selection of a procurement route that adequately recognises the risks involved. The deeper implications of alternative measures to remedy contamination should be anticipated, for example the additional costs associated with disposal due to Land Fill Tax.

- Existing Planning Designation : all land in England has an official designation, all developments need planning permission. Even where the proposed development fulfils the need allocated by the Local Plan, appeals and protests are becoming more widespread. The design team should be able to anticipate the likely level of appeal and advise the Client accordingly. The effect of these may vary from a delay in receiving planning permission to severe disruption caused by Environmental Protesters. It can probably be said that almost any greenfield development in the UK will be subjected to some sort of delay on environmental grounds. This can be guaranteed if the development uses land with rare habitats, outstanding natural beauty or has trees on it.

- Conservation : delays and disruptions can be mitigated by incorporating conserving solutions into the project design, be it for example, by preserving ancient trees or building safeguards for badgers. These initiatives bring widespread publicity that can only enhance a Client's image and can be a positive force if harnessed at the outset of a project.

- Commissioning of Appropriate Environmental Services : as the legislative obligations increase, the project leader needs to be able to select and procure the relevant environmental services. The project leader must therefore be familiar with the legal requirements. In some cases this is straight forward, the need for an Environmental Impact Assessment (EIA) is dictated by the type of development and these are clearly classified within the statute. The EIA should consider all the broader environmental issues of the land use.

Not all countries have such stringent planning and environmental laws as the UK (though some have more) but the issues raised here must be a consideration for developers world-wide. In most cases economic need has to be balanced with environmental protection. The influence of the environmental lobby is growing rapidly and their protest expertise is influencing national actions. The disruption and consequent cost of environmental protest is growing to such an extent that developers world-wide are altering or even abandoning their plans (BBC, 1997). The problem must not be underestimated.

Construction Method and Materials

Again, many of the broader issues resulting from the construction method should be investigated during the EIA, for example, the identification of sensitive areas surrounding the site and measures required to protect them. A large number of more specific issues such as noise levels, access, supply and removal of temporary and waste water etc. will be governed

by statute, local bylaws and consents. The scope and content of this legislation should be well known by all parties to the contract and may form part of an EIA. The contract documentation provides the vehicle for dealing with these issues. But there are a growing number of environmental matters which are well within the remit of the parties to the contract that are not subject to legislation but are influenced by commercial factors (Anon, 1997). These matters often involve both the construction method and the materials used. Some of the major issues include :-

- Use of Alternative Methods : most scope is offered in the Groundworks, especially for filling and stabilising the site e.g. mass imported fill, piles, lime stabilisation techniques each of which have varying additional impacts such as the extent of quarrying, the amount of road transport needed from supply to site to tip, the disruption to the site itself, to name some. Each of these have varying environmental impact and commercial benefit.

- Excavation & Filling Materials : the disposal/supply of material is subject to greater commercial incentive, or in the case of Land Fill Tax (UK), disincentive. Cost studies can reveal positive cash benefits in recycling, using materials from alternative sources e.g. borrow pits, using more spoil in permanent landscaping. All of these have varying environmental benefits, not least the reduction of the need for transportation and consequently emissions, and reducing the demand for non-renewable resources such as aggregates.

- Super-Structure Materials : all structural materials used in construction today have an environmental price tag. Concrete, stone, brick/block, steel/metal and U/PVC all originate from non-renewable finite resources. The major differences in the environmental cost will be in the amounts of energy required to extract and manufacture the individual materials and components and, again the distances and methods of transporting them. Consideration can also be given here to the amounts of energy required to incorporate the materials into the structure.

- Fixtures, Fittings and Finishes : the widest scope for choosing environmentally friendly and commercially sound materials exists within this element of building work. The farming of timber as a replenishable resource is becoming more common place, although it will be a long time before the slow growing tropical hardwoods fall into this category. Indigenous fruitwood is a very environmentally friendly option as orchards are periodically cleared to maintain the vigour of the crop and the resultant wood is a waste product. Timber is widely used in buildings, from wall paper, through flooring to formwork. It takes little effort to ensure that all timber and timber products are specified from replenishable sources, as Tarmac have demonstrated (Anon, 1997). Floor and wall coverings such as vinyl, PVC, nylon etc. are all oil based products and are therefore neither a sustainable resource nor environmentally friendly. Yet there are many natural fibres that can perform equally well as floor and wall coverings e.g. wool, cotton, linen, flax, hessian etc. although the environmental benefit may be reduced by certain dyeing, colouring or treatments of the fabric.

- Durability of components : a fundamental principle of environmentalism is the reduction of waste. One of the ways this manifests itself in construction is through more durable components and/or components that can lend themselves to re-cycling. One interesting feature noted during the research was the growing market in recycling stripped out materials to the extent of pre-selling items for recycling at the end of a pre-determined life span.

In most projects, the contractor is responsible for the choice of construction method. This research showed that whilst contractors are certainly motivated by legislation and commercial

consideration, many of the largest organisations also wished to be seen to be "green". This desire came about from pressure of both public and staff opinion and to appeal to Client organisations many of whom were also found to desire a "green" image. The specification of materials and components is the responsibility of the designer (Client and/or Contractor). The influence consumers can have over the supply of products is illustrated by the dramatic change in grocery goods over the last 10 years, for example, free range eggs, organic produce etc. Construction consumers (specifiers) could have the same influence over their manufacturers and suppliers, and far from being an "extra service" for no fee - environmentally aware specification is just keeping up to date with current product information and/or asking a few pertinent questions about an item's origin and manufacture.

Use of the Structure

Certain aspects of the use of the structure will be investigated by the EIA such as traffic flows, emissions and effluent, noise and it will also recommend mitigating actions to help reduce or overcome any problems identified. However, errors and omissions do occur; for example, a waste incineration plant was originally design to discharge cooling water directly into the river. Part way through construction, it was discovered that the waste water temperature was too high to be discharged directly and expensive redesigning was needed to overcome the situation. The designers will often know more about the operation of a structure than the environmental consultants and there are therefore, opportunities for the designers to become more involved in this part of an EIA

Two major environmental considerations in the use of structures which fall within the remit of the design team are the health and safety of the users and its energy efficiency.

- Health and Safety : this concerns the health and safety of the end users of the building. Some of the environmental issues concerning users include items that can be brought on when using the building such as Legionnella, Sick Building Syndrome, hazardous processes etc.; or external factors that need to be controlled such as radon, methane etc.

- Energy Efficiency : most energy produced in the UK comes from a finite source e.g. oil or gas, whilst nuclear power although more infinite, undoubtedly has environmental problems (although not fully exposed). The conversion of the fuels into power or heat (be it at the power station or within the HVAC systems of the building itself) releases harmful gases into the atmosphere. These are thought to contribute to the so-called greenhouse effect. Therefore, the more energy efficient a structure is the more environmentally friendly it is. It might be envisaged in the future that energy greedy structures will be penalised in some way - either through higher energy charges or by fines for heat loss measured by infrared photography.

  Energy efficiency is achieved in two ways. Firstly through the design of the structure and fabric and secondly through the sophistication of the services systems themselves. Although the main benefits are achieved through advanced HVAC design, improvements in lighting systems can also be made. Just the installation of long life, low energy lamps not only reduce energy consumption, but have significant indirect cost benefits to the building user by lasting longer, as the greatest cost is often the labour involved in changing lamps rather than the lamps themselves.

DECISION PROCESS

There is little formally structured information about the procedures associated with the inclusion of environmental issues in the construction procurement process. A comprehensive survey by CIRIA (1994), who have undertaken considerable research work in this field, also failed to identify such published data. Clearly there is a need for the development of specific procedural information.

The research undertaken so far at Loughborough, has identified a broad allocation of decision making responsibility to various construction professionals. This shows the relationship of environmental issues to the pre-design, design and construction phases of a project irrespective of the form of contract to be used.. More importantly, the outline of which team member should have the decision making responsibility for particular environmental issues shows how interwoven the environment and procurement are.

It is intended that a strategy could be developed to reflect the eventual form of procurement for the construction work itself. In order to facilitate this from an early stage, the person/s most closely involved with the decision making process was not allocated to any particular party to the contract but referred to by function. The functions incorporated are :-

Project Leader - person assuming the responsibility for the overall decision making process. (The project leader might be an Architect, Project Manager, Client or Developer.)
Designer - anyone with design responsibility
Constructor - anyone undertaking construction activities, may include suppliers
Environmental and Specialist Consultants - not part of the construction team but commissioned to undertake certain specific tasks during the procurement process.

It is anticipated that the final version of the procurement strategy will identify roles for other construction professionals such as cost manager (QS), and will track the fine variances in procedure that the construction procurement method will instil. The prototype model of the allocation of decision making is shown at Figure 1 below:-

It can be seen from this figure that much of what is required to produce an environmentally friendly construction industry involves the extension of existing tasks to consider environmental implications. The roles of the environmental and specialist consultants are an integral part of the procurement process although they are not practising construction professionals.

The techniques used for this extension of knowledge will include value engineering, risk analysis, life cycle costing and generally keeping up to date with legislation and new products and technology.

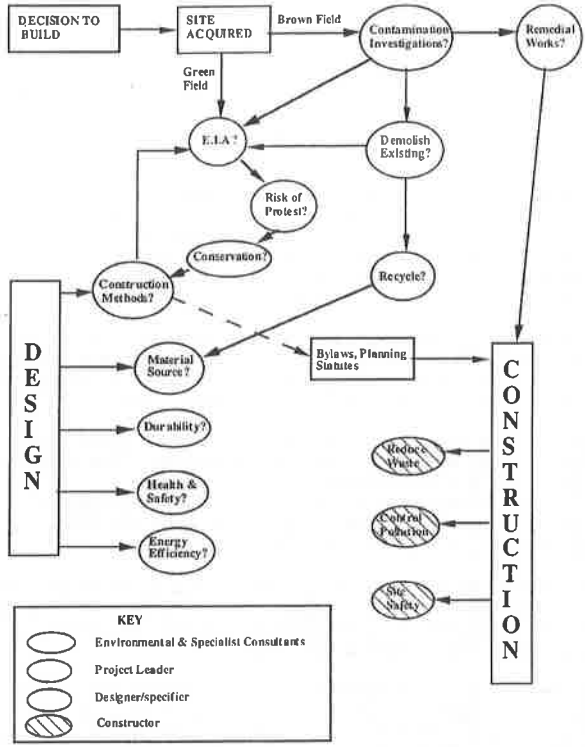

Figure 1. Allocation of Decision Making

CONCLUSIONS

The research undertaken so far, clearly identified three major shortfalls in the consideration of environmental issues :-

- Environmental decisions are already made by construction professionals as part of construction procurement; the issues are not, however, clearly identified;
- There is a distinct lack of quantitative and qualitative data available to assist the decision making process; and
- No apparent formalisation of the procedures and strategies required to ensure full consideration of the relevant environmental issues has been undertaken.

The main conclusion of this work is, despite the existing shortfalls in available data and standard procedures, construction professionals have a major role to play in environmental issues within construction. More research is needed to identify the issues more clearly, provide qualitative and quantitative data and develop formal procedures for the procurement and management of environmental issues in construction.

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DESIGN-BUILD METHODS IN FINLAND

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Abstract

In Finland many efforts have been initiated to develop tools for building and facility owners to employ more efficiently the technical and financial expertise as well as the innovativeness of the building industry. Especially efforts have been made on developing the competitive tendering and procurement methods as the means of improving the productivity both in the domestic and the export markets.

In this study, the aim is to help building owners to employ the design-build methods in the best way to serve the owner-specific purposes. There are three different design-build methods and their differences originate from the aims set out in the procurement process: to arrange competition with the emphasis on the lowest price, the greatest value for money, or the highest quality.

The first quality-oriented method is considered the most beneficial one in Finland. The target price is already fixed in the invitation to tender and the evaluation is based only on the quality of the tenderer's design solution.When the tender with the greatest value for money wins, the design-build method is more difficult because the selection must be judged on both the price and quality of the design solution typically according to principles of value analysis. In price-competition, the lowest tender which meets the quality requirements will be chosen.

The prevailing problem is to develop tendering documents that are appropriate and easy to use in many kinds of building projects and by a variety of building owners. One solution is to model tendering documents which consist of three parts. The competition program will vary in accordance with the specific aim of the design-build approach and the conditions of contract are specified by each building owner, and design instructions are prepared separately for each project. However, the structure and logical contents of each document will always remain the same.

INTRODUCTION

In Finland, the Confederation of Finnish Construction Industries and the Technology Development Centre TEKES are organising and financing a three-year "Construction procurement and delivery" technology programme (1995-1998) which consists of several

studies carried out in various research organisations, with the participation of corporate representatives like owners, consultants and contractors.

One project in this research program is to develop, as largely as possible, accepted rules for different design-build methods common in Finland. The study is implemented at the Institute of Construction Economics and Management in the Helsinki University of Technology and this paper presents the theory which is the basis for the specialists' team work.

The main reasons for the willingness to achieve general rules for design-build methods are on the one hand the fact that there is a useful range of proper design-build procedures which should be used more often, (there has been promising experience on several domestic design-build projects) and on the other hand, when used inappropriately as used to be the case, the design-build methods gained a bad reputation. The customer-orientation was forgotten and the responsibility of fulfilling the functional requirements caused a lot of disputes.(KVR-kehitystyöryhmä, 1973)

In brief, the basis for this research study has been to take advantage of all the design-build methods used in Finland and try to avoid the mistakes made in the past. The best way of accomplishing this objective is evidently to produce generally accepted impartial standards for organising the design-build competition, which are also suitable, with minor modifications, for negotiation.

DESIGN-BUILD METHODS IN FINLAND

The identified design-build methods have been classified into three categories (Fig. 1). When the objective is to choose the best design solution, the price must be fixed and attention paid only to the quality. If price competition is also included, the owner wants the greatest value for money. When only price competition is needed, the quality requirements are in that case fixed.

DESIGN-BUILD METHODS: competition for		
METHOD 1 highest quality	METHOD 2 greatest value for money	METHOD 3 price
fixed price		fixed quality requirements

Figure 1. Three differently aimed design-build methods in Finland

In figure 2 the winning tender in response to differently aimed design-build competitions is analysed with the help of quality-price co-ordinates, (the prices and quality values are arbitrary with no connection to any actual project). The assumption behind this theory is that when the

budget is too limited, the design quality is poor but when the budget is realistic or the financial resources are even abundant, there is no longer any correlation between price and quality (Haahtela and Kiiras, 1996) In general, there is an unlimited range of different design solutions with various prices for any project.

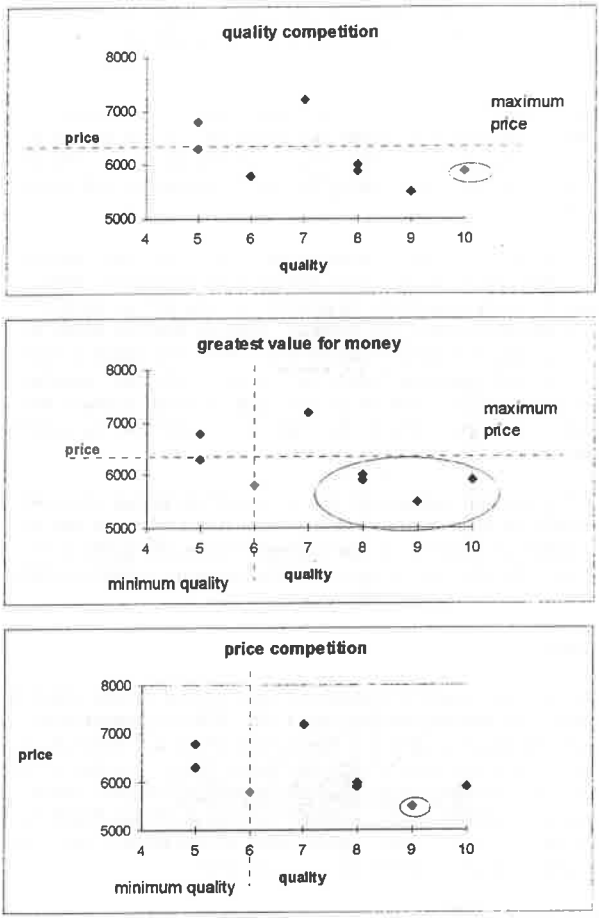

Figure 2. The winning tender in differently aimed design-build competitions. In the greatest value for money method the solution depends on the weights set in the value analysis model.

In the quality competition, a few characteristics of an architectural competition are added to the design-build approach. The evaluation of the tenders is based on subjective criteria, and the dialogue technique typical for architectural competitions is used to determine the winner. That is why the quality-oriented competition is recommended when the project characteristics are interesting enough from the architect's point of view. For example, several public buildings, headquarters offices and special housing projects could be appropriate for this approach.

On the other hand the requirements should not be too demanding concerning the architectural quality. Because the owner has less power to manage the design, the risk that none of the design solutions answers the client's needs exists. Also developing the design solution afterwards is more difficult when it has been a part of the tender. Instead, an architectural competition can be more useful.

The target price must be fixed in the invitation to tender because quality and price cannot be evaluated in the same category without value analysis.(Design-Build Institute of America, 1995) In the greatest value for money competition, the principles of value analysis are used in the evaluation. Because in this case the parts are examined separately from the whole, the result of the competition can easily be arbitrary.(Flanagan *et al.*, 1989) This aspect is easily almost overlooked by accident especially when the question concerns complex, multidimensional decision-making.(Rinne, 1989) The greatest value for money method is thus suitable for projects with few subjective aims so the result of the value analysis can be anticipated with sufficient precision.

The price competition is clear and does not need any jury to evaluate the tenders. An expert can check which tenders fulfil the requirements set in the invitation to tender, and then the lowest price wins. This method of course is the most appropriate when the quality level is simple to determine, for example when the objective is a warehouse or a small industrial facility, where it is of no use to compete on the quality level.

Cost engineering in Finland

In Finland highly sophisticated cost engineering methods are widely applied and that makes it easier to employ the design-build methods.(Haahtela and Kiiras, 1996) The target price is calculated in the programming phase on the basis of a room program and room-specific requirements. The costs are then continuously calculated and checked from the design documents available. The cost of the design is analysed with its elemental estimate, meaning that the needed building parts, modules and supplies are measured from the design documents. The cost data for this database is collected from projects carried out the previous year. The database is updated each year, so the prices are the average of real prices.

Consequently, the fixed target price in the quality competition can be defined realistically, the value analysis model can be done with the help of exact cost data, and the price level based solely on price competition can be estimated systematically.

Design-build document models

In this study, the intention is to develop suitable document models for all of the three types of design-build formats. The owner can employ them as the basis for preparing tendering documents when organising a design-build competition or negotiation. The needed document models are the competition programs describing the aim of the design-build method, the conditions of contract consisting of the owner-specific terms for the contract, and a system to give the necessary design instructions (Fig. 3). One possible way of presenting the detailed information in these documents is introduced in the reference "Tendering documents for the design-and-construct competition" (Pernu, 1996)

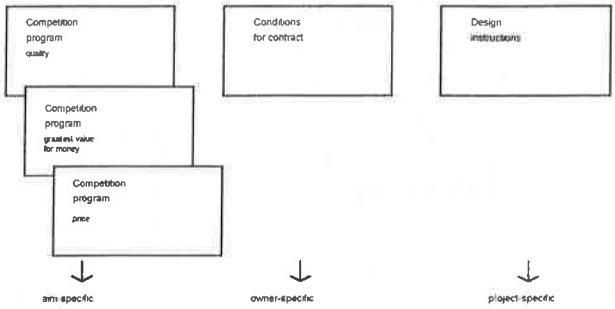

Figure 3. Model tendering document for design-build methods in Finland.

PHASES OF THE DIFFERENT DESIGN-BUILD METHODS IN FINLAND

Quality competition (method 1)

The quality competition actually starts when the owner nominates the jury (Table 1). The evaluators must be highly qualified and represent the needed expertise, depending on the aims described in accordance with the evaluation criteria. In Finland, with 5 million inhabitants, it is usual that only the names of the jury members (instead of accurate curriculum vitaes) are make known for the design-build candidates. The evaluation criteria are presented in the competition program which both the owner and the jury agree to obey. The preselection of the design-build teams is most important because the tenderers must have the necessary technical and financial power to carry out the building project. In order to prepare the tender, the design-build team typically consist of a contractor, an architect and structural and HVAC engineers.

When the competitors have been chosen, the invitation to tender is finished and sent to the design-build teams. In Finland, it has been a custom to inform the competitors about the competition situation which means that everyone knows who is participating. The purpose has been to encourage the design-build teams to focus their effort on tendering.

Table 1. Phases of the quality (method 1), the greatest value for money (method 2), and the price (method 3) design-build competitions.

	QUALITY (METHOD 1)	GREATEST VALUE FOR MONEY (METHOD 2)	PRICE (METHOD 3)
1.	NOMINATING THE JURY	NOMINATING THE JURY	
2.	PREPARING THE EVALUATION CRITERIA	PREPARING THE VALUE ANALYSIS METHOD	SETTING THE QUALITY REQUIREMENTS
3.	ACCEPTING THE COMPETITION PROGRAM	ACCEPTING THE COMPETITION PROGRAM	
4.	PRE-SELECTION OF THE TENDERERS	PRE-SELECTION OF THE TENDERERS	
5.	PREPARING THE INVITATION TO TENDER	PREPARING THE INVITATION TO TENDER	PREPARING THE INVITATION TO TENDER
6.	COMPETITIVE TENDERING	COMPETITIVE TENDERING	COMPETITIVE TENDERING
7.	TENDER EVALUATION	TENDER COMPARISON	ACCEPTING THE LOWEST TENDER
8.	PUBLISHING THE COMPETITION RESULT		
9.	PAYING COMPENSATION FOR TENDERERS		
10.	PREPARING THE CONTRACT	PREPARING THE CONTRACT	PREPARING THE TENDER
11.	CONSTRUCTION	CONSTRUCTION	CONSTRUCTION

The main reason to use a design-build method has been to obtain alternative design solutions from which to choose. So the time allowed to make the competitive design solution has been defined from the designer's point of view. The evaluation of the tenders is based only on subjective criteria. The minutes of the jury's evaluation are published together with the result of the competition. Openness is necessary to avoid the suspicion of collusion.

The compensation received for bid expenses (method 1) proves the owner's serious intention to enter into a contract. There are usually negotiations to develop the winning design solution before the contract is signed, where the purpose is not to change the contents of the tender without paying. The construction work begins when all the needed permits are ready.

Competition on the greatest value for money (method 2)

The phases of the quality and the value for money design-build only differ after the tender evaluation. The objective and subjective evaluation criteria are mixed together so

the jury must quantify the subjective criteria and, according to the evaluation model, the result is calculated with the help of the weights concerning the subjective values and price or other objective criteria such as life cycle costs. It is not so important to publish the jury's work or pay part of the bid expenses because the architectural competition does not have so much significance here.

The price-orientation (method 3)

This is the simplest design-build method to evaluate if only the comparison of tender price is considered. After the owner has been able to define his needs, the lowest tender wins on the condition that the demanded quality and functional requirements are fulfilled. The jury becomes unnecessary.

THE CONTENTS OF THE DIFFERENT DESIGN-BUILD TENDERING DOCUMENTS

The result of this preliminary study is presented in the form of suggested contents for Finnish design-build tendering documents. The research work, from now on, continues as team work, bringing together the members representing Finnish contractors, owners and designers.

Competition programs

The suggested contents of competition programs for the quality (method 1), the greatest value for money (method 2), and the price (method 3) competition are presented in table 2.

Conditions of contract

The conditions of contract supplements the Finnish General Contract Conditions (General Contract Conditions YSE 1983, 1983). Since those general conditions are initially meant to be used with a main contract, the special design-build-conditions, mainly due to the fact that design is a part of the contract, must be included.(Table 3) The objective of the competitive tendering does not have any effect on the contents of this design-build document.

Design instructions

The idea has been to show logical common contents for design instructions with documents prepared for two or three real projects. The possible headings are shown in Table 4. The customer-oriented basis for these instructions will be the rooms in the needed facilities. The room programs are complemented with the room-specific requirements concerning surfaces, fixtures, technical conditions such as temperature, lightning etc.(Pernu, 1996) In this manner, the scope of the design instructions, for example in regard to the ventilation system, will be compact and easily understandable.

Table 2. Headlines on the design-build model competition programs.

	QUALITY (METHOD 1)	GREATEST VALUE FOR MONEY (METHOD 2)	PRICE (METHOD 3)
1.	QUALITY COMPETITION	GREATEST VALUE FOR MONEY	PRICE COMPETITION
1.1	THE ORGANISER AND THE COMPETITION AIM	THE ORGANISER AND THE COMPETITION AIM	THE ORGANISER AND THE COMPETITION AIM
1.2	CONTENTS AND DESIGN-BUILD TEAMS	CONTENTS AND DESIGN-BUILD TEAMS	CONTENTS AND DESIGN-BUILD TEAMS
1.3	FIXED TARGET PRICE		
1.4	REMUNERATION FOR PREPARING THE TENDER		
2.	EVALUATION OF TENDERS	COMPARISON OF TENDERS	CHECKING TENDERS
2.1	JURY	JURY	ACCEPTANCE OF THE TENDERS
2.2	EVALUATION CRITERIA	VALUE ANALYSIS MODEL	
3.	TENDERING DOCUMENTS	TENDERING DOCUMENTS	TENDERING DOCUMENTS
4.	TENDER	TENDER	TENDER
4.1	TENDER AND DESIGN DOCUMENTS	TENDER AND DESIGN DOCUMENTS	TENDER AND DESIGN DOCUMENTS
4.2	QUESTION MAKING	QUESTION MAKING	QUESTION MAKING
4.3	TENDER DELIVERY	TENDER DELIVERY	TENDER DELIVERY
4.4	VALIDITY PERIOD	VALIDITY PERIOD	VALIDITY PERIOD
4.5	PROPRIETARY OF DESIGN DOCUMENTS	PROPRIETARY OF DESIGN DOCUMENTS	PROPRIETARY OF DESIGN DOCUMENTS
5.	CONTRACT PREPARATION	CONTRACT PREPARATION	CONTRACT PREPARATION

Table 3. Contents of the design-build model conditions of contract. General conditions with some adjustments will also be followed.

1.	THE EMPLOYER
1.1	THE PROJECT
2.	THE DESIGN-BUILD CONTRACT
2.2	SCOPE OF WORKS (design, construction, guarantees, warranties, insurances)
2.3	CONTRACT PRICE
2.4	PAYMENT
3.	CONTRACT DOCUMENTS IN THE ORDER OF PRIORITY
4.	DESIGN-BUILD PERIOD
5.	DESIGN-BUILD CONTRACTOR'S PERMITS AND APPROVALS
6.	EMPLOYER'S SUPERVISION
6.1	INSPECTIONS FOR DESIGN
6.2	INSPECTIONS FOR EXECUTION OF WORKS
6.3	INSPECTIONS BY AUTHORITIES
6.4	ACCEPTANCE OF SUPPLIES AND MODULES
7.	ADMINISTRATION AND ORGANISATION AT THE SITE
7.1	DESIGN-BUILD CONTRACTOR'S REPRESENTATIVES
7.2	SITE MEETINGS
7.3	SITE DIARY
8.	FINAL INSPECTION
8.1	TESTS
8.2	INSTRUCTIONS FOR MAINTENANCE STAFF
8.3	FINAL DRAWINGS
9.	ARBITRATION

Table 4. Contents of the model design instructions document.

1.	CONSTRUCTION AREA
1.1	Situation at the site
1.2	Information on connections of public systems
2.	INFORMATION OF THE CITY PLAN
2.1	Principles guiding the design
3.	VISUAL AND LAYOUT REQUIREMENTS
4.	FUNCTIONAL REQUIREMENTS
5.	ROOM PROGRAMS WITH ROOM-SPECIFIC REQUIREMENTS
6.	REQUIREMENTS CONCERNING TECHNICAL SYSTEMS
7.	OUTLINE DESIGN

DISCUSSION

In Finland, the design-build method is gaining more popularity partly due to pressure on public sector owners to improve their competitive tendering. This is one reason for developing equitable rules for design-build competitions applicable also for negotiation.

The other reason is that the design-build approach has been found suitable for many different types of projects. One case in point is a quite complex project where the HVAC works are requested by the design-build method. The HVAC-technical life cycle cost has the highest priority in the decision-making criteria, yet it was defined as one of the subjective criteria. The value analysis will not be used, since the jury wished to retain all the decision-making power. Another example is a timber-framed concert hall in Lahti in which the architectural competition, open to all interested, is combined with the design-build quality competition.

As part of the "Construction procurement and delivery" research program, a pilot-project is starting in which a new competitive tendering model will be developed. The model has both characteristics of the design-build approach as well as the traditional procurement. The client is responsible for the architectural design but the competitors can choose whichever technical solutions they regard to be most successful. The solutions offered must satisfy the client's requirements as noted in the invitation to tender. The question regards competition on price.

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MANAGING CULTURAL DIFFERENCES: THE CASE OF A CROSS-ATLANTIC CONSTRUCTION ALLIANCE

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Abstract

Long-term alliances between general contractors are a viable tool for entering international markets and expanding the scope of services offered to clients. Contrary to conventional wisdom, this opportunity is not limited to large firms, as it is demonstrated by the experience of an on-going alliance between an Italian and a U.S. medium-sized contractor. The paper illustrates the challenges of developing and maintaining this form of collaboration and the type of managerial efforts and resources that are required in such a cross-cultural undertaking. Understanding of corporate and national cultures, continuous upper management commitment and communication, championship and trust are major success factors.

International construction; strategic alliances; alliance development criteria; joint projects; cultural differences.

INTRODUCTION

The market for construction related services has been changing significantly in recent years, particularly in highly developed countries. Shrinking domestic markets, fierce competition, demands for proactive and comprehensive services (from financing to operation) and value added contributions are inducing firms to adjust their operations and strategic orientations. The globalization of markets with multinational corporations shifting their operations close to local customers worldwide, the growing demand for infrastructure projects in less developed countries and the entrance of foreign competitors into local markets are other changes that present opportunities and threats to construction firms. Besides a restricted number of very large contractors, the majority of firms do not have the capability to provide diverse and integrated services nor the resources for going it alone internationally. Medium-sized firms, however, can form alliances for defensive purposes, expanding their services and entering foreign markets. Commitment to reciprocal assistance and cooperation, open communication and mutual understanding of its partner's intentions are typical features of an international alliance. Its successful development, however, depends on overcoming significant differences in terms of corporate and national cultures, business attitudes and work procedures, besides the inevitable language barriers.

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This paper describes the main features of an on-going alliance between an Italian and a US construction firm, in which the author acts as a consultant for both parties, discusses the critical steps and challenges for its successful development, and presents the lessons learned from this experience.

PURPOSE OF AN INTERNATIONAL ALLIANCE

An alliance is a long-term cooperative agreement between independent firms with the purpose of satisfying the mutual interests of involved parties (Badger et al., 1993). This type of venture allows for the achievement of partial or total integration along or across the various phases of a facility delivery cycle. The corporate operations of each partner are improved by sharing resources, technology, risks and rewards, and offering mutual assistance (Badger and Mulligan, 1995). The development of an alliance is a viable alternative to (i) opening a foreign branch, (ii) acquiring a local firm or (iii) developing a joint venture with a local firm in order to enter new geographic markets. The financial exposure and risks of the first two mechanisms should be considered (Schriener and Angelo, 1995; Moavenzadeh, 1991), while the short duration of a successful joint venture may not be sufficient for developing full local expertise or acquiring engineering or management know-how (Seymour, 1987). In its purest form, an alliance is a voluntary association, based on a non-equity agreement, in which partners maintain their own independence. In this regard its main feature is vulnerability (Hall, 1995),because there is always the option of withdrawing from the venture if its performance is unsatisfactory or its goals have been achieved. On paper, vulnerability should motivate partners to commit to the venture, particularly when the extent of reciprocal interorganizational dependence increases.

BACKGROUND OF THE ITALIAN AND US ALLIANCE

The alliance between the two contracting firms is currently in its sixth year. The Italian partner is a medium-sized firm that operates throughout the national territory and in Europe, particularly in France and Germany. The operations of the equally-sized American partner are presently concentrated in the New England, Chicago and Atlanta areas. The core business of both firms is building construction and renovation. The Italian firm focuses on services, such as design/build projects, that enhance its in-house design/engineering capabilities. The American partner is a process management-oriented firm whose capabilities are eminently suited to projects of a complex nature and multi-phased delivery. Its reputation builds upon a twenty-year cooperation with a sister real estate company by being involved in all phases of a project delivery process, from planning to operation. The alliance was initiated through the academic contacts of their presidents, both involved in university teaching, and it was induced by the contingent business situations of the two firms, as will be explained later. The venture has the purpose of enhancing the competitiveness of the firms by expanding their marketing, project organization and execution capabilities. These enhanced capabilities allow the firms to service clients that otherwise would be impossible alone. In the Italian market, for example, there is a growing demand for projects with financial engineering requirements, a capability that endows the US firm. American corporations operating in Europe can be serviced by the Italian firm, following the lead and planning activities of its US partner. The same approach

can be applied to European firms operating in the U.S.A. A project for an Italian furniture manufacturer, in this regard, is currently being undertaken by the US firm in North Carolina, in cooperation with the Italian partner. The cross-Atlantic alliance, in conclusion, improves the competitive position of the firms through their expanded scope of services and easy access to foreign markets.

DEVELOPMENT OF THE ALLIANCE

In retrospect the alliance did not evolve and progress in a systematic way. As in any successful marriage, there have been ups and downs. Over the years, efforts to cooperate with or assist the partner were influenced by the continuous adjustments of the firms to the changes of their external environments. If we examine the historical pattern of activities and efforts, the following logical steps characterized the development of the alliance:

a) Define corporate objectives and needs
b) Find a compatible and complementary partner
c) Define common objectives
d) Understand and plan for cultural differences
e) Reach an agreement
f) Manage the on-going cooperation
g) Improve cooperation by learning from experience.

Define corporate objectives and needs

In the late eighties the Italian market for construction projects collapsed, following judicial enquiries about inefficiencies in public projects and the widespread use of bribes. In this context he sales of the European branches were not enough to offset the home overhead of the Italian firm. New foreign markets needed to be found. The Italian firm at the same time did not have planning, financial engineering and program management capabilities that were required by a new type of demand in the local market. As for the US firm, its traditional market of commercial projects had reached a halt because of overbuilding and the deep economic recession of the New England area. The American firm consequently was interested in entering new domestic and foreign markets through alliances in order to spread financial and technical risks.

Find a compatible and complementary partner

Both firms share a professional oriented attitude toward clients, with a record of quality projects, although they focus on different segments of the construction market. The strength of the Italian firm lies in its implementation capabilities, as demonstrated by a series of design/build projects, maintenance services of existing buildings and the in-house availability of construction workers, designers and technicians. The American firm's capabilities are best suited to projects characterized by a complex pre-construction phase that requires planning and coordination expertise. This capability has been honed over the years by working with a real estate company in the delivery of major commercial projects in Boston. The joint capabilities of the two firms, therefore, span the full cycle of the building process in which the American

and Italian firms can give a strong contribution to the services of the upstream and downstream phases respectively.

Define common objectives

As stated above, the intents of the alliance are to enhance the competitiveness and profitability of each firm in its own country and to expand business opportunities for both firms internationally. A set of common objectives whose achievement encompasses different time horizons and varying degrees of resource commitment, was identified, as follow:

- Reciprocal assistance in undertaking individual projects and marketing of products and services
- Servicing clients that operate internationally
- Exchange of know-how and improvement of organizational capabilities
- Developing joint self-promoted projects

To date the Italian firm has worked for American clients, following the lead of the partner in the U.S.A. Comparative purchasing advantage has allowed the firms to successfully bid for the Italian diplomatic mission in Washington. The American firm has assisted the Italian firm in planning self-promoted projects in exchange of a fee.

Understanding and planning for cultural differences

Any international alliance faces national and corporate cultural differences. In a typical US and Italian venture the following challenges should be considered:

National business cultures. The US business attitude generally is not prone to cooperation, given the fiercely competitive nature of local markets and the adversarial relationship among firms. Italian export-oriented firms are more inclined to cooperation, either through the joint ownership of subsidiaries or the formation of consortia for public projects. While an American executive may focus only on the financial and organizational data of a business deal, his/her Italian counterpart may privilege the development of personal understanding and relationships as a precondition of the deal. Alliances take a long time for their implementation and require patience and continuous commitment before tangible results could be obtained. US firms are generally characterized by short-term expectations, while Italian firms take a longer-term view of their investments and initiatives.

Corporate cultures. Many US firms restrict their overseas manager's decision-making authority, differently from their European counterparts. This factor may slow down joint decision making and increase coordination costs. If the corporate cultures of the allied firms are analyzed, it can be noted that the US firm's success is driven by the individual achievement of personnel, while the Italian firm emphasizes the personnel responsibilities toward overall organizational performance and effectiveness. The US firm's personnel, at least initially, was more inclined to pursue individual projects with short-term profit rather than invest in joint undertakings with long-term results such as the alliance presupposes. This

behavior reflects a US widespread culture that considers as overhead any undertaking without immediate tangible results.

Work procedures. Italian work relationships generally are based on relatively informal procedures. Contractual documentation, i.e., general conditions, plans and specifications, are not as developed as in the U.S.A. The roles of professional clients, designers and contractors build upon traditional practice, but they are not fully formalized. Verbal understanding and post-contractual negotiation supplement and sometimes circumvent the incompleteness of contractual documents. The US approach to business agreement, on the contrary, privileges extensive legal documentation, given the litigious nature of local society. The legalistic and formal approach acts as a barrier to forming alliances, because they build upon trust and mutual understanding. Italian clients, designers and firms need a significant realignment of work procedures and relationships if they want to succeed in the U.S.A. The use of the Italian informal approach to contract administration and definition of responsibilities would lead inevitably to legal and financial troubles in the US context. A US firm that wants to operate in Italy must learn to work in an environment where flexibility, negotiation and patience are more important than the blind application of contractual clauses.

Reach an agreement

Signed in January 1992, the agreement document falls between a memorandum of understanding and a formal contract commitment. The legal tone and constraints are minimized to facilitate future procedural flexibility and preserve the existing spirit of trust. Three attributes characterize the document:

- Partners exchange or provide resources on a continuing basis according to established criteria and costs.
- Responsibility for managing the venture is equally shared by the partners.
- The partners maintain their own independence by having many activities not included in the agreement.

Manage the on-going cooperation

The on-going project of the Italian diplomatic mission in the U.S.A. is performed by an integrated team under the direction of an American project executive. This type of structure facilitates reciprocal support in the case of a crisis and helps interaction among personnel. Semi-annual meetings with the participation of key executives are held for assessing the progress of the alliance. In the past both firms have assigned marketing personnel to explore and develop joint business opportunities. An outside consultant, with a good knowledge of both firms' operations and national cultures, participates in the management of the venture and joint project. The main tasks of this cultural mediator are to facilitate an atmosphere of cooperation, clarify positions and responsibility, and solve all the possible inefficiencies and misunderstandings that characterize an international undertaking.

Improve cooperation by learning from experience

Forming and maintaining an alliance is a learning experience. The following are some of the factors that, according to the experience of the author, strongly influenced the performance of the alliance.

Trust. An alliance builds upon an environment of trust that takes years to develop and is built with continuous personal interactions. In this regard the understanding of each partner's behavior and actions is more important than blind compliance with the agreement. Misinterpretation of behavior and actions can lead to wrong conclusions about partner intentions. A longtime taken in decision-making may be seen as a stalling tactic until one has understood the cultural origin of the situation. Each partner should recognize that the dynamics in the external environment change mutual needs and may lead one partner to move in a different strategic direction. "A relationship must be developed beyond the deal" (Hall, 1995). Such a relationship may be the only anchor that keeps the alliance afloat in tough times. Open communication, honesty and understanding the partner's cultural basis of his/her actions and behavior are the mechanisms for managing the vulnerability of an alliance.

Corporate support and commitment. The successful development and maintenance of an alliance needs corporate support and long-term commitment. The top management of each firm must agree on the purposes and share the vision for the alliance relationship. Their role focuses on building corporate-wide awareness of the alliance, overcoming inevitable organizational resistances and meeting on a periodic basis to evaluate progress and provide directions. Another corporate task is the training and orientation of the personnel involved in the daily operations of the alliance. Team building sessions, cultural seminars and language courses are tools for educating this type of personnel. A central activity of corporate support is the selection of qualified individuals who are team players, adaptable to changing situations, and who are patient and sensitive to the culture of the country's partner.

Championship. Both sides of an alliance need a champion. This high-level and experienced manager initiates, develops and often maintains the venture because of his/her knowledge, relationships and credibility that only an insider can bring to the table. This manager must enjoy the confidence and trust of all alliance participants, so that decisions made reflect the right concern for all. Bridge building, such as creating relationships, reminding his/her team to focus on the big picture and explaining opposing points of view, is an integral part of the championship function. His/her main challenge is to operate for the benefit of the alliance although such a behavior sometimes might appear to run counter to the interests of his/her firm. Because knowledge and trust take a long time to be developed, a champion should not be moved to a new assignment without having a suitable and acceptable replacement.

CONCLUSIONS

The increasing globalization of construction markets and the technical and organizational complexity of projects represent both a challenge and an opportunity for construction-related

firms. Alliances are a viable tool for entering new markets and expanding the scope and quality of services offered to clients. As stated above, the critical issues for developing and maintaining any international alliance (as well as domestic ones) are: mutual understanding of national and corporate cultures, continuing corporate commitment and communication, and above all, trust. In this type of venture, the major challenge is not money or time, but finding people who are flexible, open minded and willing to subordinate some of their personal interests to the benefits of an alliance. Because successful alliances induce firms to develop a long-term view and a cooperative spirit, these features may represent the basis for a radical and positive evolution of the construction industry at large.

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MORE EFFECTIVE PRE-QUALIFICATION STRATEGIES AND TEAM PRESENTATIONS IN CONTRACTUAL SERVICES

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Abstract

Pre-qualification procedures are used more widely in evaluating contractual services which allow for competition based first on a reputation for quality service and second, on price. In order to be successful a firm needs to communicate a distinctive and persuasive message to the client and his advisors. Pre-qualification presentations enable clients to make a more informed choice in their procurement process and therefore adds value. Personal presentations, combined with brochures and publicity need to be planned and co-ordinated to communicate a consistent message. The focus is on understanding the informational requirements of the client organisation and to establish their expectations and specific needs.

Services marketing requires communication of the corporate brand which is based on quality of service and a reputation for successful performance. Opportunities may only be created by sharing 'project value' information relevant to clients. The management of presentation teams needs to be supported by cross-functional co-operation to gain a clear competitive advantage. Increasingly clients are seeking long-term relationships based on a partnership between compatible organisational cultures. This demands greater attention to personal communication, negotiation and customer service skills aimed at providing total customer satisfaction.

This paper considers the intelligence and information gathering process to support presentation teams in targeting presentations towards clients requirements. It examines the role of the marketing function in the prequalification process, and identifies management skills and training requirements. It also examines ways of improving the efficiency of this vital stage in the marketing process in contractual service provision, and outlines a case study of how a major UK construction contractor has attempted to implement a more effective and targeted marketing approach to pre-qualification processes.

INTRODUCTION

Being able to satisfy the client through more effective marketing approaches in the pre-qualification stages of procurement has become a major consideration for construction organisations offering contractual services. This paper is based on

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research being conducted at the Department of Civil Engineering, University of Leeds into the development of an effective pre-qualification strategy for construction contractors and professional practices (Preece, Moodley et al 1995; Preece, Putsman et al 1996; Prece 1993; Male & Preece 1994; Preece 1994; CIOB 1992). The survey interviewed clients across a number of industrial sectors and UK construction contractors and consultants.

Pre-qualification procedures largely depend on the client and his design team advisors but have generally been introduced into the procurement of construction work due to the need to be able to judge between competing firms. The selection and appointment procedures offer contractors an opportunity to differentiate themselves from the competition through their reputation, record for successful completion of similar work and corporate brand image.

Processes usually entail compilation of lists of contractors or consultants, use of telephone and mailed questionnaires, and requests for contractors accounts and background information on turnover, value of contracts secured to date etc. The outcome is a short list of contractors for interview or to make presentations (CIOB 1992). Direct face-to-face interviews are used to gain a detailed description of the overall project, the construction programme and an explanation of the terms and conditions of the contract including responsibilities of the parties (Bernink 1995).

This paper is presented in two main sections. The first section outlines the findings of research with major procuring client organisations across a number of sectors and contracting organisations involved in selling their services during presentations and interviews with clients.

The second section details a case study of the marketing approach of Taylor Woodrow Construction.

ESTABLISHING CLIENT EXPECTATIONS & CONTRACTORS CURRENT PRACTICES

Client Expectations

Pre-qualification allows clients to assess contractors and consultants on their expertise, experience and ability to carry out the proposed project prior to tender price or fee submitted. Increasingly contractors are expected to demonstrate an understanding of the client's business; its products and markets. The qualifying factors for inclusion in select tender lists include financial standing, reputation for carrying out similar work at the appropriate level of quality, quality of the project team, managerial and communications skills, abilities to solve contractual problems, and approaches to the work with minimal disruption to the client's business'; staff and customers.

Clients have indicated in this survey that contractors may gain a further advantage if they provide detailed and credible references from previous satisfied clients, can demonstrate their interest in finding out as much as possible about the client and proposed project, and provide a single point of contact within the organisation from

first approaches in the pre-qualification period, throughout the project and into the maintenance stages.

Clients expect that those contractors or consultants who are invited to submit proposals are professional in their approach, provide a full team composed of project and site managers including some who would be responsible for the proposed project, and others with extensive contractual experience. It is important that someone at director or partner level, would be accountable for the firm and be able to draw on his/her expertise in resolving any contractual difficulties foreseen.

Criteria Of Selection
The areas of consideration when selecting contractors were found to fall into a number of main areas as follows;

- Financial standing and record
- Quality Assurance
- Current workload
- References
- Length of time in business
- Experience of project location
- Safety policies
- Previous experience of client
- History of industrial disputes
- Environmental policies and care for the environment

Other criteria used, particularly during pre-qualification presentations or interview situations include;

- **Relevance to the brief** - it was considered that in many cases, contractors too often wander away from the brief during presentations. They try to tell the client more about their own company than about the project and how it will benefit the client.
- **The team** - clients are looking to meet the people they will be dealing with throughout a project. they want to see people from various departments. Clients would like to be assured that not only will they get on well not only with these direct contact, but also with people at all levels.
- **Delivery** - an obvious lack of planning before presentations can amplify doubts about a contractor's professionalism or enthusiasm towards a project.
- **Attention to risk assessment** - it is essential to give clients peace of mind to know that contractors have paid particular attention to risk assessment.
- **Programme** - the client is likely to be very interested in the programme or schedule of construction.

Clients are seeking to work with organisations who can demonstrate an understanding of their business as well as the application of advanced problem solving skills to the specific project. In order for contractors to gain and sustain a marketing and competitive edge, they need to understand what particular clients and their consultant advisers are seeking, and to ultimately promote this during pre-qualification procedures.

Contractors & Consultants Current Practices

Contractors and consultants interviewed in the course of the research indicated that any marketing function was important in establishing contacts and conducting up-front research into the market, but that its role in terms of pre-qualification presentations and interviews was very limited. The client was interested in seeing those senior management within the contractor or consultant organisation who would be responsible for the proposed project.

A portfolio of printed material is developed by many firms and practices to be used in conjunction with presentations. These submission documents may include professionally produced brochures and project sheets which communicate the organisation profile, financial standing (possibly through bankers references), recent relevant experience, and c.v.'s of relevant project management.

Issues highlighted by contractors and consultants were

- the need for flexibility to be able to tailor packages to individual clients and current projects,
- the cost and time required to put together documentation and ensure that presentation material is kept up to date.
- generally improvements could be made to the quality and design of material, but this would likely make documentation more expensive to produce.

Presentation teams are drawn from different functions of the firm i.e. contracts managers, quantity surveyors and planners. This requires cross-functional co-operation and communication. Although representatives may be highly experienced technical managers, they may require some training in negotiation and selling skills to enable them to more clearly communicate the problem-solving abilities of the team and its ability to respond quickly to changes in clients requirements posed in the interview situation.

Common Criticism Of Clients By Contractors

There was general criticism of client organisations and their representatives. Contractors expressed concern over the amount of effort required in responding to extensive questionnaires. There appeared to be a consensus that often it was not clear why certain questions were being asked and that it may be desirable for some collaboration between contractors to try and get clients to provide a more standard format.

There was frustration when it was clear that clients and their representatives had already made their decision as to who was going to be awarded the contract, and when clients failed to provide meaningful feedback on why submissions had been unsuccessful.

Developing Winning Pre-qualification Strategies

Effective interviews and presentations depend on the firm or practice gathering as much information as possible on the following;

- the client organisation and decision making team, and their expectations.
- the clients products and markets, and problems they may be facing themselves.
- competitors strengths and weaknesses and any relationships they may already have with the client.
- the strengths and weaknesses of the firm or practice, past or current relationships with the client, the value of the service to be provided, and experience of previous similar projects.

This process allows a firm to compare its services against client criteria and identify opportunities. This will enable identification of a competitive difference which needs to be promoted through background publicity and brochures, but most importantly through direct contact during interview and presentations to the client.

Analysis of the customer, competitors and the firm itself needs to be converted into a differentiating and ultimately 'winning' message (Bernink 1995). This message needs to satisfy the basic expectations of the client team that the firm has the appropriate track record, a high calibre and reliable project team, adequate financial backing and quality management.

How can the firm or practice exceed the clients expectations? Arguments may need to be presented which very clearly differentiate the firm from its competitors. Disadvantages associated with competitors may need to be emphasised.

Development of More Effective Cross-Functional Co-operation

Regionalisation within many medium to large organisations may act against obtaining competitive advantage. Opportunities may only be created by sharing 'client and project value' information within the firm. For example, regions or divisions of a firm may have been through similar procedures with the same client organisation. The management of presentation teams needs to be supported by cross-functional information and co-operation to gain a clear competitive advantage.

It would seem essential that a flexible resource of material to support presentation teams should be prepared, kept up to date and co-ordinated by some form of centralised function. This may be a single manager within smaller firms or though departments in larger organisations, responsible for completing questionnaires and developing submission documents. This function may also be responsible for selecting teams to attend interviews and presentations.

Clients and their advisors are not looking for "slick" and glossy presentations but want to hear from people involved from director down to site level. Audio visual equipment

such as videos may enhance presentations, and if professionally produced, more effectively communicate past performance. However, their use should not in themselves distract from the main message.

Identification of the clients expectations and criteria for selection, and of competitors offerings, should be the basis of promotional efforts. The challenge is how to communicate value for money and the anticipated work load, the track record of the firm or practice, quality of performance in terms of the work done and also during the maintenance period. References from previous satisfied clients would seem to be most effective. Important considerations are the credibility of referees and the relation of previous jobs to the proposed work.

It would seem essential for the organisation to engage a member of the team who would act as a single point of contact with the client. This person would need client contact skills in addition to being able to answer technical queries throughout the project.

In the event of a firm or practice being unsuccessful, it is essential that the team finds out why. This will enable the organisation's management to refine and improve the strategy for future submissions. A constant dialogue with the client and other members of the decision making team is desirable and promotes a highly client-oriented image.

The following case study details the marketing tactics and approches to pre-qualification procedures employed by Taylor Woodrow Construction.

INDUSTRIAL CASE STUDY

Until 1990 active marketing played a secondary role in Taylor Woodrow's business strategy. Profits had increased year on year for the previous 30 years and sufficient new contracts were being won not to have to go actively looking for work. When the recession began to bite and profitable work became increasingly hard to find, the Company commissioned research to find out how clients perceived Taylor Woodrow. The response varied depending on whether the respondent had employed Taylor Woodrow regularly, occasionally or not at all. However, there were some common themes running through all the replies;

- Taylor Woodrow was a well known name with a good reputation for quality work;
- Taylor Woodrow personnel were perceived as being technically capable.

However, the following issues were also raised;

- Clients were not aware of the wide range of construction services Taylor Woodrow could offer. Most thought of them simply as one of the large building contractors.
- Taylor Woodrow personnel were sometimes perceived as being conceited in their dealings with the clients representatives.
- Taylor Woodrow were reluctant to change their working methods to suit the clients specific needs.

As a result, the "Pulling Together" initiative was launched, aimed at making Taylor Woodrow a "market driven" company. The emphasis changed from concentrating all efforts on the building process to finding out what was important to the Client.

Marketing became a wholly different activity as a result. It was recognised that all team members, not just the dedicated marketing professions, have a role in developing the business. The objective of marketing is to influence the decision-makers and to establish the precise needs of the client's project team.

Team members were encouraged to maintain contact with clients and their professional advisers whom they met in the course of their everyday roles. In this way, many business relationships were developed which previously would have ended when the projects were completed.

As a consequence a number of benefits ensued.

- Post contract discussion identified areas of Taylor Woodrow's performance which had not met the client's expectations.
- Taylor Woodrow learned more about the client's business and the problems they encountered once the new facility was put in use.
- Clients were kept abreast of developments within Taylor Woodrow which could benefit their future business needs.
- Taylor Woodrow would be advised of new project opportunities earlier than some of its competitors.

With the growing importance of pre-qualification interviews, this two-way education process enabled the firm to target projects whose needs were compatible with the expertise Taylor Woodrow had to offer.

The key messages Taylor Woodrow endeavours to communicate with clients are;

- The breadth of in-house expertise which the firm can bring to bear on the problems associated with construction projects.
- The business philosophy of Taylor Woodrow is to be non-adversarial and work with the client's team to produce the best outcome for the project as a whole.
- Taylor Woodrow people are good to work with.

Developing long term relationships with clients and their professional advisers can certainly help at the prequalification stage of a project. However, in order to progress further in the procurement process, it is generally necessary to demonstrate a good understanding of the particular technical issues associated with the project, a confidence that completion dates, no matter how tight, can be met, and a willingness to comply with onerous contract conditions.

Consequences Of The New Strategy

The new approaches adopted by Taylor Woodrow have had a number of beneficial effects. Firstly, they have resulted in a significant workload change towards Private Finance Initiative work on roads and the firm are preferred contractors on large

hospital developments. Over a period of time the firm have developed and marketed key financial skills which have enabled it to win two major concession contracts.

Partnering work and repeat business has increased. Taylor Woodrow has established long term relationships with major water companies and supermarket chains.

The company has concentrated on emerging market niches, in particular football and sports stadia and has become leading players in this sector.

CONCLUDING COMMENTS

Clients have developed select tender lists of contractors and consultants with whom they have established working relationships. The challenge is how to be considered for inclusion on those lists. This paper has highlighted a number of important issues in the creation of a winning strategy in relation to pre-qualification interviews and presentations. These may be summarised as follows;

- A need for a planned and co-ordinated approach in finding out as much about the client as possible; identifying client expectations, decision making process and criteria, the members of the clients team and culture of the organisation.
- Finding out about the competition, their possible previous relationship with the client and work on similar projects.
- Testimonial evidence from satisfied clients is more effective in communicating value for money, track record, quality of performance, resolution of problems and financial stability than glossy marketing brochures.
- Contractors and consultants need to be more proactive in establishing what clients thought about the presentations made.
- Contractors would promote a more client oriented image if they were to more often initiate contact with the client more often.

Increasingly clients are seeking long-term relationships based on a partnership between compatible corporate cultures. This requires attention to personal communication and customer service skills aimed at providing total client satisfaction and combating traditional conflicts between contractors, consultants and clients.

The case study outlined how a major contracting organisation places considerable emphasis on gaining a knowledge of the culture of the client business through well established personal contacts with professionals, clients and others, a partnership approach before, during and after a project, and on after-sales care and attention to dealing with residual problems and identifying client's views on Taylor Woodrow's performance.

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PROCUREMENT SYSTEMS AND THE ECONOMIC PROVISION OF FIRE SAFETY DURING THE CONSTRUCTION PROCESS.

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ABSTRACT: The risk of fire increases during construction or refurbishment of buildings because large quantities of combustibles are combined with numerous potential ignition sources. Financial losses are considerable and, although insured, eventually must be met by society. Many such fires could be prevented - or the damage limited - by developing and implementing effective fire-safety plans and fire safety management systems which are strictly enforced from the outset of the procurement process. Fire management systems on construction projects reduce the risk of fire and its consequences.

Key words: ***Fire Safety, Management, Economics, Risk Assessment, Procurement Strategy.***

INTRODUCTION

Over the centuries, thousands of fires in buildings have been chronicled. These range from domestic fires to wholesale destruction of large and complex buildings such as the International Exhibition Centre at Brussels in 1910 and the Pavilion "Age of Discoveries" of the EXPO '92 in Seville. The substantial rise in the cost implications of fires during the construction process is of particular concern. Fires are occurring with increasing regularity both on new-build sites and during refurbishment. The approach to fire safety in construction is unquestionably in need of review, precipitated, primarily, by the recent opening of the internal borders of Europe and, secondly, the enormity of losses due to fires in almost completed buildings.

Fire losses in the UK between 1984 and 1995 were estimated at £152.4m. During this period, two specific fire incidents, in London, should be noted. *(Table 2)* These, alone, accounted for £138.5m. of losses, 90.87% of the total UK cost of fires over the period. These two incidents should be considered exceptional or due to some special circumstances of the period, but, when analysed, the causes are clearly management and/or worker attitudinal negligence, revealing a lack of attention to prevention of fire in building processes. Research points to this problem being endemic to the industry, world-wide. Major fire incidents have occurred in many countries. *(Tables 1 & 2)* The problem, however, can be addressed by introducing changes in procedure during the early stages of procurement and a stricter on-site fire safety management regime.

Table 1. Selection of worldwide major fires on construction sites: construction, refurbishment, renovation and demolition - in the U.K.

DATE	LOCATION	Total loss in the year and number of fires	OCCUPANCY	TOTAL LOSS: £	Type of PROCUREMENT
23/06/90	London, UK Broadgate Phase 8	£39,820,000 8 fires	Commercial Building	£33,500,000	Construction Modern "fast-track" steel frame
07/08/91	London, UK 8 Minster Court	£109,575,000 7 fires	Multi-storey office block under refurbishment	£105,000,000	Refurbishment
04/11/91	Lincolnshire, UK	£109,575,000 7 fires	Hall	£2,000,000	Renovation
17/11/91	Kent, UK	£109,575,000 7 fires	School, Refurbishment	£2,000,000	Conversion and Renovation
15/06/85	Camberley, Surrey, UK	£3,300,000 4 fires	Council Offices, Construction	£2,500,000	Construction, Package Deal JCT Form of Contract

	Advancement of the work	CAUSES	Fire Damages	InjuriesMajor /Minor:
	Fire occured during the final stages ofthe construction programme	Fire began in a large contractor's hut	Limited damage to the structural framework Small deformations to the heads of the columns large deflection to floor and truss assemblies Small deflection to many secondary beams Significant smoke damage throughout the entire building	No injuries
	Advance stage of major works programme fitting out	Unknow Supposed naked flame	50% floor and 50% ceiling severely damage by fire 25% floor and 25% ceiling damage by heat and smoke	2 minor injuries
	Later stages redecoration of windows	Electric, house alight	Extensive fire damage to the southern wing Nearly complete destruction	No injuries
	Unknown	Arson	50% of the GF, 1st & 2nd severely damage by fire 100% of GF, 1st & 2nd by smoke	No injuries
	80% completed 18 months contract	Malicious plumbing work in the roof space above acoustic material	Extensive fire damages on the totality of the building (100 yards) Fire burnt 8 hours Very fast fire spread	No injuries

NB: Total Fire Losses in UK from the Worl Fire Statistics Centre

- *1991: £1,300 millions*
- *1992: £1,200 millions*
- *1993: £900 millions*

Table 2. Selection of worldwide major fires on construction sites: construction, refurbishment, renovation and demolition - in Europe and the rest of the world.

DATE	LOCATION	Total Fire Losses	OCCUPANCY	TOTAL LOSS: £	Type of Procurement
03/05/84	Philadelphia, USA Harrisson Court Building	$7,400 millions	Former Commercial Property Office space and shops	£36,000,000 equivalent to $20million	Extensive Renovation
15/01/85	Hoboken, New Jersey, USA Minneapolis Bank	$7,700 millions	Warehouse	£18,000,000 equivalent to $10 million	Demolition
3/ 01/96	Venice, Italy La Fenice Opera House	Unknown	Opera House	£180,000,000 equivalent to $100 million	Renovation
02/96	Seville, Spain Expo '92, Pavilion Descubrimientos	Unknown	Pavilion	£86,400,000 equivalent to 36 millions DM	Construction site

	Advancement of the work	CAUSES	Fire Damages	Injuries:Major /Minor:
	Removal Phase to prepare the building for extensive renovation	Spark from cutting operation which ignited combustible debris	Totally destroyed by the fire 17 other buildings received varying degrees of fire damage 27 other buildings damaged by smoke and water	6 minor injuries
	Undergoing demolition	Small fires in metal containers Burning materials from those fires ignited accumulated combustible rubble	Building, along with several small miscellaneous buildings contained in the block, was eventually destroyed by fire	Unknown
	Undergoing restoration Improving fire systems and alarms (had been switched off)		One of the 3 blocks making up the building was severely damaged Roof comes down Outer wall standing	Unknown
	Later stage of completion (2 months before completeion) Steel Frame Structure	Soldered joint in paint. Spontaneous ignition	Complete destruction of the steel frame structure Extensive fire damage of several pieces ofArt	Unknown

PROCUREMENT STRATEGY

Once the client is satisfied about feasibility within overall budgetary constraints, the design of the project can start. The type of contract and the procurement path is an important choice and, on the basis of professional advice, the client must decide how much risk to accept. The client therefore, must be given a thorough and complete assessment.

The Latham Report[1], *Constructing the Team*, recommended that choosing the procurement route should precede the preparation of the outline (brief). This must be determined by the nature of the project and the client's wishes regarding acceptance of risk, i.e. the results of risk assessment should determine the contract strategy.

Linking fire risk during construction with the choice of procurement route is a new concept. It is argued that, by the choice of an appropriate procurement route, it is possible to address the risk of fire. Until now, the risk of a fire incident during construction has been regarded as, generally, equal in all construction methods. Individually, however, it is mainly dependent on the risks presented during the whole of the procurement process. Therefore, in carrying out a risk assessment to define a procurement and contractual route, the client should also take into account the probability of a fire during the construction phase. This assessment should influence the decision as to the best procurement route, not only because the risks can be passed on to an insurer or contractor, but also because both client and contractor also actually carry a large part of the risk and bear a large part of the burden themselves.

A fire during the construction phase impacts dramatically on both contractor and client. The cost of fire can be illustrated by analogy with Heinrich's "Iceberg" explanation[2] of industrial accidents. Heinrich's detailed study of the cost of occupational accidents examined some 5000 case files. It distinguished two different kinds of cost for an accident: visible and invisible; and illustrated them metaphorically as an iceberg. Heinrich suggests that 20% of the costs associated with accidents can be classed as visible or DIRECT COSTS, i.e. those usually covered by insurance, and 80% as INDIRECT COSTS[3] which are invisible. This analysis is still recognised as the best representation of the cost of accidents, whatever the cause.

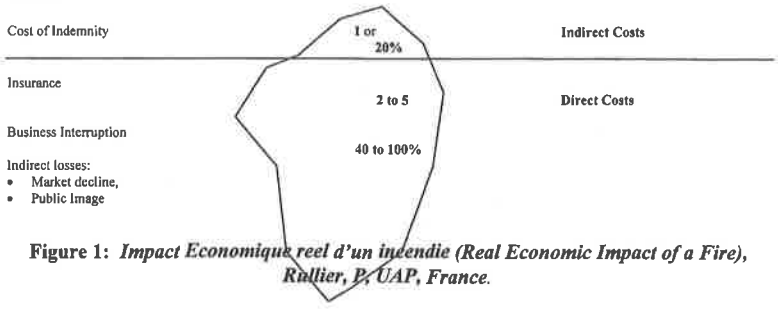

Figure 1: ***Impact Economique reel d'un incendie (Real Economic Impact of a Fire), Rullier, P, UAP, France.***

Rullier[4], in 1992 analysed the economic impact of fire. *(Figure 1)* In addition to the costs suggested by Rullier, it has become clear that there are two other aspects to this matter. The first a high probability that, following a major fire loss, the future cost of insurance premiums will rise for all insured parties as insurance companies try to recoup losses. Secondly, but more difficult to ascertain, is the costs to society resulting from the inconvenience caused by the non-availability or late completion of the building. Rullier alludes to these problems in his paper by the use of the phrase *"Pertes immaterielles"* (non-material losses). Rullier also argued that in today's economy, where management is required to be more cost-effective, control of fire loss and business interruption is of prime importance. Because of the human factor, it is impossible entirely to eliminate the possibility of fire where construction is in progress. Losses can be reduced significantly by taking proven loss control measures.

Even after assessing risks, it is not always easy for a client to understand, and accept, their importance at the outline brief stage of a project. However, the problem of fire during the construction stage of a project becomes the problem of every participant in the process should a fire occur. Transfer of responsibility is not the only solution and the site manager must not be the only person to blame.

The division of responsibility is beginning to be understood by the British government and, following a series of fire incidents, is stressed by the recent publication of a new set of regulations relating to Health & Safety:

- The *Joint Code of Practice for Fire Prevention on Construction Sites* in 1992
- The consultative draft *British Standard Code of Practice for the Application of Fire Safety Engineering Principles to Fire Safety in Buildings* in 1994
- *The Construction (Design & Management) Regulations* in April 1996

However, it should be noted that, even now, fire safety is not explicit in the third of these documents, the only one which has official regulatory status!

The Construction (Design & Management) Regulations (CDM) impose safety requirements and restrictions only with respect to design and management aspects of construction work. They give effect to *European Council Directive 92/57/EEC* on the implementation of minimum safety and health requirements at temporary or mobile construction sites. These regulations apply to, and are in relation to, construction work. Regulation 10 deals with the start of construction and states that every client shall ensure, so far as is reasonably practicable, that the construction phase of any project does not start unless a Health & Safety Plan complying with regulation 15(4) has been prepared in respect of that project. Regulation 15 describes the requirements relating to the Health & Safety Plan and Regulation 16 the duties, and powers of, principal contractors. However, although seen as innovative and stringent, the CDM Regulations make no explicit reference to Fire Precautions or Fire Safety.

The non statutory *Joint Code of Practice for Prevention of Fires on Construction Sites*[1] is applied to construction sites by the "pressure" of insurers. It includes those sites where demolition, refurbishment or repair work is being carried out. Compliance with this code will minimise the risk of accidental or malicious fires. The Code states that **proper planning for fire, safety and health must be an integral part of the overall preparation and budgeting for the efficient running of construction projects**. The Code suggests that the main contractor should appoint a Site Safety Co-ordinator who will be responsible for assessing the degree of fire risk and who should liaise with the co-ordinator of the design phase (usually the architect).

In analysing the above two paragraphs, it would appear that, in order to comply* with the Joint Code of Practice, the main contractor needs to be appointed at an early stage of the project - specifically, before the design phase - as it is necessary for the main contractor to appoint a Site Safety Co-ordinator *"for formulating and regularly up-dating the Site Fire Safety Plan as construction proceeds"*. In this case, a traditional procurement path is not possible as, in the UK, the contractor tenders in stage H, "Tender Action", of the *RIBA*[6] *Plan of Work*. However, with two stage tendering as a variation of the traditional system, i.e. where the contractor bids on the basis of a brief description of the project, it is possible to appoint the main contractor who then becomes a full-member of the team under the general direction of the architect. The contractor is then able to make technical contributions, through the site safety co-ordinator, as envisaged in the Code.

This suggestion is by way of example only. However, it demonstrates that a key decision for any client concerns the choice of mechanism(s) to manage these inter-organisational procurement process relationships in the best way to ensure an early stage fire safety contribution.

It is generally recognised that the contractual arrangements clearly establish the stage at which each team member is able to be involved in the project. This timing also affects the development of the lines of communication and the allocation of responsibilities for providing information, patterns of co-ordination and control[7]. The setting of project objectives and parameters to determine the appropriateness of Contract Strategy should, therefore, include consideration of required levels of site fire safety and of how it can be best achieved.

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* *"Non compliance with the Code by the Construction Industry, by those who procure construction and by construction industry professionals, could result in insurance ceasing to be available or being withdrawn resulting in a possible breach of construction contracts which require the provision of such insurance..."*, Joint Code of Practice, p2.

FIRE SAFETY MANAGEMENT

Construction Safety is a serious concern to most construction companies. Accidents not only reduce productivity and damage equipment but frequently also injure human beings. They affect both construction costs and profitability through delays, damage to equipment and materials, damage to the facility under construction or through compensation payable as damages for accidental injury or loss of life.

Every year, many fires occur in buildings under construction, and the occurrence of these fires contradicts the popular belief that modern buildings cannot burn. Very few fires on building sites make headline news because loss of life is relatively small. The total damage can be very costly - not only in terms of direct damage but also through the imposition of contract time penalties and because of the inflationary costs of replacement materials and labour.

Globally, the approach to Health and Safety on construction sites should take a wider view and place more emphasis on dealing with the poential for fire on site. Two important activities are fundamental to fire safety management: i/ the collection of information about fire risks and ii/ the analysis and summarising of this information. In the UK, this data is mostly collected and published by the Fire Prevention Association[8] (FPA). In the published documentation, the lack of information about fires on construction sites reflects the lack of awareness of the significance of the problem. The necessity for awareness training and preventative measures is not seen, and this situation will remain as long as the different "accidents" do not represent major losses for the construction industry in terms of material loss, business loss and, unfortunately, human loss. People only seem to learn by making mistakes and important safety lessons are learned - or at least acted upon - only after major disasters. Indeed if there were no fires, it would not be necessary to study fire safety. However, accidents give experience that often can be gained in no other way. Reference has already been made to the Fire Prevention on Construction Sites Joint Code of Practice. Even this Code results from a reaction to the consequences of two major incidents in London, in 1990 and 1991 respectively.

FIRE RISKS

Construction/demolition sites are already considered as places of risk, but only in relation to the construction activity itself. As a result, there is already a safety awareness amongst managers and a reasonably good health and safety attitudes exist. However, in managing fire safety on construction sites, two additional, but fundamental, attitudes are required:

- the assimilation of fire prevention measures into management routines;
- the promotion of the importance of fire awareness.

Unless attitudes change in respect of these points, fires on site will continue. Planning for, and implementating, construction site fire safety needs to be addressed as part of the procurement process itself. On this last point, the approach in Spain goes some way towards addressing the

problem. Health, Safety & Welfare on construction sites - and specifically, fire safety - is approached at an early stage of the procurement strategy. A Health, Safety & Welfare Plan is part of the contract and is detailed separately. Being part of the tender documentation, it is, therefore, submitted as a referenced document to the bidding contractors for estimation and selection and the Plan provisions are separately priced - rather than being implicit in other prices. During the construction process, any lack of provision or infraction of health, safety or welfare rules, is dealt with by a deduction of appropriate amounts from interim payments in addition to any application of punitive legal process.

A typical example to reinforce this view of the importance of construction site fire safety is that of Minster Court, London, in 1991[9], an 8-storey building (70 x 60m) with 2 underground levels. A fire incident was discovered at 7.30am in an upper storey; later investigation revealed that the fire began in rubbish accumulated in the atrium (which was still scaffolded). This incident, alone, accounted for approximately 90% of all fire losses in that year. The cause of the fire was, apparently, a discarded match in rubbish, i.e. human error is believed to be the main cause. Surprisingly, however, is that only three weeks after this major disaster another fire was reported which had been ignited by a carelessly discarded cigarette. Fortunately, this second incident did not kill anyone, but two persons were badly injured. Details of the extent of several other major fires which have occurred on construction sites since 1984, are provided in Tables 2 & 3.

UK LEGISLATION

In many States, the problem of fire safety awareness is often exacerbated by a plethora of different regulations. For example, in the UK, the legislative framework is contained within some 68 Acts of Parliament and a collection of some 32 sets of Regulations. To these must be added a further 21 general Acts and over 50 sets of Regulations, Statutory Instruments and Designation Orders, all of which cover or impinge upon fire safety. This set of legislation is desperately in need of simplification (without, in so doing, causing an erosion of standards); it needs to place duties and responsibility on the right shoulders; it needs to inculcate, and to build on, good working practices and, above all, it should not be a burden on either the enforcing authorities or on those expected to comply[10].

Perhaps, minimum mandatory arrangements for the prevention of fires on construction sites should be introduced. However, they would not really be any substitute for good management practice, e.g. integrating Passive Fire Protection into the primary stage of construction and, at a later construction stage, ensuring Active Fire Protection systems are available.

At present, fires on construction sites are considered in only one, non-mandatory, document - the Joint Code of Practice. The Building Regulations and their associated Approved Documents, and the Standards, are applied during design and relate only to the Fire Safety of the finished product. Nothing in these documents addresses the problem of fire prevention on construction sites.

CONTINGENCY PLANNING AND FIRE SAFETY PLAN (FSP)

Regulation in the UK does not directly require the contractor to implement a Fire Safety Plan in respect of a site but is content merely to recommend the implementation of fire safety measures to protect the contractor's employees; thereby incidentally providing a degree of protection for the building under construction.

Presently, the *Joint Code of Practice* sets out a number of recommended minimum measures against fires on construction sites. It is, currently, the only reference available on the market, but is it adequate? It is very difficult, at present, to give an answer to this question, as no major fires have been reported since the publication of this guidance document. This is not evidence of its minimal guidance being effective, nor is it indicative of improved consciousness of the importance of construction site fire safety amongst contractors since the publication of the guidance in 1993. Most contractors seem to be unaware of its existence.

It is not sufficient only to publish a Code of Practice (or guidance note), recommend it to contractors and hope that they will take the matter on board. In addition all parties should be trained to identify fire hazards on construction sites. An adequate budget, sufficient to ensure compliance with the fire safety plan recommendations, should be allocated at an early stage of the project - and in any event, before the start of the construction. All on-site personnel should undergo awareness training and should be involved in the implementation of the Fire Safety Plan (FSP). Every party involved in the building procurement process should understand and appreciate the destructive power of fire.

The FSP should be a written document which should be carefully prepared, carefully studied and fully implemented on site. Its main objectives are:

i/ the prevention of fire on site, i.e. how to avoid a fire and
ii/ the reduction of damage should a fire occur.

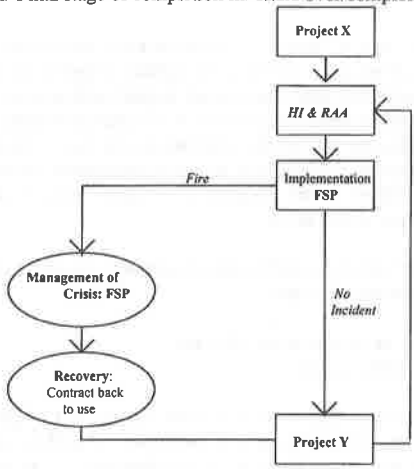
In this last regard, planning a response to a disaster/incident is not a simple task. Again the task has two parts. The first is to ensure that site layout, site operations and facilities will be supportive of first-aid firefighting and other intervention requirements. The second objective is to be able to manage any incident which affects the continuity of business. One way to achieve this task is to provide a fire recovery contingency plan. Contingency planning is not an option; it is essential. The procurement budget, therefore, should be sufficient to allow for its implementation or insurance provision should be made. Contingency planning must address the effect of a fire incident on the continuity of both the contractor's, and the client's, business as a whole.

There are four distinct phases involved[11]:
i/ Review of hazards: assessment of the risks and their potential impact on the organisation and business;

ii/ Development, maintenance, auditing and testing of the contingency plans;
iii/ Incident management, implementation of plans during an incident and the immediate aftermath.;
iv/ Recovery to normal business operation.

If Contingency Plans are included in the planning for fire safety, it should be noted that the plans initially will be formulated at the inception of the project. They must, therefore be constructed with a long-term view of the future, and will need to include an analysis of needs for business recovery. *(Figure 2)*

The preparation of the FSP, itself, starts with a fire hazard analysis. This, also, must be under constant review throughout the different stages of the procurement process and particularly during the on-site construction phase. These last can be grouped together for the purposes of the discussion, as: a) Substructure, b) Superstructure and c)Finishes: i/ Primary stage, ii/ Final stage of completion iii/ Hand over/completion.



Key:
HI & RAA: Hazard Identification and Risk Assessment Analysis
FSP: Fire Safety Plan, Development, maintenance, auditing and testing.

Figure 2: ***Planning for Fire Safety: example of a model.***

For each phase of the construction, the fire hazards must be identified. This can be commenced at the design stage, through an assessment of materials and components for fire safety. Knowledge of the performance of building elements, assemblies, contents and materials in fire is necessary. Evaluation of hazards and their associated risks is a very complicated process . The objects[12] of hazard identification are:

i. to identify combustible components and construction materials;
ii. to define the degree of hazard for content materials;
iii. to evaluate flame spread characteristics of "finish materials";
iv. to define the period of fire resistance for walls, structural frame, floors and doors,
v. to quantify the amount of "smoke" produced by a material.

It is also necessary to assess, in relation to each of the identified hazards, a probability of occurrence - from which the degree of risk can be seen. From this, comes the development of the site fire safety plan as a response to the assessment. This fire safety contingency plan (FSP) will, of course, need to be reviewed and changed on a regular basis as the building morphography and fire load changes throughout the progress of construction. Similarly, evacuation routes and the first-aid fire fighting plan will need to be regularly reviewed, updated and promulgated.

Table A: **FIRE SAFETY PLAN (FSP): an overview**

OBJECTIVES	STRATEGY	ACTION
PREVENTING IGNITION OF FIRES	♦ Understanding the common causes of fires on construction sites and evaluating the risk - through a fire risk analysis ♦ Emphasis on managerial methods Better housekeeping Training staff Fire Safety Plan Awareness of the cost of fires	• Fire Safety Education • Involvement of insurance companies • Fire safety Training • Inspection (duties of the Clerk of Work and Project Manager) • Health & Safety Adviser
DETECTING FIRES	♦ Implementation of an effective Fire Safety Plan: - Security Systems (alarm, detectors, guards...) - First Aid Fire Program	• Fire Safety Training • Involvement of the Insurance Companies • Inspections • Health & Safety Adviser
FIRE FIGHTING METHODS	♦ Manual: - Fire extinguishers - Fire Blankets ♦ Automatic - Early installation of Sprinklers First Aid Plan	• Fire Safety Training • Involvement of the Design Team • Health & Safety Adviser
RESTRICTING FIRE SPREAD	♦ Choice of Materials -slow burning and low combustibility materials. ♦ Reducing the number of storage areas on-site ♦ Protected Storage areas ♦ Early installation of a passive fire protection - fire doors and partitions to create containment, stairs for evacuation, etc.	• Involvement of the Design Team • Health & Safety Adviser • Fire Safety Equipment • Fire Safety Training • Construction Team
PROFESSIONAL FIREFIGHTING	♦ Access for Fire Brigade ♦ Fire detection systems ♦ Protection of storage areas ♦ Water supply	• Construction Team

The preparation and implementation of a project's fire safety programme, administered on-site by a designated program manager, or planning supervisor, is the most effective single measure that can be taken to mitigate the potential losses due to fires during construction and refurbishment. However, while accident prevention is understandably given top priority, fire safety is frequently overlooked by both management and workers. The FSP can, and should be, an integral part of the overall safety program required in project specifications and should be addressed as part of the overall procurement process. *Table A* shows an overview of typical content that could be included in an FSP.

CONCLUSION

There is a need, by implication, to address fire safety as a fundamental requirement of a Health & Safety Plan on every Construction Site. This, automatically, gives rise to a range of serious implications for the method of procurement, the type of contract and, of course, for the management supervision of site. Our preliminary research suggests that there is little appreciation of these implications within the EC and it suggests that a similar situation could be encountered outside Europe, possibly world-wide.

The emphasis, in this paper, has been on the importance of an early consideration of the possibility of a fire during the construction phase. The issue needs seriously to be addressed. As a first attempt to move towards an understanding of the size of the problem, and especially its economic implications, research is being carried out to establish the extent to which the procurement process might be adapted and whether an extension of supervision systems might lead to providing a more fire-safe construction environment. The importance of an early stage assessment of fire risk for any construction or refurbishment project is particularly stressed; best practice management guidance for fire-safe on-site activity, coupled with adequate legislative provision, is essential and major research is necessary to underpin all of these activities.

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CONSEQUENCES OF ILL-STRUCTURED PROCUREMENT

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Abstract

The construction industry is highly fragmented both geographically and according to its products. Members of the industry are different from one another in their activities, their interests and their organization.

Accordingly, when trying to define ill-structured procurement and its most likely consequences, no simple answer is possible. Nevertheless, an answer is required, not only from the point of view of the direct participants, but also with a view to safeguarding the interests of indirect stakeholders who could be hurt just as badly from the impact of projects gone sour.

This paper examines the shortcomings of the most frequently used project delivery systems, highlighting the consequences of their potential failings.

INTRODUCTION

One of the principal objectives of this working commission is: "to formulate recommendations concerning the selection and effective implementation of project procurement systems." It must be axiomatic, therefore that **ill-structured procurement** is something the members of W-92 recommend against and would like to prevent. Construction, unfortunately, is highly fragmented, both geographically and according to its products. Practitioners of the industry are as different from one another in their activities, their interests and their organizations as day and night. Is it any wonder then that no coherent policy has so far been developed in respect of recommended project delivery systems? One may even question whether the development of such a comprehensive system is at all possible.

Notwithstanding the diversity that characterizes the industry, the overriding importance of it must not be forgotten.

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This importance ought not be measured by the size and qualifications of its participants, but by the impact of the industry on the wellbeing of the world's population. Construction produces those facilities and/or structures which allow us to feed, clothe and shelter ourselves: the factories where our goods are manufactured; the structures where our harvests are stored and processed. The products of construction also include roads, railroads, waterways, power plants, refineries and communication facilities. In brief, construction influences, if not governs, the competitiveness of different nations. Construction is often referred to as the "balance wheel of the world economy".

The industry is, nevertheless, in the dark ages when it comes to the development and adoption of cost effective project delivery systems, which are prerequisites for the industry to be able to discharge its obligations towards the population at large. Unfortunately, when questioning cost effectiveness, the answer may vary whether one is analyzing the issue from the point of view of the buyer of the construction services (who at times may be called the client, the employer or the owner depending on the country where the discussion is taking place), or from the point of view of the contractor (which term includes both subcontractors and suppliers) or, indeed, from the point of view of a given nation or its population. There is, nevertheless, one common ground for such an analysis: how can a "mismatch" between the participants be avoided, where mismatch equals ill-structured procurement.

THE PARTICIPANTS IN THE CONSTRUCTION PROCESS

The word "participants" should perhaps be replaced with the term "stakeholders". This differentiation is becoming more and more significant if looking at the construction process from the point of view of sustainable development.

At a recent symposium, sustainable development has been explained as follows:

> "Only through continued and accelerated development will the quality of life be improved for the growing world population. This accelerated development, the physical manifestations of which are the domain of the engineering and construction industry, should be undertaken in the context of the principles of sustainability. Engineering and construction are inextricably linked to sustainability in that all elements of the built environment modify the natural environment in some manner; the built environment is designed, engineered and constructed by the engineering and construction community.
>
> Sustainable development represents a new way of thinking in planning, designing, building, operating and maintaining infrastructure facilities such as roads, buildings and

bridges. Sustainable development is the challenge of meeting growing human needs for natural resources, industrial products, energy, food, transportation, shelter and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future generations. This definition recognizes that meeting **long-term** human needs will be impossible unless we also conserve the earth's natural physical, chemical and biological systems.

Sustainability has geo-political aspects. These white papers recognize that the approach of industrial nations toward development and environmental quality can differ from that of developing nations. The challenge is to find the common ground where international collaboration and the application of research may bridge any apparent gaps".
(Symposium on Engineering and Construction for Sustainable Development in the 21st Century , 1996)

To achieve these goals, the short-term financial interests of individuals and corporations may have to be discarded so as to be able to safeguard the long-term interest of others not directly involved in the specific project. A profitable project is not always desirable, or even suitable, to achieve the goals of sustainable development.

Therefore, when speaking of **ill-structured procurement**, one must examine the point of view of not only those directly participating but also all other stakeholders. The direct participants are easy to identify: they include the owner of the proposed facility or structure, his consultants, inspectors and suppliers (e.g. insurance providers, etc.) and the contractor with his subcontractors and suppliers. Indirect participants, that is the other stakeholders, are much more difficult to list. For the purposes of this paper, it is assumed that their interests are better protected by governmental authorities and/or professional associations; accordingly they will not be discussed in detail here.

THE OWNER VERSUS THE CONTRACTOR

For this analysis, the term "owner" includes his employees and agents (i.e. professional consultants) whereas the term "contractor" includes both subcontractors and suppliers. It is the relationship between these two principal players that ultimately determines whether a given procurement is ill-structured or not. This relationship will always be adversarial. The owner wants to receive the best value for his construction dollar, including a quality project which is fit for the intended purpose, costing less (or not more) than the original budget and delivered on time, free of all encumbrances. The contractor would be prepared to satisfy these desires of the owner, but not at his own expense. The contractor wants to spend the least amount of money

while meeting his contractual obligations. This diversity in their financial interests is the reason for the adversarial relationship. The thrust of this relationship centres around the respective responsibilities and powers of the parties. From the point of view of the owners, the proper balance would be achieved by placing all construction risks on the shoulders of the contractor, after all the contractor is in the business of risk taking. To achieve this end, owners, or consultants acting on their behalf, often try to shift more and more responsibility onto the contractors and in fact try to write totally one-sided contracts where the owner has all the rights and the contractor all the obligations. This of course is an unrealizable dream. One cannot very well write a contract which would hold the owner harmless of any and every eventuality and still expect to receive bids. More importantly, however, if disclaimer clauses are introduced with a view to safeguarding the owner's financial interests, then perhaps the cost effectiveness of such an approach ought to be first analyzed. It is not always in the owner's interest to pass on all potential risks to the contractor. This is particularly true with respect to government bodies or institutional owners. Even in situations where most of the risks have apparently been successfully shed by an owner, his exposure is not necessarily eliminated. The misunderstanding by owners, and at times by their engineers, concerning the true protection that they enjoy under a contract on the one hand and their obligation towards the contractor on the other is a very frequent reason for claims. Added to this is the fact that construction contracts are seldom written in such a clear and precise language as to leave no room for differing interpretations, particularly when the interpreter's financial interest might be jeopardized by an unbiased interpretation of a given clause. Is it any wonder, therefore, that construction is plagued by disputes?

FREQUENTLY USED PROJECT DELIVERY SYSTEMS

Until the middle of the nineteenth century, virtually all construction was carried out by a **master builder**. At about that time, in the early days of railway construction in England, the **design-bid-construct** type of project delivery system was introduced. Although both systems underwent considerable developments over the years, they are still, even today, the two basic systems in use.

The design-bid-construct system is frequently called the "conventional system" , whereas the **master builder** type of approach may be called either turn-key, clés-en-main, design-and-build (design/build), EPC or package deals.

The conventional system also has many variations, such as cost reimbursable or firm price. Firm price contracts may be based on a schedule of quantities and prices, or may be lump sum. In between the cost reimbursable and firm price contracts are the target price and the maximum

ceiling price contracts. One may also include in the firm price category the management method of contracting.

Any one of these may come in different varieties, and in fact there are contracts half way between the turnkey and the conventional systems.

Notwithstanding these different types of systems, each contract can be classified, at least in the eyes of the courts, as a design-bid-construct or a design/build type of contract. Whether a given contract belongs to one group or the other depends on the allocation of the responsibility for the design. In the first group the design responsibility rests with the owner, whereas with respect to contracts in the second group the design responsibility is assumed by the contractor.

Consequently, the selection of the procurement system may depend on the type, size and location of the project, but more properly ought to be governed by the owner's preparedness and qualification to discharge the consequent responsibilities. All of the procurement systems have advantages and disadvantages. At a given time, one system may be more beneficial to the owner, whereas another system or the even same system may benefit the contractor at another time.

Without trying to generalize, an uninitiated (in terms of design and construction) owner should never undertake construction on a cost reimbursable basis, whereas an owner with a sophisticated in-house engineering department should stay away from firm price design/build arrangements. The same would also apply to contractors. Underfinanced or inexperienced contractors ought never to undertake a design/build contract. A road builder should not bid on a building project, etc. These examples, perhaps more than any other explanation, describe the meaning of the term mismatch.

Unfortunately, a mismatch could occur simply because a party either has insufficient resources or experience to undertake the project in question, regardless of the delivery system selected. There is a significant difference between owners and contractors in this respect because owners could at least have the apparent security offered by the surety companies confirming that the intended contractor is capable, both financially and experience-wise to undertake the project in question. There is, however, no one to assure the contractor that the owner is not "in over his head", unless, of course, the owner was smart enough to hire a competent professional advisor.

THE IMPACT OF A MISMATCH

In the days of the master builder, it would have been very unusual for a mismatch to occur. People and organizations were significantly less mobile than they are, by necessity, today. Accordingly, both the client and the builder would have known and trusted each other before entering into a contract. This is, of course, not the case today, particularly in the case of public tendering. The contractor may not be from the same city where the project is constructed. In fact, he may not even be from the same region or country. Trust, accordingly, has little or no importance in the life of a modern contractor. The situation is not much different from the owner's point of view even when the intended contractor has been previously prequalified. Today the relationship between the parties turns on the terms of the contract, and their familiarity with one another, if any, will play little or no role in the final outcome of the project. In situations where the proposed relationship (as dictated by the terms of the contract) is ill-suited for either the type of project or for the participating parties, the project or one or both of the parties could suffer grave financial consequences.

Moreover, arguments can be made that the impact of a project gone sour may spread beyond the interest of the direct participants and reach some, if not all, of the other stakeholders. If a high-rise residential building ends up costing much more than the original budget, then the developer will try to recoup the increased cost by charging higher rent. Similarly, the increased construction cost of a factory will result in the increased price of the produced goods. The increased cost of publicly financed infrastructures will have to be paid for by the affected citizens through increased taxes.

The impact may not be much less even in a situation where the owner is successful in avoiding the cost increases. Contractors are in the business of building things and not printing money. Losses suffered by contractors will also end up costing money to the indirect stakeholders one way or another. Income tax is not collected on debts and a reduction in the amount of income tax paid by one sector, or part of a sector, will have to be made up by others, i.e. the indirect stakeholders. Contractors going bankrupt generate more visible impact, such as suffering of the unpaid suppliers or, in more severe cases, of their employees.

Accordingly, ill-structured procurement or mismatch, as it is called in this paper, is everyone's concern and requires closer scrutiny. The following paragraphs describe the typical shortcomings of different procurement systems which frequently result in mismatches as well as the possible impact of those shortcomings.

Cost Reimbursable Contracts

The cost reimbursable regime (sometimes called time and material or cost plus), at first glance, appears to be the most equitable and the simplest way of buying construction services. After all the owner pays the contractor for the amount he has actually spent on the project. This method of procurement may be economical in cases where construction must start prior to the design being available (working hand-to-mouth) or in case of retrofitting a facility where the scope evolves and cannot be predicted with any degree of precision.

Unfortunately, the final cost of a project constructed under the cost reimbursable regime is always in excess of that of a comparable project built for a firm price. This premium may vary from as low as a few percent or, according to a fairly extensive study conducted by Revay and Associates Limited (Revay, 1981), to as high as forty-two percent. Owners with little or no prior experience in supervising construction operations could be particularly vulnerable in the hands of incompetent or unscrupulous contractors in a cost reimbursable arrangement.

Firm Price Contracts

Firm price contracts, when practical, are significantly more beneficial to the owners, particularly in geographical areas or at times with a low volume of construction. Within this group, one ought to differentiate between the stipulated sum (or lump sum) contracts and the unit price (or measured) contracts. As advantageous as firm price contracts may appear at first, they can turn out to be disastrous at the end.

Stipulated sum contracts, even with a suitable changes clause, should only be used if the design is far enough advanced prior to the tender call thus allowing bidders to prepare a realistic estimate. Owners, particularly those with little or no prior experience, may try to save money during the design phase and spend as little as they can get away with on subsurface investigation. Inadequate soil investigation, even in cases where the contract allows for price adjustment in case of encountering changes in the soil conditions, can and frequently does give rise to extended delays and significant cost overruns either for the owner or the contractor, depending on the governing terms of the contract.

Timely completion of a facility is always desirable but at times may be the prerequisite for the survival of the owner's enterprise. The desire to save money during the front end (i.e. design phase) of the project may lead to the decision to go out for tender with inadequately prepared drawings, expecting that the successful contractor could be coerced into completing the design at his own time and expense, through shop drawing submittals.

These are the owners who often end up paying more to their lawyers to defend against claims (which may have resulted from inadequately prepared design) than for the design. The impact of such a mismatch can be devastating and could also reach innocent stakeholders.

Unit price contracts are used most often for civil engineering works or when the precise scope or quantities cannot be established prior to the start of the project. Possible mismatches may result when a given unit price is intended to compensate the contractor for a number of partially related activities. Example: a municipality calls for the installation of sewer or water lines and establishes a single price to cover the cost of excavating the trench, laying the pipe and backfill; the problem arises when part of the trench unexpectedly turns out to be in rock or when the native soil is unsuited for backfill, which has to be imported from far away.

Another often occurring problem is when the tenderers are required to prepare their estimate on "standard" or "prototype" drawings because the design for the intended facility has not yet been completed. This scenario is more common in respect of the construction of mill or refinery foundations where one of the unit prices might be for a cubic metre of concrete. An increase in the quantity of reinforcing bars or the embedded steel, or a change in the shape of the footing (requiring more formwork per cubic metre of concrete) could render the tendered unit price totally inappropriate.

Perhaps an even more expensive problem could result from significant variation in quantities, particularly with respect to contracts which do not contain a provision for the adjustment of the affected unit price(s).

There are those who will argue that in situations such as those described above, one should use a target price arrangement instead of the unit price one. Under this method, the contractor is paid his actual cost up to a predetermined target price which is intended to represent the best estimate of the parties based on the information available at the start of the project. Any savings or underrun is shared by the parties, usually at a fifty-fifty ratio, while in case of an overrun the contractor has to absorb say, thirty percent of the cost overrun. A variation of the target price arrangement is when the target is a maximum ceiling and the entire amount of the overrun is at the expense of the contractor.

A *target price arrangement* is, unfortunately, an oxymoron. One tends to justify its use because the design is not far enough advanced to allow tendering on a firm price basis. On the other hand, the frequency and severity of changes that so often occur when construction starts ahead of the completed design could render it inappropriate. For it to be a practical solution, the target would have to be adjusted each time a change or variation in quantity is introduced. If the owner

is fair and reasonable, and is prepared to allow the virtually continuous adjustment in the target price which may be required by the ongoing design changes, then the contract, for all practical considerations, could turn into a cost reimbursable arrangement, whereas in the opposite case, it would turn into a stipulated sum contract. Either way, the very reason which gave rise to the idea would defeat its acceptability.

Management Contracts

Another variation of the so-called conventional method of project delivery is the management method of contracting. Pursuant to this method, the owner retains a construction manager who acts as his agent in all commercial and contractual matters, including the calling for tenders, and the award and supervision of the execution of the contracts. Under this method, the project is divided into relatively small packages which are called in a predetermined sequence according to the completeness of the design.

This method of contracting is subject to all the pitfalls enumerated above with respect to the fixed price arrangements with the added problem of the lack of a general contractor who would have both the incentive and the authority to coordinate his subcontractors (prime contractors under this regime). Construction managers, as a rule, are not very good at coordinating trades because they are unprepared to take the inherent legal responsibilities for the actions of the various prime contractors working under their supervision and over whom they have authority.

Design/Build Contracts

Let us now turn to the design/build type of arrangement where the mismatch can be even more pronounced. In a conventional setting, the owner has all the responsibility and the authority for the design of the facility or structure, meaning that he can build what he wants the way he wants it. This freedom of choice is not available under the design/build system. It is easy to see that owners with fixed ideas and readily available design capabilities ought not tread into the potential minefield represented by the design/build arrangement. On the other hand, the design/build solution offers savings in both the cost and time of execution. Furthermore, it may even yield a better and more cost effective facility due to the selected contractors' particular expertise in the design and construction of the intended facility. How can an owner take advantage of these benefits without giving up his freedom of choice? He cannot, and by trying to achieve these two mutually exclusive goals he creates a mismatch.

If the requirements of the owner in the request for proposal are left vague enough to allow the bidders to come up with their own solutions, then the owner may be buying an underdesigned

facility. On the other hand, if the request for proposal is so well detailed as to preclude misunderstandings, then the owner may lose the benefit of his contractor's particular expertise. The answer, obviously, lies somewhere between these two extremes, but the solution to this predicament is not the scope of this paper.

Design/build contracts going sour can be very expensive. The contractor may, after all, be required to build to the owner's (often unspecified) requirements but will be compensated pursuant to his tender price based on his own expertise and perhaps unrelated experience.

Losses in the range of fifty to seventy million dollars are not unusual on design/build contracts. These losses are often accompanied by significant delays in the project completion, thereby further exacerbating the damages.

CONCLUSION

The consequences of ill-structured project delivery systems are delays and financial losses. These impacts can and often do give rise to economic hardship not only on the part of the direct participants in the project but also on the part of indirect stakeholders. A fifteen million dollar loss on a five million dollar contract may be unique, but it has happened. Losing seventy millions on a one hundred and thirty million dollar contract is not unusual but equally disastrous. At the root of both of these disasters, as well as most construction-related losses, is the conflict between the financial interests of the contracting parties, resulting in a mismatch in their relationship. Although there is no single project delivery system that would satisfy all conditions, there will always be one which is best suited to the joint interests of the parties and will create the least animosity.

There is, nevertheless, an overriding prerequisite for all successful contractual relationships; this is the allocation of risks to the party best qualified to deal with them.

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PROCUREMENT SYSTEMS: THE VIEW FROM HONG KONG

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Abstract

The construction industry in Hong Kong has been extraordinarily successful. One of the symbols of Hong Kong, the Hongkong Bank, has led the way in construction of innovative and state of the art buildings with its current building and its predecessor, constructed in 1935. Hong Kong has also had great success with BOT projects and its new airport project has presented new challenges that have been tackled with vigour and determination.

Within this context of innovative construction projects there is an underlying inertia which falls back on traditional influences. Of paramount importance in understanding the Hong Kong construction industry is the fact that the ratio of land cost to construction cost is 80:20. This high land cost leads to an emphasis on quick construction rather than innovation. What is required is a tried and tested means of achieving an objective. It should not be overlooked that Hong Kong is an extremely interesting mix of East and West and the impact of a unique Hong Kong culture on projects is apparent. This paper uses the example of the Hong Kong Convention and Exhibition Centre to illustrate the impact of culture on projects and project performance in Hong Kong. This leads on to a discussion of the impact of culture on project management in Hong Kong.

Keywords

Procurement systems, Hong Kong, innovation, the client, culture.

INTRODUCTION

No one doubts the success of Hong Kong, particularly the success of its construction industry. Yet this impressive skyline and infrastructure has been built, in the main, on a background of traditional, conservative approaches to procurement. However, the most significant achievements have been obtained through innovation (a theme to which I shall return) whilst the majority of construction work has plodded along in a very conventional manner. This is probably true everywhere; few clients have the foresight and few consultants the courage to suggest that the client attempt the untried.

Examples of innovative procurement systems abound: the second Hongkong Bank building, built in 1935, was perhaps the first example of a construction management contract, the construction manager being a firm of civil engineers (Walker & Rowlinson, 1990). This brings to light another theme; much of the innovation in procurement has come from the civil engineering sector, as will be seen later. The current Hongkong Bank is a masterpiece in terms of design, off-site prefabrication and the management approach to procurement. It was not a cheap project but with the share price of HSBC standing at HK$ 185 as I write, this is not an issue; it stands as the flagship of a highly successful, perhaps the most successful, banking corporation and is recognised worldwide.

BOT PROJECTS

The first Cross Harbour Tunnel was an example of a continuing trend, the private sector taking on a major role in infrastructure development on a Build Operate Transfer (BOT) franchise. This lead has been followed, somewhat belatedly, by the Colonial Power, the United Kingdom itself. Indeed it can be said that the Territory has led the way in innovative procurement systems. Hong Kong's other major undersea tunnels, the Eastern Harbour Crossing, completed ahead of schedule in 1989, and the newly opened Western Harbour Crossing are interesting examples of a construction company taking a major role in constructing and operating a facility. Hong Kong's success with BOT projects can be put down to a commercial mix of Hong Kong Government (HKG) initiative, private finance (from Hong Kong and international markets) and collaborative joint ventures by local and international contractors.

In many ways this success has been driven by the desire and need of contractors and developers to search for new and lucrative contracts rather than by any political will of the client. In fact, the Hong Kong client has been most conservative in its approach to procurement; the Hong Kong government has been prompted into producing infrastructure projects on a BOT basis rather than going to the market with such an approach in mind. Hence, the innovation has come from the construction industry, essentially as part of its marketing strategy, rather than from any policy decision by the client.

The main area in which the government has been innovative has been in the field of contract documents, and in particular payment methods. The Mass Transit Railway Corporation (MTRC) introduced the concept of milestone payments into its construction contracts in the 1980s and this approach has subsequently been adopted by the government on the airport core projects. It was not until the 1990s that a Design Build contract was produced by the Hong Kong government.

THE NEW AIRPORT

The New Airport Core Projects (ACP) presented a different challenge. This is a programme of major projects (13 in all) involving, at one point, 75% of the world's dredging fleet; it has to be constructed at break neck speed in a climate of political change and strategic diplomacy. That such a collection of projects is currently nearing completion is nothing short of a miracle and can be put down to the willingness on the part of Hong Kong Government's Works Branch to be pragmatic in its approach to major projects. A package of traditional and Design Build projects has been put together under a common set of contract conditions with an over-arching management team, the New Airport and Port Coordination Office (NAPCO), undertaking a management role. Performance compares well with, say, the Channel Tunnel, another significant infrastructure project.

The approach to this project can hardly be classed as innovative however. Much of the procurement is undertaken by traditional methods, with some Design Build work thrown in. A programme management system has been implemented in order to follow the progress of the projects but major changes to traditional working practices have not been

demanded. Certain innovations in terms of conditions of contract and dispute resolution and avoidance have been implemented but the issues concerning an unfreezing of traditional roles and a changing of the culture inherent in projects has not taken place.

CONDITIONS OF CONTRACT

Innovations in conditions of contract, combined with a commercial approach to dispute resolution (an engineering rather than hard-core surveying approach) and a willingness to see the job completed has led to the successful initial construction and subsequent extension of the Mass Transit Railway Corporation (MTRC) and Kowloon Canton Railway Company (KCRC) lines. Again, these companies have been a successful combination of government initiative and private sector acumen. The property market has also played a big part in the success of these organisations, in that they are not dependent on transportation revenue as the sole means of generating income but the large areas of property development above and around the stations provide a major source of income. However, such an innovative approach to funding of public transport does not translate into a change in procurement forms; there is still no innovation apparent in this area. Perhaps one might explain the Hong Kong phenomenon by reference to the high cost of land which dominates the total project cost in almost all instances.

TRADITIONAL INFLUENCES

Despite the fact that Hong Kong is an international city many relationships are still founded in a Confucian culture (Rowlinson et al, 1993) and, consequently, much of what goes on in Hong Kong is still very traditional. Tradition has ruled the HKG conditions of contract and it was not until 1994 that a set of conditions for Design Build contracts was produced and even then these conditions were adopted conservatively, for fitting-out contracts in the first instance. There has been a singular lack of innovative contractual infrastructure which may well have stood the industry in good stead. Innovations have come from bodies such as the Hong Kong Jockey Club, which has used the New Engineering Contract six times now with great success, particularly in the construction of the magnificent public golf course at Kau Sai Chau - probably the best and most expensive public course in the world other than St Andrews.

One issue of which many are unaware but which is of paramount importance in understanding the Hong Kong construction industry is the ratio of land cost to construction cost, typically an 80:20 ratio. When considering a property development this is crucial: a ten per cent increase in construction cost leading to early completion can make a huge difference to a development's profitability in that the early revenue flow far outweighs the almost insignificant construction cost increase. Hence, Hong Kong construction has been traditionally very quick, even when relying on apparently outdated construction techniques. A commercial approach by all parties, a sense of shared energy, Confucian values and *guang-xi* have made the concept of partnering commonplace in Hong Kong long before the current western interest in the idea. Long term relationships have long greased the wheels of procurement in this big city, which in many ways is still a small village.

A good example of this is found in the account by Walker and Kalinowski (1994) of the construction of the Hong Kong Convention and Exhibition Centre. One of the key factors

identified as making the project a success was the granting of a potentially very valuable tract of land to the developer, New World Development Company (NWDC), by the Hong Kong Government on behalf of the Trade Development Council. The basis for this deal was that the contractor and developer, would provide a world class Exhibition Centre. However, the granting of this land only set the scene for the project; the relationship that developed between the leader of the client, Dame Lydia Dunn, and the leader of the NWDC, Cheng Yu Tung, was paramount in ensuring the success of the project. In addition, NWDC employed its own contractor, Hip Hing, to act as construction managers on a cost plus basis. Again, the nature of the relationship between the developer and the contractor ensured a successful project. Unlike many projects, the whole of the client, design and construction team was committed to the success of the project (see Moss, 1994 for more details).

The issue of relationship, often referred to in the West as partnering, was a key factor in the success of this project. So much so in fact that the procurement form, although assisting in many ways to make the project a success, was secondary to the relationship developed between the two contracting parties.

INNOVATION

Innovation is related to the question "how can the industry be helped to assume this responsibility to innovate in order to satisfy the up-front expectations of the building owners". In Hong Kong, in part because of the importance of relationships, innovation in procurement has not been strongly encouraged except for special projects where, through careful planning, spectacular successes have been achieved. This leads to the question, is innovation a virtue for run of the mill projects?

The contractor, rather than the client, has pushed the concept of Design Build for Hong Kong infrastructure projects; only in a few major projects has the government taken the lead. These projects, the cross-harbour and hard-rock tunnels, such as the Tate's Cairn tunnel, required specialist construction expertise and a financing package. With the construction for the new airport at Chek Lap Kok, Hong Kong probably leads the world in Design Build for infrastructure projects, but it is still slow to take up Design Build for building works. In the private sector, Hopewell Holdings has exported its design-build expertise to China in the construction of the Shajiao B power station and the Shenzhen superhighway, and to the Philippines in the construction of power stations there to help solve Manila's energy crisis. All of these projects operate on a build-operate-transfer basis, a sub-set of the Design Build approach (see Rowlinson & Walker, 1995).

It seems that innovation in procurement forms has not been encouraged in Hong Kong. However, what has been encouraged is the establishment of what might be considered non-conventional relationships between parties in the construction process. In particular, the nature of relationships within the project team is seen as a key issue in project success; the structure of the team has a much lesser impact on potential for success.

Build-operate-transfer projects have been seen as a way to deal with issues which are of public interest but for which the public purse has not been responsible. By providing an infrastructure within which private enterprise can satisfy the public need a culture has developed within which such projects are both acceptable and profitable. This comes

from the adoption of a free market philosophy, a hands off policy and a low direct tax regime on the part of government. As the client, the government has an interest in promoting projects but is happy to leave the responsibility for the promotion to the private sector. This cannot take place without some safeguards on behalf of both parties. The government has taken an active part in many of the projects through the enabling legislation which gives it either a golden share or a means of regulating price increases. The franchisee on the other hand normally has some means of guaranteeing either throughput and/or the cost of resources needed to run the facility.

PHILOSOPHY

There are many local and overseas contractors in Hong Kong that are capable of providing exceptionally quick construction to high quality standards, even in the current climate of very low margins. This long tradition of open competition to all comers is in marked contrast to the European markets which have only opened up in the past few years. A key element in this is, of course, people. Hong Kong has been the training ground of many top project managers. These people are first class and work long hours to ensure the performance expected; no matter what procurement form one adopts, it will not be successful without such people. These managers thrive on responsibility and the freedom to get work done and this is one of the characteristics of Hong Kong business, the "can do" philosophy. Continuity of workload and employment has also allowed construction companies to act as learning organisations and store within the company the knowledge gained by individuals from each project.

CULTURE

An interesting and growing, area of research in procurement systems is the culture which exists within the construction industry. Following a joint research project on culture with Bath University (Rowlinson & Root, 1996), UK it came as somewhat of a surprise to observe that the impact of the conditions of contract on performance was very limited. Rather, it was the quality of pre-existing relationships (social and commercial) which generally determined the culture "brought" to a project and the actual conditions of contract merely provided a channel for these understandings (or lack of such) to be expressed. This explanation, that project pre-history and prior working relationships (and, to an extent, the procurement form adopted) have the most significant impact on project culture is important. The view often has been expressed that the conditions of contract are only necessary when a dispute arises and that good working relationships can avoid this scenario. Thus, development of a positive project culture, even before a contract is let, is the best means of ensuring a smooth running project.

As Rowlinson and Root state, "Managing projects is increasingly recognised as requiring a greater sensitivity to the values and priorities, assumptions and attitudes, expectations and habits of mind that are developed within different occupational and corporate groupings. The interest in encouraging teamwork expressed by Latham (1994), presupposes common objectives amongst the project participants, both corporate and individual. Articulating and achieving a commonality of objectives increasingly requires the development of subtle negotiation skills which, in turn, require sensitivity to the ways 'other people see things' and the willingness and ability to accommodate to them (Fisher and Ury, 1981)". If each participant comes to the table at the first meeting with an agenda

of pre-project grievances, then conditions of contract will only mark out the battle lines; they will not change attitudes.

The view was put by one of the interviewees in the study that the conditions of contract, even if innovative, themselves did not provide for any greater co-operation between parties nor did they engender a culture of co-operation. These characteristics came only from the individuals involved and their relationships. However, paying a fair price for a good job was a key issue in the client body's eyes. This was more likely to engender a harmonious working relationship and a common project culture than the specific conditions of contract or procurement form. However, the view was expressed that new conditions, such as the NEC, did provide a flexible form for dealing with contractual issues and its emphasis on rapid response and early resolution of disputes and claims assisted in maintaining co-operation and a common culture which was in existence prior to the contract.

The issue of rapid response and a fair price was also echoed to some extent by the users of other special contracts (such as the MTRC and ACP contracts). The main point raised in this context was that rapid and fair resolution of (legitimate) claims greatly assisted in the maintenance of existing, good relationships and this approach was promoted even if it required some formal procedures to be ignored. Thus, both client and contractor objectives can be met.

There are many examples of the impact of project culture (and procurement form) on project performance in Hong Kong, perhaps one of the best being the twin projects for the construction of the Hong Kong Convention and Exhibition Centre and the Hong Kong Convention and Exhibition Centre Extension, some six years later (Moss & Rowlinson, 1996). In these projects two very different approaches were adopted, the former having been briefly described above. In the latter a completely different approach was adopted. This approach involved a much more conventional system of procurement and was heavily constrained by government procedure. As a consequence of the competitive tendering system demanded by government practice there existed the potential for conflict before the construction process was started. Despite the employment of a dispute resolution adviser a number of areas of dispute arose and the project has suffered because of these. The harmonious relationship which existed between client and contractor in the first project was not evident in this second project. Significantly, the potential for mutual benefit from the project did not really exist outside of the formal contract and, for the contractor, any claims which might accrue during its course. Hence, this lends weight to the view that strong prior relationships help to formulate both the procurement form adopted and a culture of co-operation which drive the project forward to success.

POWER

Newcombe (1994) suggested that selection criteria for procurement system are less important than the realisation that "procurement paths create power structures which dramatically affect the ultimate success of the project". Using this power paradigm, Newcombe criticised the fragmentation and friction evident in the traditional system. He does not suggest that alternative procurement forms should be used but rather that attention should be paid to the power structure within the project team, as this is a key factor in determining project success by its influence on the nature and scope of

relationships. This is further supported by Derek Walker's (1994) work in that he draws the conclusion that project construction speed is strongly determined by how well clients relate to the project team.

These concepts are particularly relevant to the situation in Hong Kong. A different culture pertains in business relationships in Hong Kong and throughout Asia. Hence, the way that relationships are perceived is an important aspect in determining the structure of an organisation and the way in which individuals will work together . The concept of face (Rowlinson et al, 1993) is a particularly important issue in relationships and this obviously pertains to the power relationships. One of the distinguishing characteristics of Hong Kong commercial development is the heavy and continuing involvement of the client in all phases of design and construction. This calls for a flexible approach to the management and organisation of the construction process and relies on a high level of give and take for all parties concerned. As mentioned earlier, the high land cost and subsequent holding costs of the land are a key driving force in property development and so this factor, combined with the relationship factor determine the nature of the organisation structure developed for the management of Hong Kong projects.

CONCLUSIONS

The construction industry in Hong Kong is alive and well and looking forward to the challenges that will inevitably come with the transition from a Territory to a Special Administrative Region. Hong Kong will continue to innovate in the field of procurement systems and it will be the special combination of Hong Kong's openness and the skill and expertise of the Hong Kong project managers which drives this innovation forward. Following on from one of the themes of the CIBW92 Symposium in South Africa (Taylor, 1996) it must be borne in mind that, as with all innovation, these changes will be suited to Hong Kong's unique position and what works in Hong Kong will not necessarily work elsewhere. One must strive to fit procurement systems to the environment in which one operates and recognise that there is no universal panacea.

It can be argued that project culture is the key to successful procurement, and not innovation for its own sake. A project culture may lead to innovation but the key issue at the outset of the project is the strategic management of the construction process. This must take place at the conception of a project; if the project process is strategically thought out then there may well be no need for innovation in procurement forms. On the other hand, innovation is required in how we draw the contractor and consultant into the project at project inception and in the nature of business practice in construction. This may well be a marketing issue.

However, many of these issues may become redundant when we design and build interactively through media such as the Internet. The client then will be so much closer to the design and construction interface and those clients wishing to participate fully and exercise high degrees of control will be afforded this opportunity. The communication barriers, so long a problem in the construction industry, are likely to be broken down by this new technology thus forcing change on the construction process.

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IMPACT OF DELIVERY SYSTEMS AND REMUNERATION METHODS ON EDUCATIONAL FACILITY CONSTRUCTION

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Abstract

U.S. educational institutions face a considerable deferred maintenance backlog and a challenge of optimizing scarce resources. To facilitate solutions to these problems this paper first presents the relative importance of 19 different construction project goals. Then the specific impact of different construction delivery systems and remuneration methods on cost, schedule, and quality performance of 33 educational building projects is explored. The timing and impact of various primary decisions and preconstruction services are also presented. Recommendations are offered regarding the preferred timing and sequence for making the primary decisions associated with the allocation of roles, responsibilities, and risks between the contracting parties. Finally, a decision tree for selection of a delivery system and remuneration method is presented.

Delivery systems; remuneration methods; decision tree; project performance; educational facilities.

INTRODUCTION

Within the higher education construction market the magnitude of deferred building maintenance throughout the United States was reported at $60.0 billion and growing [APPA, 1989]. As a result, administrations are facing a decay crisis which is contributing to their inability to attract and retain quality students. When unacceptably low rates of capital renewal are coupled with the declining enrollments caused by recent student demographic trends, the need for physical plant managers to ensure that every construction dollar is effectively invested becomes even more acute.

An educational facility requires special attention from the project team to ensure that the end results of the construction process effectively satisfy the functionality requirements of the user community. Faculty, staff and students are no longer willing to accept the simplistic solutions offered by turn-of-the-century structures or from the glut of modernistic flat-top buildings

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erected from the 1950s through the 1970s. Increased demands are being placed on the requirement for sophisticated building systems, including infrastructures to support the electronic classroom and building control systems, and for facades with both interior and exterior appeal. These requirements, new quality expectations and tight construction and renovation schedules exercise conflicting pressures on the limited capital resources of academia. Educational institutions consequently are finding it necessary to consider the use of non-traditional methods to deliver construction projects that satisfy these requirements. Alternative delivery systems and remuneration methods can create an environment within which all project team members can introduce innovative cost, schedule, and quality optimization contributions according to the roles and responsibilities that are set by these alternative approaches. The execution of a successful construction process involves the careful implementation of many different tasks and responsibilities by all of the parties involved with the project. How these tasks and responsibilities are sequenced and distributed influences significantly the choice of the delivery system to be used in a given project.

This paper presents and discusses the results of a survey of the delivery systems and remuneration methods that were used by 22 public and private educational institutions in 33 renovation and construction projects. The discussion of systems and methods is introduced by the relative importance of 19 different project goals, as perceived by owners The timing and impact of various primary decisions and preconstruction services, as they result from the selection of a given delivery system, are also presented.

RESEARCH STUDY

The study (Sears, 1995) assessed the impact of 4 delivery systems and 4 remuneration methods on the cost, schedule and quality performance of projects and on the satisfaction of the owners. The delivery systems under consideration are: Traditional (TRAD), Construction Management at risk (CM=GC), Construction Management without risk (PURE CM) and Design-Build (D-B). Each of these approaches assigns the parties a different set of roles and responsibilities. The systems were used in conjunction with the following remuneration methods: Lump-Sum (LS), Lump-Sum with Unit Pricing (LSU), Cost of Work Plus a Fee (C+), and Cost of Work Plus a Fee with a Guaranteed Maximum Price (GMP).

Within the independent secondary and higher education markets there are two associations whose members were solicited to provide data for this research. The first was the Association of Physical Plant Administrators (APPA), the Association of Higher Education Facilities Officers, an international organization comprised of facilities management personnel from over 2000 colleges and universities world wide. The second was The Association of Physical Plant Officers (APPO), an organization comprised of 36 independent high schools located in the northeast section of the United States. A survey instrument with a Likert type scale was designed to collect subjective evaluations of the respondents. The survey instrument was mailed to the 92 colleges and universities that were active members in the Southern New England chapter (Rhode Island, Connecticut, and Massachusetts) of APPA during 1994. For this population the survey

was sent to the most senior facilities management officer whose position title was focused on construction management. The survey was also issued to each of the 36 schools within APPO. To expand the boundaries of the sample population, data was also solicited from participants of APPA s annual regional meeting held in Pittsburgh, PA in October of 1994. Solicitation concluded at the fall meeting of the Southern New England chapter of APPA held at MIT in November of 1994.

RESPONDENTS PROFILE

In January 1995, 33 complete surveys had been received from 22 different schools. Table 1 shows a profile representative of the type of information obtained from the survey. The information was extensively processed using the statistical package SAS. The sample of 33 projects was first analyzed; then a smaller subset containing only data for dormitory buildings was processed. The analyses from both sets produced similar results.

Table 1. Sample set statistics

- Private (87.5%) colleges/universities (71.9%)
- Facilities size of 1,000,000 thru 2,500,000 GSF (51.6%)
- Student population of 1,000 thru 5,000 FTE (56.3%)
- Dormitories were the most popular building (25%)
- Renovation was the most prevalent construction project (53.1%)
- Respondents were mostly owners (84.4%) and project managers (62.5%)
- Most respondents had 11+ years of experience (81.3%)
- Respondents had a significant experience with the project type reported
- All respondents were involved with the construction phase of the project, 83.5% were involved in some portion of design and 43,8% were active in all phases of the project

RELATIVE IMPORTANCE OF CONSTRUCTION PROJECT GOALS

A critical first step in any construction project is the development of a clear goals statement or solution requirement regarding the desired outcome of the design and construction activity. For example, a recent study of colleges and universities in southern New England found that schools which developed long-term capital planning goals received significantly more funding to address facility improvement needs than schools that had no capital planning goals (Sears, 1992). Other studies related to project goals also suggest that the level of project success is a function of how well the goals and expectations of the participants are defined (Sanvido, 1992). Therefore, in order to develop an understanding of the relative importance of project goals in educational building construction, the survey requested each respondent to rank 19 possible project goals as a function of a delivery system.

Because it is very difficult for an individual to rank 19 variables consistently, the top five project goals were quantitatively ranked from one to five (one being the most important goal). The other sixteen goals were ranked qualitatively as high, medium, and low in terms of relative importance. A point scoring system was developed. Goals that were ranked number one were assigned 8 points; goals ranked number two were assigned 7 points and so-on. Goals having high importance were assigned three points; those with medium importance were assigned two points and those with low importance were assigned one point. For each of the different goals, the frequency associated with each goal was multiplied by its corresponding assigned points. Overall ranking was determined by the total number of points. Qualitative ranking was used when the total number of points was less than or equal to three. Table 2 shows the overall rankings of the 19 goals for each type of delivery system. Cost within budget, satisfy users and customers, constructed quality, schedule, and designed quality were consistently ranked the most important goals for this sample set of 33 projects.

Table 2. Overall ranking of project goals

GOALS	All	TRAD	CM=GC	PURE CM	D-B
Cost within budget	1	1	1	3	1
Satisfy users & customers	2	2	3	2	3
Constructed quality	3	3	5	2	4
On-time schedule	4	5	2	4	2
Designed quality	5	4	4	1	5
Appearance	6	7	7	3	4
Working relationship	7	8	6	Medium	3
Safety	8	6	8	High	High
End results as planned	9	9	8	High	4
Minimize owner's risk	10	10	10	Medium	High
Avoid aggravation	11	11	15	Medium	High
Avoid litigation	11	12	9	Medium	Low
Avoid claims	12	12	12	Medium	Low
Value Eng. savings	13	13	13	Low	Medium
Marketability of project	14	16	14	Low	High
Minimize architect's risk	15	15	18	Low	-
Minimize contractor's risk	16	14	17	Low	-
Minimize CM's risk	17	17	16	Low	High
Underrun GMP	17	18	11	Low	-

The survey also investigated the impact on the satisfaction of project performance obtained when owners specify clear goals and then carefully select a construction delivery system which is consistent with their objectives. The results from the survey indicate that clarity of goals produces noticeable differences in the cost impact but no significant differences are found with regard to schedule and quality.

Other specific findings derived from the study were:

- Projects which experienced cost goal adjustments during the construction phase produced significantly lower satisfaction in comparison to projects which did not experience cost goal adjustments.
- All projects with negative cost satisfaction experienced cost goal adjustments during the construction phase.
- Projects which experienced schedule goal adjustments during the construction phase produced significantly lower schedule satisfaction in comparison to projects that did not experience schedule goal adjustments. Schedule goal adjustments during the bid phase produced the opposite impact on the degree of schedule satisfaction.
- 83% of the projects with negative schedule satisfaction were associated with Traditional delivery systems.
- Projects which experienced quality goal adjustments during the bid and construction phase produced significantly higher quality satisfaction in comparison to projects which did not experience quality goal adjustments.

IMPACT OF PROJECT DELIVERY SYSTEM AND REMUNERATION METHOD ON PROJECT PERFORMANCE

The analysis of the impact that a project delivery system and remuneration method have on project performance was conducted by comparison of arithmetic means. The number of projects from the sample on each category were as follows:

PROJECT DELIVERY SYSTEM				REMUNERATION METHOD			
TRAD	CM=GC	PURE CM	D-B	LS	LSU	C+	GMP
16	11	2	3	12	9	4	7

Because of the relatively small sample sizes for each project delivery system and remuneration method, this study did not run a comparison of the standard deviations or attempt to assess whether the data were normally distributed. A Lykert type scale between -3 (extreme negative impact) and 3 (extreme positive impact) was developed. The arithmetic means for the most significant observations that are derived from this analysis are shown in Tables 3 and 4, as follows.

Table 3. Impact of delivery system on project goal

GOAL	TRAD	CM=GC
Impact on cost	1.46	0.9
Impact on schedule	0.69	1.6
Impact on quality	0.86	1.2
Extent of owner satisfaction with cost savings effort	0.5	0.91
Extent of owner satisfaction with schedule performance	-0.06	1.55
Extent of owner satisfaction with constructed quality	1.19	2.09
Impact of remuneration method on cost	0.5	0.9
Impact of remuneration method on quality	0.47	1.3

The most important implications of Table 3 are:

- Traditional delivery systems have a greater positive impact on cost performance than Construction Management at risk.
- Construction Management at risk has a greater positive impact on schedule performance than Traditional delivery systems.
- Construction Management at risk provides greater owner satisfaction on cost savings, schedule, and constructed quality than Traditional delivery systems.
- The remuneration methods normally associated with Construction Management at risk have greater positive impact on cost performance, schedule and quality performance than those associated with Traditional delivery systems.

Table 4. Impact of remuneration method on project goals

GOAL	LS	LSU	C+	GMP
Impact on cost	0.83	0.33	0.8	1.2
Impact on quality	0.45	0.56	1.2	1.2
Extent of satisfaction with quality performance	0.58	0.44	0.2	2.5

The most important implications of Table 4 are:

- Guaranteed Maximum Price has the greatest positive impact on cost performance whereas Lump Sum, Unit Pricing and Cost of Work Plus a Fee have slight impact.
- Guaranteed Maximum Price and Cost of Work Plus Fee have the greatest positive impact on quality performance whereas Lump Sum and Unit Pricing have negligible impact.
- Guaranteed Maximum Price produced the greatest level of satisfaction relative to quality performance whereas Lump Sum, Unit Pricing and Cost of Work Plus Fee produced only slight impacts.

PRIMARY DECISION TIMING

When constructing new or renovating existing facilities, owners are faced with the critical task of organizing a team of design and construction professionals to execute the desired results. Depending on the owner's goals, experience, and capabilities, and on the project characteristics, the parties involved in the construction process are assigned different roles and responsibilities. Also, the attitude of each party toward risk and the level of trust between the parties (Salazar et al., 1994) greatly influence the risk allocation to each member of the project team. These conditions and decisions help determine the specific delivery system that should be used when executing the project and further establish the remuneration method (Gordon, 1994), contract type and contract language (Construction Industry Institute, 1988) that should be incorporated into the different agreements.

To further explore the project performance impacts caused by timing, the survey respondents were asked to indicate when primary decisions were made about the allocation of roles, responsibilities, and risk to each party involved in the project. Timing information was also solicited regarding when a construction delivery system, remuneration method, and contract type were selected for the project. The construction process phases were used to indicate when such commitments were made. Project performance impacts, as caused by the preconstruction services underlying the Traditional and the Construction Management at risk delivery systems, were also explored. These preconstruction services included cost estimating, value analysis cost saving effort and scheduling services. The results of this part of the study are graphically depicted in the decision tree shown in Figure 1.

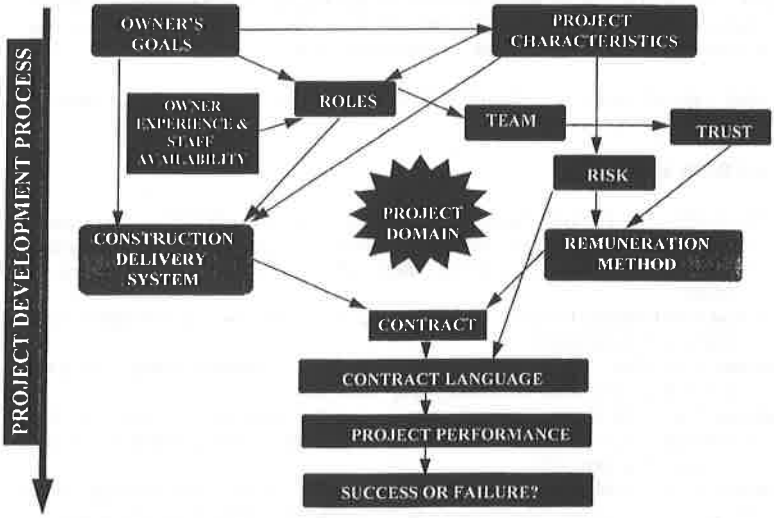

Figure 1. Delivery system and remuneration method decision tree

Owners should first define their goals with regard to the project. This leads to the definition of the project characteristics. A clear assessment of the construction experience and availability of the owner's project staff should lead to the identification of the roles and responsibilities that the owner is capable of playing within the project team. These conditions should lead to the selection of the most appropriate project delivery system. Once these decisions are made, it is easier for the owner to identify the amount of project risk that his/her organization is willing and able to take. The level of trust the owner may have on the parties involved in the project should

be also considered. The owner can then make a decision regarding the most appropriate way to remunerate the parties for their professional services. Once these decisions have been made, the contract type and language can be defined to better reflect the owner's goals, the characteristics of the project and the nature of the relationship between the parties.

CONCLUSIONS

Based on the findings of this research it has been determined that the Construction Management at risk and the Cost of Work Plus a Fee together with the Guaranteed Maximum Price can produce better, more satisfactory cost, schedule, and quality performance results in comparison to the Traditional delivery system using Lump Sum or Unit Pricing remuneration methods. Construction management at risk also produced a higher degree of satisfaction on cost saving effort, constructed quality and specified quality. The resulting improved performance can be seen as directly linked to the timing of various preconstruction services and the choice of personnel who participate in and lead the various preconstruction efforts.

Further research should be performed with a larger sample size to increase the statistical reliability of the results of this study.

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OWNER DEMANDED QUALITY SYSTEMS IMPLEMENTATION IN CONSTRUCTION PROJECTS

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Abstract

A summary of the principal characteristic, problems, limitations and benefits of the processes of implementing quality systems based on the ISO 9000 in Chilean construction projects, is presented. These implementation processes were carried out by different construction companies with no previous experience on quality systems or ISO 9000, at the requirement of one owner. The implementation processes were divided in different phases, which are described. The particular and general characteristics of the processes and the lessons learned are analysed according to the appraisal of the different participants. Special focus is given to the impact that quality systems had on the relationship between the owner and its contractors. Finally, some recommendations are proposed for improvement of the implementation process of quality systems in construction projects, as well as for future implementations in countries with limited experience on this regard.
Key words: Quality systems, ISO 9000, construction projects, owners' requirements.

INTRODUCTION

According to research accomplished in 1986, the activities of quality assurance in most of Chilean construction companies were limited only to meet the technical specifications of final products, with a strong dependency on the owner's inspection (Serpell and Alarcón, 1986). This situation is still a reality in the current time, although it has started to change. Recently, some owners have begun to transfer the responsibility for quality assurance to contractors. Thus, construction companies have begun efforts to implement quality systems in construction projects impelled or "forced" by the owners and not by their own initiative in almost all the cases.

It was therefore considered to be interesting to know about the problems, limitations and benefits to expect in implementing processes of quality systems in a environment with limited knowledge and experience in this topic, and how the relationship between an owner and its contractors can be affected by this situation. It seems obvious that it is not correct to directly apply experiences from developed countries like Japan (Koivu, 1994; Hirao, 1994) particularly with application of QS from the 1950s or the approach of the Scandinavian countries (Baden,

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1994) with large advances in the last years. In all these countries, quality systems are generally recognized, to which must be added the cumulative experience through years of research and development.

An additional focus of this study was to observe the impact of the inclusion of QS on the relationship between an owner and its contractors, and how it possibly affects the procurement of construction services. In the cases studied, QS was a procurement obligation and the longer term issue is whether it should always be one or whether QS becomes "second nature".

The research was accomplished with the purpose of identifying the barriers and difficulties which owners and contractors can find if they try to force the implementation of QS following approaches based on other realities or without providing the necessary flexibility needed to compensate for the lack of expertise not only of the owners themselves but also of local contractors.

To achieve the previous objectives, 3 construction companies which were running 5 construction projects between November 1993 and April 1994 were observed and interviews applied to projects' personnel. The contractors were contractually required by the owner to apply quality systems based on ISO 9000 series during the execution of mining projects . The description of the projects observed in the study is shown in Table 1, along with the time at which the observation on site was carried out.

Table 1. Description of projects studied (adapted from Crovetto, 1995)

Project	Type	Completion term [months]	Contractor's Previous QS Experience	Date of study (*) [months]
A	Civil works and steel structures	12	NO	2.5
B	Civil works, piping and steel structures	7	NO	2
C	Civil works, piping and steel structures	6	NO	2
D	Civil works, piping and steel structures	6	NO	1.5
E	Civil works, piping and steel structures	11	YES	10

(*) Time from the beginning of the project

The interviews were carried out through all the levels of personnel involved in the QS implementation processes. A total of 33 persons were interviewed as shown in Table 2.

Table 2. Description of interviewed personnel (adapted from Crovetto, 1995)

Project	Top company management	Site Professionals	QA/QC Office	Crew Foremen	Site Administratives	Owner's Representatives
A	2	2	3	2	2	2
B	0	1	2	1	0	1
C	0	2	2	2	0	1
D	1	1	0	1	0	1
E	0	1	1	1	0	1
Totals	3	7	8	7	2	6

Figure 1 shows the relationship between the different participants involved in the QS implementation processes. Regarding the projects included in the study, the following aspects are interesting to note for clarification purposes:

- Two of the three companies involved did not have previous experience in the application of quality systems in their projects, neither did they possess any knowledge of the ISO 9000 series.
- The time between the adjudication of contracts and the beginning of projects was 45 days and this was used for the preparation and development phases of the QS for each project.
- The two contractor companies without experience in QS, required the services of a consulting company which had acted as the owner's inspection in a previous contract.
- The control of the quality system was exercised by the owner itself through quality auditors at the site that were trained during a previous contract.

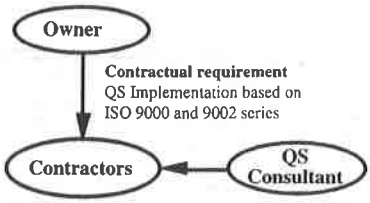

Figure 1. Relationship between projects' participants

The structure of the implementation processes was similar for all the projects and it included three sequential phases: preparation, development and implementation, as described in Figure 2. Each phase was considered concluded when specific planned objectives were reached. Then it was possible to continue with the development of the next phase.

CHARACTERISTICS OF THE IMPLEMENTATION PROCESS

The QS implementation introduced changes in different aspects of the organisations involved in the process. Interviews served to analyse the impact of this changes and to identify ideas for improving future implementations. In the next sections of this paper, the main issues observed are discussed.

Characteristic associated with the organisational structure of the work

The contractors

Concerning their organisational structure on site, contractors had to incorporate a Quality Assurance and Control Office (QA/QC), which was directly under the control of Project

Management. The chief of the QA/QC office counted on a person in charge of documentation files and QA/QC inspectors, which were in charge of the system follow-up and control.

Contractors' site organisations were quite similar, but differences were found in their support towards the QA/QC office which depended on the magnitude of the project and each contractor's commitment to the QS.

The owner

The principal novelty for the owner's organization, was the inclusion of site quality auditors in charge of assuring the effectiveness of the contractors' quality systems. Due to the lack of experience of contractors and indeed of their own, they had to be very flexible and appeal to the good faith of contractors to achieve this purpose.

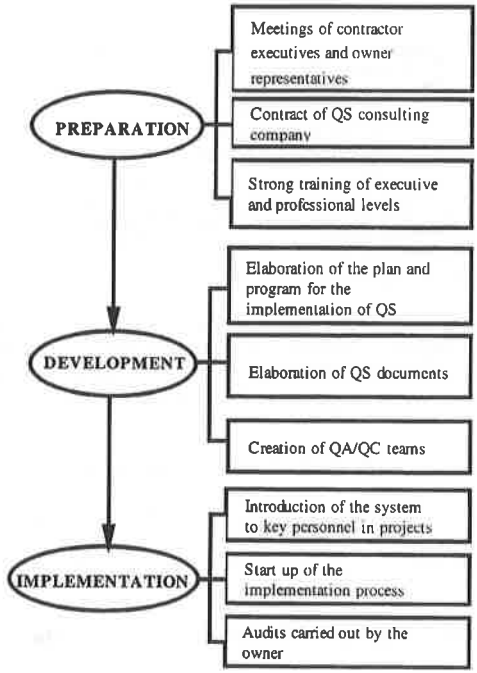

Figure 2. Description of the phases of the process

Characteristics related to incentives

The contractors

In order to motivate and achieve the workers' commitment to the system, the contractors took some of the following actions:

- Key implementation processes personnel received monetary and non monetary incentives.
- There was a permanent presence of management on site to show commitment to the quality system.
- Supervisors were consulted about operating procedures and they participated in the elaboration of procedures associated with their jobs.
- Objectives pursued through the implementation of QS were communicated in a clear and precise way to site personnel.
- Personnel was convinced that training on QS would provide them with better qualifications for future jobs.

The owner

The main incentive given by the owner to contractors, was the promise to incorporate them into a "short list" for future projects. In spite of this incentive, contractors were not very convinced of the benefits of QS and the system was only seen as an owner's contractual requirement. As a direct consequence of this, none of the construction companies was able to maintain the application of the system beyond the time specified by the contract.

Characteristics related to training

The contractors

The contractors had to take several actions to confront the training needs of personnel, as follows:

- An intensive multi-level training program at work was developed, with the objective of reducing the lack of knowledge and experience in the use of the concepts and techniques that sustain the application of a QS.
- A permanent evaluation of the learning and the progress of participants was performed, and a constant and periodical evaluation of the training program was carried out.
- Professional profiles of each one of the key positions were elaborated for the application of the QS.
- Knowledge matrixes were developed, in which each member of the organisation was associated to the needed quality knowledge and abilities.

It is also important to underline, that the results obtained by one contractor that extended the training programs to direct labour levels were not better than those which only trained down to foremen level. This situation was basically due to the lack of workers' interest, to the work pressure produced by the short construction time allowed, and to the lack of appropriate incentives.

Barriers or limitations

At the beginning of the QS implementation processes, both cultural and operational barriers were observed, some of which could not be surpassed and notably affected the success of the processes. The most important were the following:

The contractors

Several barriers were faced by contractors as follows:

- Lack of knowledge of the concepts and tools of QS systems.
- Deficient communication of objectives to personnel.
- Unlinked implementation processes between the main office and the site.
- Improper organisation of the company, not adequate for the implementation process.
- Lack of real commitment, leadership and interest of the company's top management.
- Problems with the definition of the QS project scope due to inexperience in the topic.
- Lack of interest and commitment of site personnel.

Furthermore, particular barriers faced by project managers at the construction sites were as follows:

- Lack of knowledge about the company's quality manual and procedures.
- Short project completion times.
- Lack of participation in the elaboration of operational and administrative procedures.
- Insufficient knowledge of project documents, a fact that produced a mis-management of changes and supplies as well as late detection of design quality problems.
- Rejection of the change of attitude needed for the application of the system.
- Lack of knowledge and expertise in the market, in order to involve designers, suppliers and subcontractors in the process.
- Natural rejection of the system due to the extra efforts that its implementation implied.
- Lack of qualified personnel on quality and quality systems in the market at all levels.

The owner

The owner's staff also faced several important barriers which are mentioned below:

- Rejection of the QS by owner personnel.
- Insufficient management of changes and supplies that affected the owner/contractor relationship.
- Improper training of the contract administration team.
- Insufficient control of the main parameters of project management: quality, time and cost.
- Divergence of objectives inside the owner's team.
- Weaknesses in the creation of owner/contractor teams.

Particular problems of the implementation processes

The contractors

Problems indicated by contractors' personnel are shown in Table 3.

Table 3. Problems mentioned by contractors' personnel (adapted from Crovetto, 1995)

Problems	Projects A	B	C	D	E
Lack of knowledge and expertise of site personnel	√	√	√	√	√
Lack of performance parameters to evaluate the implementation process	√	√	√	√	√
Rejection to the system by site personnel	√	√	√	√	√
Difficulties associated with system documents	√	√	√	√	√
Rotation of site personnel (foremen and workers)	√	√	√		
Difficulties in the design and implementation of the files required by the system	√	√		√	
Objectives conflicts between production area and the QS	√	√	√		
Difficulties in management and consolidation of the QA/QC office at work	√	√	√		
Lack of presence and motivation in site of companies' top management	√	√	√		
Mistakes and difficulties in the training program	√	√			√
Difficulties in the integration of professionals to the implementation process	√	√	√		
No prior knowledge about the system	√	√	√	√	√
Negative reaction and bad initial attitude	√	√	√	√	√
Difficulties associated with training and communication of the system at the site	√	√	√	√	√
Lack of relationship between the new system and benefits that workers could receive	√		√		

Owner

According to the owner's personnel, the following problems were associated with the contractors' performance:

- Difficulty for generating commitment of site personnel to the system.
- Contractors demonstrated severe difficulties in the management of system documentation and in the maintenance of the system files.
- Lack of initiative of contractors to begin with the implementation process, that amplified the impact of the short construction completion time.

Benefits of the system

For the contractor

The most relevant benefits perceived by contractors' professionals are shown in Table 4.

Table 4. Benefits mentioned by contractors' professionals (adapted from Crovetto, 1995)

Benefits	Projects A	B	C	D	E
Relationship with the owner improved ostensibly	√	√	√	√	√
System provided order, control and planning to site works	√		√		√
System favoured quick treatment of doubts and/or work modifications	√		√		√
System increased the participation and communication at site	√		√	√	
System improved team working of personnel	√			√	
Implementation processes allowed to spread companies and projects objectives	√			√	
Implementation processes improved the leadership conditions of people in charge of workers			√	√	

Foremen also added the following benefits:

- Once the system was put under way and accepted, it increased the order and the speed in the projects progress.
- Trust between the hierarchic levels on site increased considerably.

- A re-evaluation of workers' responsibility, image, and ethics by professionals was achieved.
- The disappearance of the classic antagonistic point of view about work inspection for workers and foremen was encouraged.

For the owner

Benefits perceived by the owner's staff from the implementation of QS's are mentioned below:

- The relationship owner/contractor shifted to an issue of mutual trust.
- The combination of the QS with the organisational structure of the owner reduced the "work dead times", due to better decision making on site.
- Re-work was reduced due to the fact that the personnel became conscious of a greater responsibility on their assigned tasks.
- The management of changes and/or modifications was improved.
- The completion of tasks was documented and registered in detail, avoiding the possibility of subjective interpretations.

Success factors

The processes were also supported by success factors or positive aspects found in the cultural characteristics of the members of the construction companies, which should be taking into account for future QS implementation processes. Among the most important factors mentioned are the following:

- Local companies showed high levels of personal involvement in their human relationships. Their relationships with owners, suppliers, and personnel were based on seriousness and honesty.
- There were adequate levels of self-examination between the professional and management levels.
- Many workers felt very identified with their companies, a fact that was used for motivation purposes.

RECOMMENDATIONS

The analysis of the research results provided several recommendations for future improvement of QS implementation processes. These are discussed in the next sections of this paper.

Regarding the organisation of the work

For contractors

- To assure that company and project organisational structures are fitted to the proposed projects objectives.
- To adequately structure and support the QA/QC office at the site, according to the tasks that it must fulfil.

- To reduce the hierarchies and delegate decision making at site level, in order to achieve a greater flexibility and decrease "work dead times".
- To provide the necessary training and abilities to QA/QC offices members.
- To establish means for improving communication among different levels.
- To assure the use of a clear and common language to avoid distortion of QS concepts and terminology, specially at the lower organisational levels.

For owners

- To introduce the contractors at early stages of the project in order that they can better understand owner's requirements.
- To consider the possibility of "partnering" with projects participants.

Regarding incentives

For contractors

- To develop statistical tools to measure the achieved results and communicate them in order to increase the commitment to, and trust in the system.
- To stipulate adequate incentive plans for critical implementation personnel.

For owners

- To establish actions for increasing QS knowledge and expertise in the construction market, by requiring their use within their procurement processes.
- To promote by incentive, ISO certification of suppliers and service companies, as well as the involvement of designers and subcontractors.

Related to training

For contractors

- To increase the quality of persons in charge of the training program.
- To continue with training at all levels, given the fact that the fundamental limitations for the implementation processes were the lack of knowledge and expertise of site engineers and personnel on the topic.
- Construction companies should keep applying quality systems in their projects even if it is not a contractual requirement, to learn and acquire expertise on it.
- To use quality circles as a better and quicker way to acquire knowledge, expertise and search of solutions.

For owners

- To foresee realistic periods between contract adjudication and the beginning of the construction project, to allow proper planning and implementation of the QS by contractors, and in this way, to avoid the contractor's dilemma of attending to the system or to the production.

CONCLUSIONS

The introduction of the modern concepts of quality systems is not an easy task in environments where the lack of knowledge and experience create particular limitations or barriers to implementation processes.

This exploratory study allowed us to know the limitations and the most important characteristics which were presented in different QS implementation processes. Also some benefits produced by a QS were identified. Furthermore, an effort was made to transform the information obtained into useful recommendations. These recommendations are directed to prevent foreign and local companies which want to implement a QS basing it on external experience, without taking into account the particular characteristics of the local construction market.

It is stressed, finally, the need of creating a "domino effect" in the market towards quality systems, in order to convince construction companies about the advantages of its application and in this way to induce their use by their own initiative and not as an owner's contractual requirement. Also, this initiative should be extended to suppliers, designers, subcontractors and other organisations in the construction industry.

Regarding construction procurement, the main conclusion is that quality systems can provide a suitable mechanism to improve the relationships between an owner and its contractors. The main advantages offered by this approach are as follows:

- It establishes a common goal for all parties involved.
- It performance depends on the creation of a team spirit between the contractor and the owner, and it favours partnering.
- It creates communication channels between owner and contractors, as required by the QS.
- It requires a formal and rigorous handling of documentation and the creation of records that help to solve problems.
- Because of its nature, a QS requires the attendance to problems and conflicts in the short-term.

However all these advantages can also be sources of problems if the QS is not well applied and if there is a high level of distrust between the parties. This fact makes it necessary to teach contractors and owners to work under this scheme.

ACKNOWLEDGEMENTS

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THE INSENSITIVITY OF THE PROCUREMENT PROCESSES IN THE UK CONSTRUCTION INDUSTRY TO THE PROBLEMS OF OCCASIONAL BUYERS FROM THE INDUSTRY.

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Abstract

Most clients (by number) of the UK Construction Industry can be categorised as small or occasional clients. Even where large corporate organisations form the client base, most are divisionalised, regionalised or subdivided in such a way that they fall into this sector. Many of the decision-making executives are mobile within or between organisations and there appears little evidence that they learn by experience in terms of the process associated with construction procurement.

This paper examines the problems met by a sample of this category of client and what mechanism, if any, exists in the sector to address these problems or to seek long-term strategic improvement. The paper considers the frequency of types of problems and their causation. The extent of involvement by the client in the pre-construction selection of strategies and participants is analysed as is the awareness level of this category of client in terms of the procurement processes. Consideration is also given to any changes in the relationship between the parties during the procurement process. The paper concludes by identifying the type and extent of problems identified by small and/or occasional clients and summarises the steps being adopted by the client sector to seek long-term solutions.

Key words
Small construction clients, occasional construction clients, problems, procurement strategies, relationships, long-term solutions.

INTRODUCTION

Between 1993 and 1994 the UK Construction Industry was the subject of a review initiated jointly by the Government and the industry itself. The need for this review emanated largely from those sectors of the industry and those client bodies who were constantly disappointed by the Industry's performance. This review was led by Sir Michael Latham who produced his final report 'Constructing the Team' which advocated, inter alia, that construction clients have a leading role in the construction process and should come together in a Construction Clients Forum. He states that:

> "Clients will have a vital role to play in ensuring the implementation of best practice, and they will also have most to gain from it" (Latham, 1994, p4).

The Construction Client's Forum (CCF) was established in 1994 soon after the publication of Latham's review, with a brief (i) to represent clients in industry/Government consultation, as well as in the newly formed Construction Industry Board (CIB) and (ii) to initiate research on issues identified in the Latham report (1994) as of crucial importance to construction industry clients.

The CCF recognised that the construction industry is acknowledged to be highly fragmented; even seasoned project sponsors are often unaware of the opportunities for greatly enhanced value and of the many traps for the unsuspecting client. They estimated that 96% of project owners are "Small or Occasional Clients" (SOC's) and that "occasional clients" include owners of some very large projects (Price, 1996).

The CCF quickly took steps to ensure that the particular problems associated with being a small or occasional user of the construction industry or being a small or medium sized enterprise (SME) were addressed, and that solutions were sought. The research discussed in this paper aimed to contact SOC's and to establish networks which would encourage the benefit of improving value for money to be brought to the attention of clients who are thinking of building.

In discussing the experiences of a client through the construction process, Blackmore (1990) recognises some of the key problems. He proposes that:

> "Little wonder that the lay client is often bemused by unrealistic expectations. Confusion is worse confounded by a failure to identify who is responsible for what, and how the different parties interact.....Clients become worried and over-sensitive mainly because they do not understand the design process (and no one troubles to explain it) and the part the client has to play in it. Ignorance, uncertainty, history and tradition can all sow seeds of doubt" (Blackmore, 1990, pp28, 31-32)

Research Context and background

There is a level of belief that market failure exists in the UK construction industry. Market failure in this context reflects a market where the bargaining power is unequal; in this case largely because the level of understanding of one party in respect of procurement practices and processes is greater than the level of understanding of the other. Consequently terms of agreement are distorted and information accessible unequally. Market failure arises typically in the construction context where clients are small in relation to contractors or are involved infrequently in contract negotiation and project management. The principle cause is information asymmetry - contractors and designers are more knowledgeable than their clients. Market failure reduces the efficiency of the market for construction services, to the detriment of the client and the industry because of the consequentially slower move towards best practice (Cockerill, 1996, p37).

The CCF wanted to see that the interests of SOC's are fully taken into account in the debates on change in the construction industry. It recognised that it is difficult to be sure that this is achieved in the context of the current structure of the construction industry and

the ways in which clients themselves are distributed across a broad range of types and sizes.

The Forum held a series of meetings with individuals who have a particular interest in the subject of small and occasional clients. Those involved have included the Confederation of British Industry (CBI), Chartered Institute of Purchasing & Supply (CIPS), consultants, academics, contractors and active clients. The meetings facilitated the identification of some of the key issues, introducing new thinking into the subject area and bringing forward ideas for ways in which the interests of SOC's could be more effectively pursued.

The participants in the meetings considered that a research project under the framework of the Department of the Environment's Partners In Technology (PIT) programme would be the most appropriate vehicle for undertaking the analysis and for identifying priorities and a set of actions for securing the interests of this important group of clients.

The CCF group has generated key issues which are particularly relevant to small and occasional clients of the construction industry.

In order to clearly and accurately identify small and occasional clients of the UK construction industry, a definition has been applied to identify and subsequently prequalify respondents used in this investigation.

A small or occasional client of the construction industry is therefore an individual owner or person acting as "the client" for his/her organisation who commissions the design and construction of a new or refurbishment project (not repairs and maintenance) and is from:

- a small or medium sized enterprise (SME) * or
- an organisation of any size who is "a first, second or third time buyer" of the construction industry and who has does not have access to an in-house construction procurement adviser within the last 10 years.

Purpose and Objectives of the Research

The purpose and objectives of the research was to bring the benefits of the Latham Review, the work of the Construction Industry Board and of the Construction Clients Forum to small and occasional clients of the UK construction industry.

Specifically, the research intended to provide the following:

- A definition and categorisation of SOC's
- Identification of those "Latham" policy issues which are of critical importance to small clients and an examination of how they are being addressed by the CIB processes to date.
- Specific suggestions as to how SOC's might be able to develop market strength through information-sharing business networks.

* defined by the European Commission as an enterprise having less than 250 employees, a turnover of less than ECU 40m (£32.2m**) and annual balance sheet total of less tan ECU 27m. (£21.7m**)
** ECU 1.242 = £1 on 20.6.96

- Identification of opportunities for existing regional and national small client networks to be developed, or used as examples for the purpose of developing new SOC's networks in the construction industry.

The principle outcome of the research is intended to provide the basis for a reform of the market conditions faced by SOC's in the UK construction industry. The reform will be driven by empowerment of SOC's to establish and develop information-sharing regional and national networks, and will highlight what supply-side bodies can do to improve the service their members provide to their SOC's.

It is recognised that the research will also provide very valuable information to the bodies represented on the CCF, its Small Clients' Group and academic establishments. The information will enable such bodies to demonstrate to their members the benefits of adopting the recommendations which have been established through this research, and should be a catalyst to further academic research into the market dynamics and purchasing of construction services.

The initial target audience will be those bodies and organisations with an understanding of the issues surrounding the construction industry (CCF, supply-side and demand-side representative organisations, Government, academic institutions, etc.) The report will form the basis for further appropriately-worded information targeted at SOC's, suppliers and the public.

It is anticipated that the ultimate benefits of this work will accrue long term over several years, as these involve the extensive dissemination of information and significant changes in behaviour among SOC's and suppliers.

Methodology

It was identified that networks of SOC's do not appear to exist either formally or informally. The identification and establishment of a true population of SOC's proved to be extremely difficult within the constraints of this study. Consequently, establishing the size of representative samples also proved to be problematic. This is a limitation in terms of true representativeness, but by establishing the largest practical sample frame this limitation is seen as having been addressed.

Although a data base of potential SOC's was established, even though no networks existed, there is a level of geographical limitation to the respondents used in this investigation. Despite attempts being made to overcome this limitation, some geographical areas were inevitably unrepresented.

The response rate in relation to the number of questionnaire surveys distributed is considered to have been relatively low. This appears to have resulted from the non existence of the frameworks referred to above and an inability to follow up all those contacted by questionnaire 1 due to the large size of the sample frame.

Data was collected primarily through the use of questionnaire surveys. Two questionnaires were developed for the purpose of collecting data. Due to the relatively wide geographical

spread and number of respondents used in the investigation, the use of questionnaire surveys was identified as being the quickest and cheapest method of data collection (Nachmias & Nachmias, 1992, p216).

The questionnaires were developed and piloted to 12 SOC's from around the UK. Each questionnaire was subsequently revised and distributed to the respondents on the database. In addition to the questionnaire surveys, a number of workshops were arranged throughout the country. The primary purposes of these workshops was to verify the findings of the questionnaires and to communicate the purpose of the research programme to small and occasional clients. These workshops have also facilitated the collection of case study data from clients who have recently bought from the construction industry.

A database of possible SOC's was established by contacting planning authorities around the UK and asking for details of applicants who have applied for and successfully been granted planning permission during the last 10 to 15 years. The "Municipal Year Book and Public Services Directory 1996" was used to identify the District Council planning departments in the UK. A total of 84 planning authorities were contacted.

Information was received from a total of 14 planning authorities, and a total of 5334 addresses of successful planning applicants were received from these authorities. As a result of duplication of addresses, the inclusion of large clients and developers and the details of applicants who are applying for minor alterations to existing buildings (such as new windows and doors) the total number of addresses which were actually used was reduced to 3181.

In addition, additional client details were obtained by "cold calling" from a range of business directories of areas around the UK. Approximately 1,250 businesses were contacted by telephone and asked to participate in the study if they had purchased from the construction industry. These included businesses such as hotels, restaurants, doctor's surgeries, dental practices, nursing homes, motor garages, veterinary clinics, leisure centres/facilities. In each case, the nature and background of the research was discussed along with the potential benefits which the study was expected to provide to SOC's. From this source a further 400 respondents agreed to take part in the research by completing the questionnaires.

Business Links, an extensive network of a range of businesses including small and medium sized companies in the UK, were contacted in order to provide additional details of SOC's for the investigation. Each Business Link was contacted by telephone (followed by a letter) detailing the nature and purpose of the research and asked to assist by providing names and addresses of businesses in their area. A total of 55 Business Links were contacted across the UK. From these only 9 sent details of clients. However, a further 200 client details were provided by this source. These clients were contacted by telephone and letter, and asked to participate with the research.

Two questionnaires were designed, piloted, adjusted and distributed to collect primary data. Each respondent on the database was sent a copy of questionnaire 1 with a cover letter which detailed the nature of the work, encouraging the respondent to take part with the research and a freepost envelope to return the completed document.

Questionnaire 1 was specifically designed to prequalify the respondents into the category of SOC's (as defined) and to establish the overall level of satisfaction and dissatisfaction faced by the respondent when dealing with the construction industry. The respondents were asked if they wish to assist further with the research by identifying up to three construction projects with which they had been involved with during the last ten years and to provide detailed information on the problems they faced on such projects. This questionnaire was distributed to all the respondents on the database.

Questionnaire 2 was distributed to respondents who had completed questionnaire 1 indicating that they wished to contribute to the research, and to respondents which could be categorised by the definition of SOC's (as defined previously). It was designed to specifically identify the variety of problems being faced by SOC's when buying from the construction industry. It identified why the client used the construction industry, details of the project which was built, information regarding the design consultants and contractors, how the project was managed, the relationships which were created between the project team, the defects which appeared on the projects and other difficulties which the respondent experienced during the construction of their project. Due to the poor response rate to questionnaire 1, additional SOC's were identified through cold calling and through information provided through the Business links and were sent questionnaire 2.

Overall, the response rate was disappointing in quantitative terms but very encouraging in qualitative terms. Some 175 responses were received after extensive follow up work. Although a relatively low response rate was expected from a population which was ill-defined in terms of size and where no databases were available, the number was nonetheless considered to be low. However, the additional data collected through the workshops helped to verify and validate the data collected by the questionnaire surveys.

Commentary on Results

The results of the questionnaire 1 indicated that more than 25% of responding clients from a broad range of organisations were dissatisfied with the services of the construction industry of where some 60% experiencing problems with dates and quality and some 70% with minor or serious defects. When analysing the results by size of company (expressed by turnover) it was evident that smaller clients (less than £5m turnover) expressed greater levels of dissatisfaction and identified more serious problems than the rest of the sample.

The results of questionnaire 2 also indicated that some 60% of responding clients experienced problems with dates and quality standards, with some 73% suffering defects and/or omissions (mainly of a minor nature). Most of the causes of delay and quality were attributed to the contractor but the design team were also seen to contribute (see table 1).

Table 1: Frequency of principle problems met throughout the construction process
Note: Respondents could respond to more than one section. Percentages are of total number of respondents.

Problems	None	Minor	Serious
Achieving Completion Dates	36%	43%	17%
Achieving Quality Standards	33%	50%	10%
Achieving a Suitable Design	57%	32%	3%
Achieving Within Cost/Budget	33%	50%	11%

Some 60% of respondents to questionnaire 2 also expressed problems in meeting cost targets and in this case the predominant cause was seen as the inexperience of the client or late changes initiated by him. Some 70% of changes were identified as emanating from the client (see table 2).

Table 2: Responsibility for Changes to the design of the project
Note: Respondents could respond to more than one section. Percentages are of total number of respondents

Changes by Yourself as Client	67%
Changes By The Design Consultants (Architect/Engineer)	35%
Changes to Meet The Requirements of Statutory Regulations	11%
Fire	31%
Building Regulations	22%
Safety (Construction, Design & Management regulations)	14%
Proposed By The Contractor	25%
Other: Clients Risk Assessment Consultant	4%

Questionnaire 2 further identified whether design consultants were selected from those known to the client or recommended by others. Most contracts for design were based upon negotiation. Identification of contractors was carried out on the same basis but most of them were selected by price competition after having subjected them to some form of pre-qualification process. The JCT family of contracts were those predominantly used to formalise the relationship between the parties.

By far the majority of clients identified an individual within the organisation to co-ordinate the interests of the organisation and to deal with the decision making process. There was indication of wide consultation in the pre-construction phase, with the briefing process involving the design team. Contractors were not heavily involved at this stage. Almost all respondents felt that the brief was adequate to achieve the project's objectives.

In terms of managing the project itself, the respondents identified the design consultants and internal managers as of equal importance. The contractor was not normally identified in this role. Although relationships between the client and contractor were identified as having changed during the project, there was more indication of improved relationships rather than deteriorating relationships. Notwithstanding this indication, some 25% of clients identified that they had significant disputes with their contractors, although most were settled by negotiation.

Of the total projects surveyed, only 20% of projects were completed with no inherent defects, some 65% suffering minor defects or omissions caused predominantly by the contractor.

The decision to undertake projects was usually made by in-house staff who most often sought advice on how to proceed from a member of the construction design team (in most cases an architect). Most respondents indicated that choices of ways to proceed were offered and that viability/feasibility in terms of time and cost was evaluated (on the basis of information provided by architects, quantity surveyors and other identified).

Notwithstanding the latter response, some 30% did not seek further advice about design time nor procurement route, nor the role of the client. Some 20% did not seek further advice about construction time nor specification standards. Only some 50% sought further advice about design layout.

Consistently, respondents identified as a major concern the lack of clarity about the roles and responsibilities of consultants and contractors, and difficulty in understanding the construction procurement process. Similarly, making project decisions whilst still performing the client's main business function, and planning and organising minimal disruption were seen as primary problems.

In analysing the results by the procurement method adopted, there is evidence to suggest that problems are more likely with the traditional method than other forms of procurement. The first area which is highlighted as a cause for concern relates to design problems. From the results it may even be inferred that there is an association between procurement method and design problems: there is a greater likelihood of suffering problems if the traditional procurement approach is used. When making this claim, it is important to appreciate the significance of it in statistical terms, which, with the given distribution of results, will only be incorrect 1 in 20 times.

Under the design and build strategy, a lump sum figure is submitted by the contractor for designing and building the project. The research has identified that if a client chooses this route, it is less likely that problems will be suffered. A disadvantage of passing the risk to the contractor is that the client loses a certain amount of control over the project. Also in theory, the contract price should be higher than with the traditional strategy due to the risk transferral. In practice, due to the very competitive market for construction work in the past few years, this does not seem to have been the case. If the market rises, and contractors have more choice, they may be less willing to except additional risk through design and build unless a premium is paid. Although design control is reduced with design and build, the research shows that clients are still more satisfied with the design.

A major shortcoming perceived to be associated with design and build is that achieving quality can be a problem. The results show that for this sample no association exists between this procurement method and quality standards. This could be due to the types of projects that use design and build and which were covered by this survey.

Inherent buildability and single point contact are often cited as advantages of design and build (Masterman, 1992). The research confirms this claim because less design problems are reported to be suffered when a design and build route is used. A further advantage is that price certainty is obtained before construction starts, provided that the client's requirements are adequately specified. The results confirm the above to be true as the clients experience less cost problems with design and build than with the conventional method. These advantages of design and build are mirrored by the disadvantages of the traditional strategy i.e. open to abuse, no buildability information and adversarial relationships developing.

Under the traditional method of procurement, the client appoints the design and cost consultants. Only after the design work is completed is the contract let to the contractor who carries out the work. It is here where problems occur because:

> "Under the traditional procurement strategy, design should be completed before tenders are invited and the main construction is let. As a result and assuming no changes are introduced, construction cost can be determined with reasonable certainty before construction starts" (Morledge & Sharif, 1996, p36)

If this is so, why should the traditional method lead to more problems in design? Unrealistic targets are often initially set by either the client, or the professional advisors who try to satisfy the client's needs in the short term (Morledge et al., 1996). However, if targets are unrealistic, the design team may fail to meet expectations. This failure can lead to problems in terms of unsuitable or incomplete design. Claims from the contractor often result due to late changes which then affect the client's costs. This link is reflected in the survey results as cost and budget overruns are also identified as problems which have been experienced by clients using the traditional procurement system.

Conclusions

Most clients used the traditional procurement method, so why is it so popular if it is associated with design and cost problems? This phenomenon is known as the "procurement catch" and is particularly important to small and occasional clients. When an inexperienced client recognises a need for a building he/she will probably seek the advice of an architect. From this point forward, the client will rely heavily on the advice given by the architect. When the traditional method is employed, the architect is likely to gain a higher fee due to the greater design work required. It is therefore in the interest of the architect to persuade the client to use a traditional method of procurement.

This "procurement catch" may be responsible for the high usage of the traditional methods in the sample. If clients are to use the most appropriate procurement method, then they must be better informed of the variety of systems which are available and the characteristics of each of these systems. The problem is that most small and occasional clients will only build once or twice. It is therefore essential that professional bodies market professional advice to ensure that clients choose the most appropriate procurement strategy and maximise their satisfaction with their project.

The research largely verifies the characteristics expected to be associated with clients buying infrequently from the construction industry. There is clear evidence of a lack of understanding of the roles and responsibilities of the parties involved and a heavy dependency upon external consultants. There is also clear evidence of client disappointment with the services obtained, with a high proportion of projects experiencing minor or major problems. Paradoxically, a general level of satisfaction was indicated from the first questionnaire in relation to the overall service obtained from the industry. This could perhaps be due to the fact that the survey was seen as a post contract user survey, since plainly two thirds of the projects display difficulties and problems during the procurement phase, and the survey related to completed projects.

The short-term objectives with the process of procurement are frequently not achieved, although it appears that the long term objectives associated with building performance may well be achieved in most cases. These short term objectives, associated with time, cost and quality, seem to relate to difficulties in understanding the process involved, the roles and responsibilities of consultants and contractors, and how to achieve value for money. This is recognised by Blackmore who proposes that:

> "The first priority is to find an excellent design, for the client is going to have to live with it for a very long time. In the short term, tight discipline and the skills needed to avoid delays or contain those which are unavoidable are of paramount importance" (Blackmore, 1990, p38).

A major problem associated with this research and which was anticipated in relation to the dissemination of the results and chosen examples of best practice, is seen as the non-existence of representative bodies or linkages leading to existing or potential small and/or occasional clients. The findings can, however, illustrate to those bodies representing design consultants and contractors where improvements in the nature of their services is desired, to achieve greater value for money for their customers, and where reduction in the occurrence of problems can be achieved.

In practical terms, there are many publications identifying good or best practice, but in general small or occasional users are unlikely to be aware of their existence or where to obtain them. It was a primary aim of this research programme that the general awareness level of clients be raised through pamphlets, workshops and electronic communication facilities. It is hoped that this may be achieved in a relatively short time, with particular reference to the publications of the Construction Industry Board and the Royal Institution of Chartered Surveyors which are prepared specifically to improve practice standards in procurement processes.

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Procurement strategy, innovation and the assessment of project success.

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Abstract

The extent to which the construction client's procurement strategy limits or encourages innovation by other collaborators in the delivery of a construction project is affected by many issues. These would obviously include the type of project, the location, available resources, and time and cost constraints, but perhaps the most important factor is the extent to which the client really understands, and can adequately communicate, what is really wanted (i.e. the adequacy of the brief). All of these factors could be expressed in terms of the risk that innovatory practices pose to the various parties involved, and the penalties which are likely to be incurred if things do not go according to plan. It is argued that the *extent* to which innovative practice is desirable or is likely to be encouraged, particularly in respect of design, procurement strategy and construction methods is an issue which should be positively considered by the client at the briefing stage.

This paper attempts to address this issue through a review of some experience in Hong Kong, and examines the procurement strategy employed, coupled with the extent to which innovative practices were incorporated, in an attempt to relate these factors to perceived project success. Finally the paper suggests some factors which appear to be critical if innovation is to be successful from the client's point of view.

Innovation in construction

Innovation in this context may be defined as the process of introducing something novel into the construction environment. Innovation may, of course, be introduced in many different ways, for example through:-

i) the development of new or improved products,

ii) improved construction management techniques,

iii) developments in construction technology (i.e. the process by which products are assembled to satisfy the client's needs),

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iv) new approaches to architectural and engineering design so as to improve the client's and users' level of satisfaction whilst also enhancing the quality of the built environment,

v) improved approaches to construction procurement (e.g. "one-stop shopping", the use of private finance for public sector projects etc.).

Contemporary thought would appear to advocate that innovation is something to be encouraged, but at what cost? The bespoke nature of construction projects means that all innovation involves risk, and ultimately the risk that one or more of the parties involved will be dissatisfied with the final outcome, usually because of over-runs in cost or time or both. If innovative practice is to be truly successful, these risks must be understood and adequately managed, and the potential costs and benefits must be properly evaluated.

It is a basic tenet of good risk management practice that risks, and their consequent financial effects, should be placed with the party best able to control them, and in the case of the items listed above, the risks fall on a variety of parties. The risks, and the financial consequences, of product development fall largely on the manufacturer, whilst the risk and cost of innovation in construction management falls largely on the contractor.

This paper is concerned with the risks posed by items iii) - v) above, where although the risks are, in the main, incurred by the client's consultant team, the financial consequences fall largely on the client. There might therefore be a temptation for consultants to be less risk averse than they otherwise might be if the financial consequences were to fall directly on themselves. A further factor concerns the *extent* of innovation in any particular construction project. Plainly since all innovation involves some risk, then it is at least likely that the greater the degree of innovation introduced the greater the total risks will become. One therefore is led to question the extent to which innovative practice can be safely introduced whilst still maintaining the overall risk within limits acceptable to the client, and this in turn leads to the need for a methodology for risk measurement and evaluation.

All of these issues ought to be resolved during the briefing process, but there is considerable evidence (summarised in Wilkins and Smith, 1996) that this process is commonly both misunderstood and mis-managed both by clients and by their advisors (Latham, 1994). It would appear that clients are rarely if ever presented with any kind of risk analysis of the innovative practices proposed by their consultants, and that the client's attitude to risk is rarely established. An exception might be the Hong Kong Government's novel approach to setting risk parameters at the earliest inception stage of public projects, some features of which are included in the suggestions outlined below in the section: *The management of innovation.*

The possible dangers of innovation have long been well recognised in law in a number of cases of negligence where designers have used innovative techniques which have subsequently gone badly wrong; perhaps the best known example being Greaves and Co. (Contractors) v Baynham Meikle and Partners (1975). The contention that clients should be made expressly aware of the possible

consequences of innovation has also received some support from the Judiciary. In the case of Victoria University of Manchester v. Wilson and Womersley (1984), the trial judge, J. Newey, went so far as to say that:-

> "For architects to use untried or relatively untried materials or techniques could not in itself be wrong, as otherwise the construction industry would never make any progress. However architects venturing into the untried or little tried were wise to warn their clients specifically of what they were doing and to obtain their express approval."

Construction innovation in Hong Kong

Hong Kong has, in recent years, become renowned for its harbour skyline and the diverse quality of its urban architecture. The construction industry in Hong Kong is well-known both for the scale of its construction projects and for the speed with which they are completed.

But what about innovation? In many ways the public face of the industry, the working sites, often appear, particularly to outsiders, to be barely out of the stone age. Construction sites in Hong Kong are very dangerous places, with an annual average of over 300 accidents per 1000 workers (Tam & Fung, 1996). In addition the penalties levied on contractors for industrial accidents and even deaths on construction sites are minuscule, and the use of bamboo scaffolding on 30 storey buildings is a frequent cause of amazement to overseas visitors. And it is true that, in the main, Hong Kong's major private sector clients, the property development companies, are extremely risk averse where innovation is concerned, to the point that innovative practice of any type is extremely rare in this sector of the market.

Nonetheless the Hong Kong construction industry has, on occasion, been genuinely innovative. Examples in the area of construction procurement would include the Hong Kong Cross Harbour tunnel completed in 1972; probably the world's first example of a modern build/operate/transfer project, and the model for a whole series of subsequent tunnel projects over a period of some 25 years. These "contractor financed" principles were later applied to buildings, in the construction of the Hong Kong Club building and the headquarters for the Standard Chartered Bank. In terms of innovation in construction technology the Hong Kong Housing Authority has over the last forty years progressively introduced technological innovation through successive programmes of housing. Design parameters in each new programme are based first, on the performance of the previous programme, and second, on a systematic evaluation, including large scale mock-up testing, of readily available new technologies. The success of this approach depends on a guaranteed workload to ensure contractor participation and performance.

It would however be very unexpected to find, in Hong Kong, a building which included all of the five types of innovation described above; nonetheless the Hongkong Bank headquarters was, at the time of its construction some 10 years ago, one of the most innovative buildings in the world. It is therefore appropriate to examine the problems encountered and the lessons learned, and to review the long-term effects which the construction of this building has had upon the Hong Kong construction industry.

The Hong Kong Bank

Norman Foster's 52 storey Hongkong Bank Headquarters, completed in late 1985, was one of the most technically innovative buildings in the world at the time of its construction, and has been widely acclaimed as an architectural masterpiece. The choice of architect was made through an architectural competition, on the basis of a brief which said little more than that the Bank required "the best bank headquarters in the world", and which should also provide total flexibility to cope with future changes. This fuzzy definition of the client's requirements in objective terms was to prove to be a major problem throughout the project, and with hindsight it could be convincingly argued that the choice of an architect with a reputation for innovation to be responsible for a project where the client plainly did not understand either the briefing process or the limits of the construction industry highlights perfectly the risk/responsibility paradox discussed above.

Williams (1989) chronicles the history of the project, which includes all of the five types of innovation listed above. In terms of the development of new products, perhaps the most significant among many innovations were the pre-fabricated packaged washroom assemblies, each the size of a cargo container delivered to site completely pre-plumbed and pre-finished. The whole project demanded improved construction management techniques and construction technology in order to achieve the kind of engineering tolerances (e.g. 50mm in 183m for the vertical components) demanded by the design, and the fact that the project included so many innovative elements meant that a radically new approach was required to architectural and engineering design. Project architects and engineers had to work hand in hand with industrial product designers and sub-contractors to develop completely new solutions to problems. Examples are the packaged washroom assemblies noted above, the steel frame, itself radically innovative in form, and the proposed structural glass floor to the main public space. These issues were also complicated by the fact that in order to maintain some semblance of cost control, the relevant subcontracts were all let on a lump sum fixed price basis.

These factors in turn also demanded a radical (at least for Hong Kong) change in procurement approach for the project as a whole. The project was constructed using fast track management contracting under a joint venture formed by Wimpey and the local Hong Kong company John Lok.

Although Foster had used most of these concepts before on earlier projects, none had ever been used on a building of this scale, and never all on the same project. And yet the building was required to be completed in record time, only four years from the start of detailed design. A truly revolutionary building, but at what cost?

In monetary terms the budget escalated from a cost estimate of HK$2.167 billion (US$270,875,000) at the start of construction to a final cost of some HK$5.13 billion (US$641,350,000). Design variations on the steelwork sub-contract alone virtually doubled the subcontract sum, to the extent that, in the end, the original budget figure proposed by the bank for the whole building barely covered the cost of the structural frame. It was christened the world's most expensive office block.

In terms of client satisfaction, although the client publicly expressed satisfaction with the finished result, Williams shows all too clearly that the client was very far from satisfied with the

procurement process:-

> "The relationship between the architect and the client during the fit-out phase was equally uncomfortable, with many crucial client decisions unfinalised and the clients view of the architects one of obfuscation and inability to provide consistent and responsible cost advice" (p. 225)

Williams also writes that the whole of the problems really stemmed from the fact that the Client did not understand the problems inherent in the degree of innovation they had approved. The constant clash of a client clearly unable to articulate his needs coupled with an extremely innovative design and poor management both of and by the client led predictably to a process fraught with constant misunderstandings and, at the end, crisis management with the architect's project team personally directing work on site and "literally hundreds and hundreds of architects instructions being issued" (Ibid p.252). The peak rate was 2,500 instructions per month, many of which were directly caused by problems of co-ordination. Williams writes (p.252) that "almost every interface between the installed work of one package and completion of another's work....involved an insurmountable clash requiring discussion, analysis and remedial instructions". The tension came to a head when the client finally grasped the fact that innovation involved risk and decided to take over the project management role:-

> "Saturday 10 March (1984): The glass floor is out. Fosters say there is no reason why they cannot telescope the work that remains to be done in the time (available) but HS Property Management cannot afford to take the risk that it might not work. Three years of design work is thrown away in a day" (Williams, 1989 p. 233)

The Bank Chairman's reaction indicates the total frustration generated by the process:-

> "Three years of design work and they still can't get it right."

The project had immediate repercussions throughout the Hong Kong property market, particularly since a number of the Chairmen of the larger Hong Kong property companies were also Directors of the Bank. Innovation was publicly seen to be an extremely expensive and very risky process. Such a building would never again be constructed in Hong Kong and management contracting, although it has been used since, is still looked upon with deep suspicion.

Progress since 1985

Other banks have since built new headquarters in Hong Kong on the same scale as the Hongkong Bank building, principally the Standard Chartered Bank completed in 1990, and the Bank of China completed in 1989, both of which embody some innovative features. The Standard Chartered Bank used a very innovative application of the build, operate and transfer procurement route (Porter, 1990), and the Bank of China employs a structural frame designed using an innovative blend of structural concrete and structural steelwork. Both were constructed, apparently to the complete satisfaction of all parties, and with much less frustration and *angst* than was the case with the Hongkong Bank.

In terms of procurement approaches, increasing use is being made of the design and build family of techniques in both the public and the private sectors (Wong et al., 1994) in a deliberate attempt to shift the burden of risk from the client to the contractor, and this to some extent mirrors a local expansion of the use of the build, operate and transfer technique for infrastructural development.

The management of innovation

We draw out the following issues which appear to be important if innovation is to be successful:-

i) Innovation must be managed. One of the major problems of the Hongkong Bank building was that the process was not adequately managed either by the client or by the architect. Many commentators have set out procedures for risk management, but Coppendale (1995) succinctly summarises the process well as it relates to major engineering and development projects.

ii) On the basis of recent research work examining the procurement of hospitals (Smith and Wilkins, 1994, 1995) the authors believe strongly that the role of the client's project manager is crucial in briefing and for the successful procurement of complex projects, (Wilkins and Smith, 1995) and that this role must include an assessment of the possible risks and benefits of innovation.

iii) The extent of innovation within any particular project needs to be controlled. Apart from public housing, experience in Hong Kong clearly shows the dangers of attempting too much too quickly.

With regard to individual projects (as opposed to continuous programmes of work), the effective organisation of the inception and briefing phase provides the framework for the successful management of innovation. This framework needs to be structured around an early feasibility study which results in a *conceptual project profile* suitably assessed for its risk potential. Effective project management appointed at the earliest possible stage to co-ordinate affected personnel, including designers and end-users, would be essential. Such a study would include site investigation, environmental assessment, user requirement data, leasing and statutory constraints, method of proceeding, and resource requirements. On the basis of this comprehensive overview of the background and scope of the project, the conceptual project profile would be developed, consisting of a schedule of accommodation, alternative conceptual proposals, cost estimates, procurement strategies, programmes and risk analysis. All this output of the initial feasibility study, co-ordinated by the project manager, would then be assembled into a single *agreed* briefing document for project implementation. The assessment of risk in these early project stages should be seen as a creative process and a collective responsibility involving all members of the client team together with the designers, and co-ordinated by a project manager. It should also be seen as a continuing process. The intention initially is to identify significant risk features to provide a strategic framework for later choices, and subsequently a yardstick against which uncertainties are resolved as the project progresses. Modern co-operative contracting approaches would of course tend to support the success of the process.

Postscript

It would be appropriate at this stage to pose the question as to whether the intervention of management in this way would stifle the development of architecture? If these concepts had been applied in the past would we have many acclaimed modern buildings, or for the matter some far older ones such as Europe's medieval cathedrals? Would the modern movements of the twentieth century which eventually generated an entirely new contemporary urban environment founded on untried technologies such as structural steel, reinforced concrete and industrialisation have been permitted to flourish? The Hongkong Bank would almost certainly not have been built in its present form, and neither would other landmark buildings such as the Sydney Opera House, the Pompidou Centre, the Tokyo Olympic Sports Arena, and some of the buildings of Chandigarh and Brasilia; innovative and exciting buildings whose long term contribution to the built environment and contemporary culture is much more lasting than the relatively short-term impact of the huge cost of their construction. It is suggested that the formal structuring of the briefing process to provide for the development and evaluation of a range of well-founded concepts could allow creativity and lateral-thinking to flourish while at the same time avoiding the high costs and adversarial relationships which seem to bedevil the creation of great buildings.

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Teambuilding - A Key to Innovative Procurement: Assessing Belbin's Team-Role Self-Perception Inventory

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Abstract

In order to secure innovation in procurement it is necessary to review the selection processes designed to elicit the composite team. Other industries have long undertaken psychometric testing of team members in order to establish, and build upon, the particular strengths of the individuals.

Use of the Belbin Team-Role Self-Perception Inventory (BTRSPI) allows the identification of particular team roles and the individual's predisposition for the identified roles. Analysis of responses from a variety of industrial specialisms found within student cohorts illustrates significant differences within the groups.

The findings may raise significant issues for innovative procurement within construction in terms of the processes involved in team development and composition.

Keywords: teambuilding; procurement, Belbin; psychometric testing

INTRODUCTION

As the importance of teams becomes more prevalent an increasing amount of attention is being focused on identifying how individuals should be combined to ensure group success. This involves examining the behaviour of each team member and monitoring how different individuals interact. One of the most popular methods of examining team behaviour is the Belbin Team-Role Self Perception Inventory (BTRSPI). The aim of this paper is to assess the impact of the findings from execution of this test upon a multi-variate student cohort.

Before assessing the findings from the test itself, attention was focused on determining if a person's team role was dependent on whether the Ipsative or Likert form of test was used. To assess if such a difference existed the Ipsative and Likert versions of the 56 item inventory were given to 45 people from a variety of backgrounds. As no significant difference was detected in an individual's team role across the tests, both tests appear to be measuring the same criteria. To assess the validity and dimensionality, a 5 point Likert scale version of the newer 70 item inventory was issued to over 100 students from 3 different career disciplines.

Over the past decade, an interesting amount of attention has focused on identifying the instrument responsible for sustained and enduring success in industry. Initially, it was thought that success was dependent almost exclusively on one individual. However, when it was noted that many of the qualities of a good manager were mutually exclusive eg forceful

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yet sensitive to subordinates, intelligent yet not too clever, the focus was diverted towards identification of the optimal team composition. There is now a general consensus that it is effective teams and not specific individuals which are necessary for the continual growth, development and day-to-day management of an organisation.

Whilst there has been a considerable amount of work in the field of creating teams, observing how they function and monitoring their performance, little is known of how people behave in teams, what criteria measures team success or what actually makes a good team. What is known, is that individuals have different behaviour, abilities, learning and cognitive styles, and it is when these individual differences are combined that the most effective teams were formed.

Today, emphasis is focused on identifying the factors responsible for group success. Information relating to the optimal interaction of individuals could have an enormous impact on an organisation i.e. it could lead to more successful training, team selection and ultimately have a bearing on motivation and profit. Reflecting the importance of this area is the vast catalogue of psychometric tests which provide insights into team roles, e.g. Belbin,1981,1993, Myers-Briggs, 1985.

The aim of this paper is to examine responses from one such test, namely the Belbin-Team-Role Self- Perception Inventory (BTRSPI) Specifically:

- Can a factor analysis of the team role replicate Belbin's proposed 4 dimensions. (Negotiators, Manager-Worker, Intellectual and Team Leader)or Furnham, Steele and Pendelton's (1993) 3 factors (serious-hard worker, team worker-specialist, extroverted divergent-thinker)?

- Does the BTRSPI support findings from the Herrmann Brain Dominance Instrument (HBDI)?

- Are there any differences between students in different faculties within Glasgow Caledonian University ie are students drawn towards specific courses because of their team roles, profile, etc or is it purely a result of career choice to date?

- Does the BTRSPI vary between male and female respondents?

- Does the Introvert-Extrovert scale proposed by Belbin correspond to an individuals self perception , as extracted from the HBDI.

The BTRSPI Test Instrument

Two main criteria governed the reasoning behind the use of the BTRSPI. Firstly, the BTRSPI, has been used extensively throughout the UK e.g. Cadbury Schweppes, Team Dynamics, ICI etc. Secondly, it was desired to detect if there was any association between team roles and a person's functional role. Belbin, who has already carried out research in

this area, says no such relationship exists, claiming that it is only the way in which they are combined which effects job success. However, having carried out the test with student's from numerous disciplines we instinctively felt that team roles fluctuated with career choice. Two versions of the BTRSPI are currently available: the earliest version which comprises a 56 item inventory which identifies 8 team roles [Plant (PL), Shaper (SH), Co-ordinator (CO) Implementer (IMP), Completer-Finisher (CF), Resource Investigator (RI) and Monitor-Evaluator (ME)], and the newer 70 item inventory which acknowledges an additional role known as Specialist (SP). The newer inventory also makes provision for a filter variable, called Dropped, which detects when an individual is trying to appear socially desirable.

The BTRSPI does, however, have its drawbacks. The most obvious drawback of this questionnaire is that it is designed in a form which is quite clearly ipsative. That is, the subjects are asked to consider either 8 or 10 statements, depending on whether the 56 or 70 item inventory is being used and then distribute 10 points in a manner which best describes their behaviour ie the highest score being assigned to statements which most accurately exemplar them. Whilst there is much debate underlying the use of ipsative tests, 5 uncontroversial drawbacks of ipsative tests have been pointed out by Johnson, et al. (1988). Cornwell and Dunlap (1994) provide strong evidence to support the belief that it is incorrect to leave the test in its ipsative form when the intention is to compare individuals, correlate tests or conduct factor analysis.

Do Belbin's Team Roles Relate to Brain Dominance?

In order to investigate any undelying link a second test, the Herrmann Brain Dominance Instrument (HBDI) was issued. Unlike the previous test, which is psychological in nature, the HBDI has its roots in physiological theory and, today is thought of in metamorphic terms.

This pencil and paper assessment tool, which measures preferred styles of thinking, consists of 120 'clues' which are distributed under headings such as: key descriptors, work elements, hobbies, etc. By analysing the results from these 'clues' using the factor analysis it is possible to obtain an indication of an individual's hemispheric specialisation.

The Herrmann Brain Dominance Instrument is bases on the premise that the brain is divided into the following 4 quadrants: left cerebral (A) which is reflective of logical and rational individuals, left half of the limbic system (B) representing and controlled and organised thinking, right half of the limbic system (C) which relates to interpersonal and expressive individuals, and right cerebral (D) which corresponds to imaginative and innovative thinking styles. By calculating an individuals score in each of these quadrants, an indication of their preferred thinking styles is obtained.

Illustrated in Figure 1 is the profile of a left brained person whose double dominant thinking style preference encloses quadrant A and quadrant B. In general, a person with such a profile will be meticulous, detailed, organised, highly verbal, very capable in writing and will acquire knowledge primarily by reading factual information. He/She is also inclined to be conservative and tend to introversion.

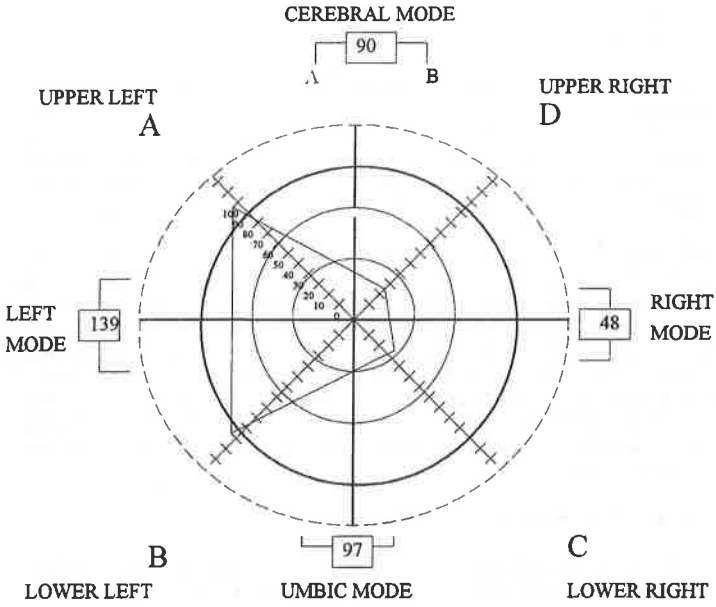

Figure 1 Illustration of Herrmann Brain Dominance Profile

Validity and Reliability of HBDI

Whilst this survey form is not a scientific test i.e. it merely gives an expression of thinking preferences, previous studies (as sourced in Herrmann, 1993) have shown that it gives results which are both valid and reliable.

However, as the HBDI is being used here solely to support/assess the validity of the BTRSPI, it is only important to report the findings on internal and external construct validity. Internal construct validity is concerned with determining which kinds of thinking styles cluster together, which are unrelated and which are negatively related. Two tests have been used to test for internal validity, one by Bunderson and Olsen (1980) and the other by Kevin Ho (1987). Analysis from both of these tests support the hypothesis that the 4 quadrants of brain dominance satisfy the criteria underlying internal construct validity.

External construct validity assesses the validity of the proposed 4 constructs by comparing internal constructs with external constructs. Three tests, 2 of which were conducted by Bunderson and Olsen (1980b, 1982) and one by Bunderson, Olsen and Herrmann (1982), compared the HBDI with a battery of cognitive ability tests, several instruments measuring

personality dimensions and learning and thinking strategies. The findings from these tests suggest the HBDI has valid external construct validity. Specifically, the left vs right score and the 4 quadrant scores were related to mental processes involved in measures of the above external constructs. In addition, the quadrant constructs were shown to have explanatory and predictive power well beyond the HBDI item types.

Furthermore the Herrmann Brain Dominance Instrument has been shown to be extremely useful in a variety of applications, most notably staffing, team building, teaching and learning, creativity and self understanding. SmithKline Beecham and Polaroid are examples of companies which use the HBDI to achieve the desired effects in the above areas.

METHODOLOGY

Subjects

A total of 92 students completed the BTRSPI and HBDI, 41% of whom were male and 59% female. All students attended Glasgow Caledonian University, although, although they were selected from 3 different disciplines: Business, Engineering (containing Quantity Surveying, Building Engineering and Building Surveying) and Occupational Therapy, and ranged from 18 to 52 years of age. These courses were selected as they satisfied the following criteria:

1 They had more than 30 students in each final year cohort. This ensured that a satisfactory sample size would be obtained.

2 All students had been on industrial placement relevant to their chosen career discipline, thereby increasing their experience of group work.

3 Each course was taken from a different faculty in order to maximise the probability of any differences being detected.

As a matter of course, information was also assembled on marital status, reason for career choice, number of brothers/sisters etc. An explanation of the study and the individual meaning of each of the tests was given and provision was made for any questions to be addressed as they arose. The tests took approximately one hour.

Questionnaires

Whilst no changes were made to the HBDI, the BTRSPI was slightly adapted from its ipsative format. Specifically, the BTRSPI was changed from its original ipsative format, in which respondents were asked to allocate 10 points between a series of statements, to a non-ipsative Likert form. A 5 point scale (1- Strongly Agree, 5- Strongly Disagree) was used as this was considered large enough to ensure that all opinions were accounted for. It was not considered necessary to modify the HBDI as the original format permitted the required comparisons to be made.

By changing Belbin's test from its original ipsative form to a Likert scale, the role of the questionnaire was undoubtedly changed i.e. instead of comparing each statement relative to

every other statement the student was now evaluating each statement in exclusion of the others. Whilst this encouraged the student to express a preference for several team roles, it still allowed the dominant roles to be identified.

Before the ipsative test was converted to a Likert scale, an attempt was made to assess if an individuals team role was dependent on which form of the test was used. This analysis involved asking 45 subjects to complete the ipsative and Likert version of the 56 item inventory. To ensure a representative sample was obtained the subjects consisted of students, staff at the university and employees from outside organisations. Two sub-strata were also created to eliminate any influence resulting from the ordering of the tests.

Of the 45 respondents who completed the questionnaires 73% had the same team role assessment across both versions of the test, suggesting that there is no significant difference in the prediction of team roles with either the normative or ipsative version.

A Chi-squared test was being used to test the hypothesis that the proportion of respondents selecting the same team roles is independent of the order in which tests were issued. The result of this analysis ($p>0.85$) provided sufficient evidence to conclude that a person's perceived team role is independent of which test was issued first. Although these findings support our expectations, it must be pointed out that they were based on a small sample and no time elapsed between completion of both tests.

As an individual's team role does not appear to be unduly influenced by the form of the test which is used and the Likert version is more easily understood and allows more analysis to be conducted, there is no reason why the BTRSPI should not de-ipsatised. The remaining analysis will, therefore be based on the Likert version of the BTRSPI.

DATA ANALYSIS

Results for BTRSPI

When the 3 groups are analysed together ie Business Students, Engineer (composite) and Occupational Therapists, Team Worker was expressed as the most popular team role accounting for 26% of the students. Implementer was the next most popular (17%) followed by Shaper and Dropped, each of which accounted for 11%.

Results for HBDI

Of the students who completed the HBDI, the majority had thinking preferences located in either quadrant A or D. With regard to the most popular hemisphere, right brain was the most popular accounting for 26%, followed by left (21%), limbic (20%) and cerebral (15%). The remaining 18% was distributed among those respondents whose preferred thinking mode was located in either AD or BC.

Factor Analysis

In order to determine the factor structure of the BTRSPI, factor analysis was conducted. Factor analysis is a statistical technique which is used to help identify underlying constructs

which are not directly observable. That is, it is used to reduce a large set of independent variables to a smaller set by combining those variables which are redundant into a smaller number of common factors. The Principal Components (PC) technique was considered the most appropriate as it did not require any assumptions and it enabled the dimensionality of the data to be reduced whilst still explaining a large percentage of the original variation. That is, when the dimensionality is reduced it is inevitable the information will be lost by the PC analysis enabled this loss to be kept to a minimum.

As can be seen from Table 1, the correlations in general are quite high. Of the 45 correlations, all but 3 (TW and R1, TW and SH, and TW and ME) were found to be significantly correlated This supports the view that the team roles are interrelated and are therefore likely to have common factors.

Table 1 Correlations

	CF	CO	IMP	ME	PL	RI	SH	SP	TW
Completer Finisher	1.00								
Co-Ordinator	.27	1.00							
IMPlementer	.55	.33	1.00						
Monitor Evalautor	.47	.50	.42	1.00					
PLant	.38	.38	.28	.43	1.00				
Resource Investigator	.26	.49	.35	.44	.50	1.00			
SHaper	.39	.59	.47	.54	.39	.60	1.00		
SPecialist	.55	.32	.59	.36	.37	.25	.34	1.00	
TeamWorker	.29	.39	.38	.12	.20	.07	.08	33	1.00

The highest correlation we found were RI & SH (0.60), CO & SH (0.59) and IMP & SP (0.59). Using the principal components technique, 3 clear principal components (PCs) emerged which accounted for 70% of the variation. This means that 3 linear combinations of the observed variables were formed:

PC1 = 0.69CF + 0.71CO + 0.72IMP + 0.73ME + 0.65PL + 0.67RI + 0.76SH +0.68SP + 0.42TW

PC2 = 0.35CF - 0.21CO + 0.36IMP - 0.21ME - 0.18PL - 0.5ORI - 0.37SH + 0.44SP + 0.57TW

PC3 = -0.36CF + 0.51CO - 0.17IMP - 0.15ME - 0.01PL + 0.05RI - 0.03SH - 0.22SP + 0.65 TW

It can be seen from the above that all team roles have a high loading on PCI suggesting that this PC may represent a general set of behavioural characteristics. PC2 is split into 2 opposite poles with CO, ME, RI and SH being clustered at one end CF, IMP, TW and SP being located at the opposite end. With the exception of TW and ME this replicates the Introvert - Extrovert separation of team roles. Belbin suggests that the Introvert -Extrovert classification is the most important psycho-physiological factor underlying behaviour. The third PC, which is dominated by CO and TW, corresponds to Belbin's Stable Extroverts.

Although this principal component analysis has a meaningful interpretation it was rotated using the varimax orthogonal technique as used by Furnham, Steele and Pendleton (1993) in an attempt to replicate their results.

Whilst 3 factors did emerge, the factor loadings did not conform to those expected. Whilst Furnham, Steel and Pendleton found that RI had a high loading on factor 1 and factor 3 and CF and IMP on factor 1 and factor 2, we found that it was the following team roles which had the high loadings across 2 factors in the rotated factor matrix: CO (PC1 and PC3) and ME(PCI and PC2) (See Table 2 below). This table also lists the factor score coefficient matrix which essentially gives an idea of which variables are important for which factors.

Table 2. Rotated Factor Matrix and Factor Score Coefficient Matrix

	Factor 1	Factor 2	Factor 3	PC1	PC2	PC3
CF	.23	.82	.04	-.11	.47	-.17
CO	.72	.06	.53	.30	-.28	.45
IMP	.27	.75	.22	-.08	.37	.02
ME	.66	.41	-.03	.22	.10	-.17
PL	.60	.30	.08	.21	.02	-.03
RI	.83	.10	.00	.39	-.16	-.08
SH	.80	.27	.01	.32	-0.4	-.11
SP	.17	.79	.20	-.14	.43	-.00
TW	-.00	.27	.92	-.14	.-04	.83

Construct Validity

An objective of this study was to assess if Belbin's team roles were in any way related to a person's brain dominance from the HBDI. The investigation was considered important for 2 reasons: firstly, it enabled any relationship between team roles and brain dominance to be detected and it also enabled the construct validity of the BTRSPI to be assessed.
The importance of construct validity was recently highlighted in a study conducted by the Educational Testing Services (Messick, 1989) in which it is reported that "construct related validity is the only fundamental and necessary type of evidence to assess the value of a test".

In order to test for the presence of a relationship between tests, it was necessary to correlate the results. Since the groups in the study were independent and the data was in discrete categories the Chi-squared was the most appropriate. Correlations were calculated for the BTRSPI and HBDI. However, both of these conditions were found to be insignificant at the 10% level of significance.

Initially the 9 team roles underlying the Belbin test were used as the basis of this correlation but, when it was found to be non-significant ie no relationship was found to exist between Belbin and HBDI, the 9 roles were classified according to the 4 factors identified by Belbin. However, this also resulted in a non-significant relationship.

Team Role Dependency on Course Choice

When a Chi-squared test was calculated to asses if any difference in team roles could be linked to career choice it was found that the team roles associated with the Belbin test did fluctuate among the three disciplines which were tested ($p < 0.05$). In particular, whilst the majority of Business and Occupational Therapy students were team workers (24% and 50% respectively), the Engineering (composite group) students were mainly implementers (33%), co-ordinators (19%) or shapers (19%).

Team Role Dependency on Sex

It was also considered beneficial to check if any fluctuations in team roles could be connected to the sex of the respondent i.e. do males and females have significantly different team roles? When the hypothesis of no difference was tested using a Chi-Squared test, there was enough evidence to conclude that a significant difference existed between the team roles of females and those adopted by males ($p=0.0001$). The majority of males were implementers (25%) or co-ordinators (23%) whereas the majority of females are team workers (45%).

Relationship between Perceived Introvert/Extrovert and Belbin's Classifications

As part of the HBDI, respondents were asked to rank themselves on 9 point Introversion - Extroversion scale. When an individual's self perception on this scale was compared to Belbin's Introvert-Extrovert classification, a relationship was found to exist. However, upon closer examination, it was observed that the majority of introverts according to their team role actually perceived themselves as extroverts in the HBDI and those extroverts by the team role listing considered themselves to be introverts. Thus, it would seem that either individuals do not perceive themselves in a true light or, Belbin's introvert-extrovert classification is not appropriate.

DISCUSSIONS OF FINDINGS

Although the results do provide valuable information, it is important to point out the limitations of this analysis, namely:

1 the subject matter on which Belbin basis his questions is not clearly expressed and there is no direct link between statements and the team roles.
2 Belbin's test has not yet been theoretically or empirically derived.
3 the BTRSPI was not issued in its original form.
4 the sample size was relatively small and was drawn from 3 different strata.
5 undergraduates were used which draws into questions their experience of working in groups.

The detection factor 3 factors throws doubt on Belbins's 4 dimensions and suggests that perhaps the 3 factors were reflecting 3 essential criteria for group work ie knowledge of the task, process of dealing with team members eg getting people to talk, resolving conflict, etc and the problem solving process. Other theories also suggest that the essential components

of group work can be described by 3 elements eg John Adair's functional leadership model (1973) states that for any group to be successful a balance must be reached by an individuals, group dynamics and the task.

The research has supported Belbin in his assumption that the roles are separate entities. It comes as no surprise that individuals appear to adopt several roles as, in reality, the majority of people are required to do a substantial amount of work outside the influence of a team and are therefore required to adopt several different roles. It would seem that people are capable of adopting all roles but only choose to highlight those which they prefer either as a result of natural ability or past behaviour which was rewarding.

However, the popularity of the BTRSPI and its ability to distinguish between students from different disciplines and male between and female respondents suggest that there may be some underlying determinant within Belbin's theory.

Emphasis must now be placed on identifying why the BTRSPI can distinguish between students of different sex and from different disciplines. It may be that team roles are a result of courses which students take ie are students inclined to adopt the team role which their lecturer most frequently displays? Alternatively, team roles may be more influenced by nature as opposed to nurture. Further research is also needed to determine why an inverse relationship was found to exist between the introvert-extrovert classification of Belbin and an individual's self perception in this regard.

Many areas of uncertainty surround the BTRSPI and if these are to be clarified more research is needed. In the past, supporters of the BTRSPI have explained any deviances by arguing that it is not appropriate to de-ipsatise the test. However, it has been shown that a person's team role is, for the majority, independent of which form of the test is used (ie ipsative or Likert).

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LEGITIMATION CRISIS AND INNOVATION IN CONSTRUCTION MANAGEMENT

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ABSTRACT

Ideas taken from Habermas' social theory form a framework for critical analysis of construction management, with particular relevance to development of United Kingdom health care buildings. Whereas postmodernists see society as having changed its nature, Habermas views modern society as an incomplete project. Society can be in crisis at one or more of economic, political and socio-cultural levels. Current problems in United Kingdom construction management reflect such crises. These problems include a *legitimation crisis* since economic and administrative changes have undermined the accepted arrangements and culture underpinning building construction, for instance in the National Health Service. The importance of shared perceptions is emphasised by Habermas' more recent work which distinguishes between types of interaction including goal-directed communication and communication to support mutual understanding. Whilst United Kingdom project management methods have evolved to maximise the efficiency of goal-directed communication, problems have arisen because they ignore the multiple levels of communication needed for successful outcomes. Partnering agreements are one way of overcoming this problem: understanding of social communication needs should assist their effective use. Habermas' theory provides an analytic tool complementary to empirical investigation. The theory offers explanatory power to explain recent innovations in construction management as well as predictive power to suggest improvements.

Keywords: Habermas; communication; construction management; health care buildings; innovation

INTRODUCTION

The purpose of this paper is to consider the procurement of buildings in the light of some ideas taken from Habermas' social theory. More specifically, such critical appreciation may lead to identification of reasons for current deficiencies in the construction process, and hence enable suggestions to be made for innovations to improve construction management. The paper is orientated towards the client's perspective. In particular, as a thought experiment the ideas discussed in the paper are illustrated through consideration of the procurement of United Kingdom health care buildings.

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Habermas' work has developed historically from the Frankfurt School of critical theory (Held, 1980). Critical theory, the further development of which is central to Habermas' work, regards empirical work in the positivist tradition as inadequate. Crudely, the notion of science as the accumulation of "objective" facts is insufficient because the evidence gathered must be interpreted within a framework of understanding, and because it is always seen within the context of the purpose for which it is used. The presentation of this paper, with illustrative rather than systematic use of empirical observations, is intended to reflect this theoretical approach.

THE SYSTEMS APPROACH TO PROCUREMENT

A major concern of Habermas' work is to expose limitations in the ideas of social theorists such as Talcott Parsons (Habermas, 1981/1987, Chapter 7) who adopt a systems approach. By contrast, empirical and systems approaches have been central, if implicit, to the study of construction management. The procurement process is seen in flowchart terms (Turner, 1990; Franks, 1990) as consisting of the transmission of information between the various parties who take decisions as construction proceeds. Issues relating to the comparative advantages of procurement methods such as Traditional Method and Design and Build are in essence about optimisation of such information flows and the allocation of decision processes to participants in the construction process; but they do not question the intellectual framework within which this process is understood. Mutual acceptance of systems assumptions legitimates construction management as a subject. The legitimation crisis referred to in the title of this paper, alluding to the title of one of Habermas' major works (Habermas. 1973/1976), reflects the thesis of this paper, i.e. that Habermas' criticisms of the modernist, systems, approach to society in general can be applied to the construction industry in particular.

The systems approach is not just an academic method; but is unconsciously adopted throughout the construction industry. Everyday managerial techniques, such as use of standard forms of contract and project planning using bar charts, implicitly accept this philosophy.

The systems approach is rejected by many recent thinkers over a range of academic disciplines including architecture (cf. Jencks, 1991) as well as the social sciences and humanities. Such postmodernist thinkers see modernist methods as relating to a historic period which has just finished. The present author has discussed the implications of this movement for construction procurement in a previous publication (Stansfield, 1995). Habermas, as will be seen from discussion of his theories later in this paper, does not reject modernism; but sees modernism as an unfinished project (Habermas, 1980/1983).

CONCEPTS APPLICABLE TO CONSTRUCTION MANAGEMENT FROM HABERMAS' WORK

Habermas' publications are awesome both in quantity and in their intellectual complexity, to the extent that it has been suggested (Outhwaite, 1994) that much of his potential audience is

deterred. Habermas' work is, of course, still very much in progress, and not all of it is available in English (and hence accessible by the current author). The purpose of the current paper is not therefore to review Habermas' work comprehensively in relation to construction management. Its scope is rather to apply a few concepts from Habermas' theoretical work as a means of suggesting how the activities involved in building construction can be improved.

Roughly following the historical evolution of Habermas' thought, the next sections of this paper will first consider how Habermas' concept of legitimation crisis may be relevant to construction management. This leads on to the theory of communicative action developed by Habermas, which will be related to the building process in terms of the different levels at which communications between those involved can be understood. For space reasons, this paper concentrates upon Habermas' social theory rather than his, generally more recent, interest in moral development and legal theory. Outlines of these topics will be used to illuminate aspects of construction management. In consequence, it will be possible to conclude by drawing together the issues identified to suggest an agenda for improvement of construction processes.

THE LEGITIMACY OF PROPERTY CONSTRUCTION

Habermas (1973/1976) sees crises in society as being like medical crises in which the reactions of the body, through processes unavailable to higher conscious awareness, at a critical time in the progress of the illness determine its outcome. By analogy, Habermas sees crises as occurring in "advanced capitalist society because of tensions between the hierarchy of economic, political-administrative and socio-cultural systems".

The economic crisis in provision of health care properties

At the economic level, Habermas expects crises in the system to occur as a result of diminishing returns on capital (drawing upon a Marxist analysis of capital). These crisis impact upon the political system. They also drives the state to intervene to provide necessary capital no longer available in the market, and in consequence to act as the agent of monopoly capital.

In the United Kingdom, medical care has been delivered by means of the National Health Service for nearly 50 years. This is notionally funded by compulsory National Insurance contributions made by both employers and employees. However, financial pressures affecting the provision of health care properties can be interpreted in relation to two issues arising from Habermas' conceptions of economic crisis. One of these issues is that the diminishing availability of capital leads to inability of the Government to invest in health care buildings. This is particularly true given the heavy emphasis in the United Kingdom on short-term investment (cf. Hutton, 1994), which makes the financing of properties for health care delivery unattractive by comparison with other innovations such as telemedicine. The second economic issue relating to the provision of health care buildings in the United Kingdom fits less well with Habermas' concept of the economic crisis since in the United Kingdom the Government itself is short of capital for health service investments. This has lead to the introduction of the

"Private Finance Initiative", whereby private companies are invited to provide capital for new health care facilities and to take control of their procurement [cf. Ridout (ed.), 1996]. Nevertheless, there are similarities between this process and Habermas' theory. The Private Finance Initiative represents an attempt by the Government to direct the allocation of capital which is scarce because of the failings of the economic system. In addition, economic pressures upon the system are seen as interacting with political and administrative crises.

At the socio-political level, Habermas (1973/1976) believes that there are two types of crisis. Firstly, he predicts that rationality crises will occur in the administrative system. The system will become increasingly irrational as individual capitalists manoeuvre its operation and also as the state tries to reconcile the inconsistency of its roles as a regulator of capitalist competition and as a provider of monopoly capital. The second type of socio-political crisis indicated by Habermas relates to identification with the political system: this is what Habermas refers to as the "legitimation crisis".

The rationality crisis in provision of health care properties

Habermas' analysis of the socio-political system can be seen as a framework within which several developments in the procurement of United Kingdom health service buildings can be analysed. The framework has explanatory power for understanding the increasing diversity of organisations involved in the procurement of such properties. For instance, whereas teaching and local hospitals were formerly commissioned by Regional and District Health Authorities within the NHS structure, these administrative bodies have been replaced by Trusts with a wider remit to identify and provide health care services. Further complexity has been introduced through the Private Finance Initiative whereby Trusts commission commercial organisations to finance and operate facilities.

Fragmentation of administration systems impacts on hospital construction through the procurement arrangements used as well through changes in the Clients involved and their building requirements. After it was set up following the Second World War, the NHS developed a network of in-house professional services including architects, quantity surveyors and engineers employed within the Service. These services are now at various stages in the process of being transferred to the private sector. Expertise within the NHS has been lost or devolved to Trusts, whilst more roles within the procurement process are filled by private companies.

The diversification of administrative mechanisms for NHS buildings been accompanied by changes in contractual arrangements. The NHS as developed in Britain after the Second World War used the "Traditional Method" for the procurement of buildings, evolving its own comprehensive version of this methodology, CONCODE, to ensure that design requirements were met. In parallel with organisational changes relating to the design and construction of NHS buildings, some recent health care buildings have been procured using other routes such as Design and Build. More radically, the Private Finance Initiative already referred to in this paper transfers procurement decisions from the end user to the contractor.

Problems relating to the reduced involvement of the end users and to the NHS Trusts as client organisations representing their interests in procurement systems for the acquisition of health care buildings follow from crises arising from the identification (or more precisely lack of identification) of participants with the system. Habermas (1973/1976) identifies two such types of crisis, the legitimation crisis concerning identification with the administrative system and the motivation crisis affecting identification with the socio-cultural system.

The legitimation crisis in provision of health care properties

Legitimation crises occur, according to Habermas, in part because of system limits: since the state fails to deliver the programme it promises, as a result of the systematic crises which occur for reasons discussed above, it loses the support of the population. The other reason why legitimation crises occur is because the state unintentionally interferes with cultural traditions in its attempts to overcome economic and administrative difficulties.

The causes for the legitimation crises that Habermas identifies are currently relevant to health service buildings in the United Kingdom. Lack of resources for state health services in general has been a perennial and major issue in the United Kingdom over the past twenty years. For family medical services, lack of funds and consequent underprovision of premises is a cause of concern to GPs (NHS Estates, 1996) to the extent that property issues form a major barrier to the appointment of doctors.

The legitimation crisis discussed by Habermas is perhaps more clearly reflected in relation to health properties by the disintegration of cultural consensus relating to the provision of medical services. In the United Kingdom before the Second World War, medical services in the community were delivered by doctors paid privately (or through insurance schemes), whilst hospitals largely operated as charitable organisations (c.f. Miller and Swensson, 1995). However, the formation of the National Health Service set up a system implicitly accepted by everybody, in which GPs provided universal access to medical care from simple premises, whilst referring patients onto NHS specialists where necessary. The provision of premises reflected this culture in that GPs were provided with finance to provide their own properties, whilst the state funded hospitals containing specialised facilities. In recent years, there has been a trend towards decentralisation of medical care in the United Kingdom, because of medical developments such as anaesthetics enabling day surgery as well as because of social and political pressures. This is leading to replacement of well-loved hospital institutions by smaller facilities, to public outcry in many communities, whilst GPs are distanced from their place in the community by the increasing complexity of their premises, grouping state employed professionals such as community nurses and midwives with doctors and providing more complex facilities.

The loss of legitimation for the political arrangements for United Kingdom health care suggested by the developments indicated in the previous paragraph is reflected at the socio-cultural level by the erosion of traditions which Habermas sees as constituting motivational crises. The National Health Service has been universally accepted as the provider of health care services to everybody. It followed that hospitals needed to be provided as necessary to

support this service. Current developments such as cash limits on health care provision, as well as the fragmentation of health care delivery referred to in the previous paragraph, undermine this imperative to provide health care buildings. In consequence, there may be a loss of momentum for new building, with adverse results for the construction industry.

CONSTRUCTION AS A COMMUNICATIVE PROCESS

So far, this paper has concentrated on the earlier part of Habermas' thought as reflected by his book "Legitimation Crisis" (1973/1976). This work provides a framework for understanding how issues arising at different explanatory levels interact, so that inadequacies in modern soci ety generally reflect on procurement processes. But Habermas' ideas have subsequently evolved, notably through the publication of his major work "The Theory of Communicative Action" (Habermas, 1981/1984; 1981/1987). The following section of this paper applies only a few of the more important ideas from Habermas' work to construction procurement issues. The author has drawn to a considerable extent on Outhwaite's (1994) introduction to Habermas' work for identification of these ideas.

Levels of communication identified by Habermas

It is central to Habermas' recent work that communication takes place on several levels:

1. *Teleological or goal-orientated action*. Habermas points in particular to "strategic action", in which the communicator seeks to maximise her or his personal benefit by taking into account what the recipient(s) of the message will do.
2. *Normatively regulated action* in which members of a group regulate their behaviour to match social values.
3. *Dramaturgical action* in which the actor seeks to present an image of herself or himself.
4. *Communicative action* whereby two or more actors seek to understand their situation.

Communicative action, which is central to Habermas' ideas, relates to the concept of the *lifeworld* which Habermas' takes and adapts from Husserl's phenomenology, contrasting it with the systems world. The lifeworld evolves historically at a social, unconscious, level, consisting of shared understandings which people accept as the basis for their communications.

Habermas himself (1981/1987) uses the example of communications on a building site to illustrate his concepts of the different types of action, using as an illustration an older construction worker who sends a younger one to fetch some beer (if Habermas were English or Welsh one feels sure he would have used the example instead of making a cup of tea). At a teleological level, this communication is of course designed to make the younger worker carry out certain actions - such as to go to a shop selling beer. Yet Habermas points out that this communication also transmits a normative framework which, among other things, defines subjectively the social status of the workers on the building site. This is defined within time and space within the lifeworld of the building site contains assumptions which do not have to be spelt out: Habermas uses the (German) example of issues relating to the insurance of a

"guestworker" which do not have to be made explicit until he becomes injured; but which are taken for granted within the lifeworld of the construction site.

Habermas' analysis of social communication has implications for construction procurement in that the management processes must take into account the various levels at which communication takes place. In particular, new forms of the procurement route, in particular Design and Build, try to increase efficiency and avoid conflict by clarifying and simplifying the procurement system in terms of information flows, in other words by addressing the teleological system to which Habermas refers. Yet building contracts do more than regulate the achievement of goals. Indeed, Clegg (1992) has cynically suggested that contracts cause conflicts. Clegg, who is a noted exponent of the applicability of postmodernism to organisational behaviour, points out that the contract document was used by the various professionals involved in the project as a reference point to project their own importance. In terms of Habermas' framework, this can be seen as relating to dramaturgical action.

The construction of health care properties necessitates complex communicative processes

In the case of health care construction projects, a major issue relates to the complexity of the client organisation and consequent complexity of the briefing process. Both Loosemore and Davies (1994) and Smith and Wilkins (1996) point to the many building users who expect to be involved, including doctors, nurses and other staff as well as the client's own property professionals and the patients who ultimately benefit from the property's existence. The Consultants who head medical departments in particular have a major influence not only because of their power within the organisation but also because of the knowledge they must provide to identify building requirements needed for the provision of specialist treatments. This complexity of organisation, together with the existence of specialised property units such as NHS Estates and Welsh Health Common Services Authority, would appear to lead to development of a well-distinguished lifeworld, the cultural norms of which need to be taken into account for successful procurement.

One example known to the author which may be taken as illustrating the importance of the lifeworld relates to the provision of fire precautions in a community hospital procured using the Design and Build route. The contractor provided fire precautions to meet commercial expectations; but the expectations of the client organisation differed both at a strategic level, in that they knew of additional Fire Regulations specific to hospitals and at a normative level through their interpretation of the regulations. The result is a dispute. In principle, clearly it is insufficient to improve building contracts to resolve such disputes as successful completion of the contract also depends upon shared values.

A major reason why new United Kingdom procurement routes such as Design and Build are expected to be more efficient from a systems viewpoint is that they provide a single point of responsibility for a project manager to control the work on behalf of the client. This contrasts with the division of responsibility between the architect and the contractor which occurred with the "Traditional Method". It is a plausible hypothesis that such concentration of power

within the project structure of its essence restricts the communicative action whereby participants in the project share the norms of their lifeworlds. Such a hypothesis is even more plausible in the case of Private Finance Initiatives where even the functionality of the building is left for a contractor to determine. Leaving aside the political issues involved, it is not clear how the contractor in such an arrangement will develop the richness of communications needed to deliver a product which will be acceptable within the end users' lifeworld.

Emphasis on the importance of good communications for successful construction procurement has been reflected in the United Kingdom by the growth of partnering agreements (c.f. Hellard, 1995, 1996). Habermas' theory of communicative action offers potential for identifying means of enhancing the partnering approach. In particular, it affords opportunities to integrate the currently rather separate topics of organisational behaviour and project management in relation to construction.

IMPLICATIONS OF HABERMAS' THEORY FOR INNOVATION IN CONSTRUCTION MANAGEMENT

So far, this paper has taken the form of a description of some of Habermas' ideas alongside an evaluation of their applicability to construction management, with specific reference to health care buildings. From this description, it is apparent that Habermas' ideas throw light on innovation in construction management in three ways:-

1. Habermas' theory has explanatory value for understanding changes in recent years in the types of buildings procured.
2. The theoretical framework provided by Habermas' work has predictive value to suggest improvements in construction management methods.
3. The theoretical approach used by Habermas offers researchers an additional method to investigate construction management.

The explanatory value of Habermas' theory extends to understanding of the needs for which buildings are constructed, and the reasons for them, as well as to appreciation of reasons why construction methods themselves are changing. Such explanation has been illustrated in this paper in relation to health care buildings where economic, political and social pressures, identified through consideration of Habermas' theory, have been seen to affect the type of buildings procured. These pressures also explain changes in the procurement methods used in the United Kingdom for health care buildings.

In relation to the predictive power of Habermas' work, his theory has particular value in identifying the inadequacy of construction management systems built upon the concept of information flows. Such an analysis ignores the normative and cultural values which are implicit in the operation of such a system, as shown by the influence of the values of a national health care organisation on the procurement of hospitals. Habermas' theory of communicative action enables this interplay of cultural values and system organisation for construction management to be identified. Moreover, his theory provides a framework to identify improvements and to integrate them with other construction management methods.

Habermas' theoretical framework supports a method of investigation which is subjective by comparison with (more) objective reports of empirical research; but it has a number of compensating advantages. Perhaps most importantly, use of a theoretical framework as a basis for analytical thought enables the derivation of an integrative view of the topic studied. Such a view is distinct from the inevitably fragmentary nature of empirical research in settings such as those of construction management. Recent changes in the construction management of United Kingdom health care buildings have to some extent restricted opportunities for empirical research both because of the loss of established industrial collaborators and because the rate of change of procurement methods has become faster than that of constructing hospitals - hence empirical findings from completed projects are of limited future relevance.

Finally, Habermas sees research within the empirical tradition as having essential limitations which his social theory avoids. However, the pragmatics of research are surely such that the methods of social theory should complement, rather than replace, conventional means of investigation. Habermas' theoretical framework is attractive because it has practical as well as academic value. It provides a flexible and integrative means giving researchers potential to give practitioners involved in construction management new insights so that they can deliver better buildings by better means.

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CHANGES IN THE RELATIONSHIPS BETWEEN CUSTOMERS AND PROVIDERS OF FACILITIES, AND USEFULNESS OF THE NEW ASTM/ANSI SERVICEABILITY STANDARDS FOR THE PROCUREMENT OF OFFICE FACILITIES

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Abstract

This paper puts the procurement process in the context of changing relationships between the players, and looks at the tensions that currently impact on those relationships. At the heart of the procurement process is the essential task of defining what needs to be built or changed, for what purpose and at what level of functional capability. To improve the strategic decisions made by the intending building owner or occupier during the front-end planning phase of building projects, also called project initiation phase (Glover, 1976), is most important in order to allow valid responses to these tensions. To that effect, demand-pull is usually more effective than supply-push. A set of new ASTM/ANSI standards (ASTM, 1996) and the Serviceability Tools & Methods (ST&M) (Szigeti and Davis, 1996) can provide building owners and occupiers with a systematic, comprehensive, and easy way to improve the quality of the information they rely on to make those strategic decisions about the functional requirements for a project.

Keywords: functionality; performance; procurement; quality; rating; serviceability; user requirements.

INTRODUCTION

Certain drastic changes have been shaking the building and real estate industry, starting in the late 1980's. After a ten year period when the in-house Corporate Real Estate (CRE) and Facility Management (FM) groups grew dramatically and became much more professional, the restructuring and re-inventing that is sweeping the corporate world has had a similar impact on the CRE-FM functions. Many companies have outsourced the majority of this work, seeking cost reduction and increased effectiveness. These changes are having a profound effect on the procurement process. The strategic issues raised by the management of outsourced CRE and FM functions have not yet been properly understood. How well those functions are procured and managed affects the *functionality* of the facilities provided, and thereby affects the bottom line of corporate business units.

Facilities are still mostly considered as overhead and viewed as a cost center. Their impact on the productivity and effectiveness of the core business is starting to be recognized, but is not yet widely accepted, and is still difficult to prove. However, the notion that the occupants are to be treated as valued customers by the providers of the facility they occupy, be they in-

house or outsourced, is slowly but surely taking hold. The last few years have seen the dawn of the Age of the Customer .... Two recent uses of "customer satisfaction surveys" illustrate this point.

In 1995 and 1996, the US Public Buildings Service (PBS) of the General Services Administration commissioned Gallup to conduct a customer satisfaction survey of the occupants of its buildings, using as a starting point the survey instrument prepared by the International Facility Management Association (IFMA). PBS has also been testing the effectiveness of the Serviceability Tools & Methods (ST&M) and the links between levels of Serviceability and the scores from the customer satisfaction survey for a given building (Davis *et al*, 1996). A large portion of the 7,550 buildings in the PBS portfolio were covered by the survey. The self-administered questionnaire was left on the desk of almost two thirds of all the occupants of the PBS buildings, and over 45% responded, a total of approximately 250,000 respondents. PBS is using the results of these surveys to identify the aspects of their services and of the facilities which the occupants care about. The target of these initiatives is to improve the quality of the facilities where it counts, and to understand how to deliver services and facilities in the most effective manner. In one building, the solution to improving the relationship between PBS and its tenant groups has been to locate a facility management officer in the building. That person is described as "the face of PBS" in that building. In another building where security was noticed as a problem, a single uniformed police officer patrolled the corridors and building lobby. Reports of petty theft in that building dropped by 75%. Better hardware is not always the solution.

A second example comes from the new Ciba-Geigy, laboratory in Tarrytown, N.Y. In this case, the design-build team for the project agreed to incentives for schedule, cost and satisfaction. Payment was subject to winning at least 75% of the vote from all the employees on a 15-question ballot regarding satisfaction. The team won 84% of the vote. The client is so pleased with the results that this design-build team is being asked to do the next projects for Ciba-Geigy.

If the occupants at work do matter, and if they do in fact know a thing or two about what they need, then how can this knowledge be incorporated early on in the strategic decisions of the intending building owner or occupier? The new ASTM standards on Whole Building Functionality and Serviceability, now American National Standards, do just that. The Serviceability Tools & Methods (ST&M), which incorporate these standards, offer a macro, broad-brush methodology appropriate for strategic decision making in office facility procurement. They were developed by the International Centre for Facilities (ICF) as a way of dealing with the relationship between users and their facilities and to bridge the gap between the occupants' "lay-persons' language" and the technical language of the professionals involved.

As mentioned above, the other major development affecting and shaping the field, and having an impact on the procurement process, is the change in relationships between the key players and shifts in the organizational context. In this paper, several organizational models of procurement of workplaces and workplace services are compared in terms of control of facilities and the extent to which provision of workplaces and services are separated from, or integrated into, the core business of a company.

ORGANIZATIONAL SHIFTS

Who are the customers

As stated above, in the last few years some organizations have adopted a more customer-oriented perspective than is traditional in the real estate and building industry. For the CRE and FM groups, customers are the building occupants. Building occupants are the true end users of the buildings, workplaces and services provided by internal and external providers. However, only a few years ago, even forward thinking organizations sent their survey of customer satisfaction only to the "tenant" facility administrators, who are surrogates for the occupants. Many did not routinely survey the actual occupants.

Much of the real estate industry is still catching up. For instance, NACORE says that "End users, as they are becoming known, comprise the basis of the NACORE membership and are involved in office, industrial, retail and many other types of property activities". NACORE defines these end users, its regular members, as "property professionals who are involved in managing property assets for corporations whose primary business is not real estate" (NACORE, 1995). These NACORE members, in fact, are "end users" to the building industry, but only surrogates for the real "end users" who, as noted above, are the building occupants, and the core business units.

Input-oriented cost containment

In NACORE's ***input-oriented*** perspective, corporate real estate organizations are suppliers of workplaces, providing complex products (buildings, furnishings, technology) and services.

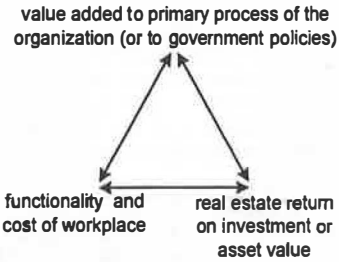
As companies and governments strive to reduce expenditures, cut staff, economize and minimize, this focus on the inputs to a business process leads naturally to cost control and expense cuts. In our work, many senior executives of real property groups tell us that their organizational culture and priorities drive them to this focus on cost containment and real estate values. Quality, which is seen as expensive, is confused with functionality, which is not measured and therefore not compared.

Output-oriented managers

In contrast, ***output-oriented*** facilities organizations focus on helping the core business to be more effective and competitive. They are committed to outcomes, rather than inputs. To them, the building, with its furnishings and support services, are means, not ends. Economy, efficiency and skillful management of physical assets are still necessary, but will no longer suffice. Top priority goes to meeting the needs of the occupants, by adding value to core business processes, and responding to changes in the core business workforce, all to best contribute to organizational success.

Managing the tensions in the system

In most organizations, the essence of facilities management seems to be to manage the tensions between cost control and functionality of the workplace on the one hand, and the management of the portfolio of real estate on the other (Evers, 1995). The ownership of buildings should yield income! Real estate should cost less. Next comes the focus on "the customer" and the value added by the facilities to the primary processes of the core business. New tensions arise. The tensions thus created for facilities management organizations can be diagrammed as follows:



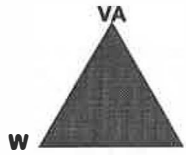
Top executives are starting to think about it

Top executives are only just starting to think about how to increase the added value to the primary process, or core business, of their organization.

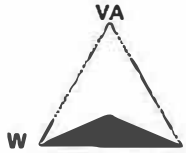
These executives realize that this triangle of tensions needs to be managed not only by developing and implementing a strategy, but also by showing leadership in balancing those three equally important issues.

In the private sector, we see leading-edge facilities organizations focusing on adding value to the core business processes of their parent organization. Recently, in the public sector, the political pressure has been to focus on the bottom side of that triangle. Indeed, several CRE-FM organizations which have been recently re-invented, have excluded from their mandate any responsibility for value added to the primary processes or policies of government. Decisions that affect added value are explicitly left to "tenant" organizations.

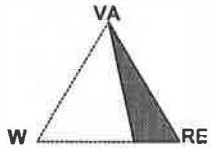
The three triangles (shown below), each represent the profile of a real estate/facility management organization with a different balance to those three tensions. The tensions from these competing demands are currently shifting, and it is not yet clear what the balance will be for most organizations.



Strategic, strong CRE/FM, seen as an asset to the corporation, present on the executive level.



Typical real estate organization in government, not present in major decision making.



Real estate organization of a bank where strong pulls are for buildings to serve core-business tenants, as well as to make money on investment

Legend:

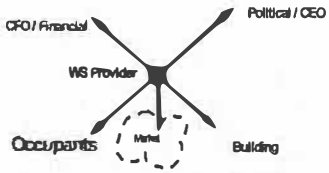
VA means the pull to add value to primary process of the organization.

W means the pull to manage quality and cost of the workplace.

RE means the pull to enhance real estate return on investment or return on asset value.

The provider function changes in response to changes in these tensions

The diagrams on the next page expresses the changes in the forces that pull at the CRE-FM groups in a different way. In the first diagram, the dashed line represents the relative strength, historically, of pulls on the provider of workplace facilities, services and support. In the second diagram, the solid lines represent the future, driven by demand from building occupants, who are the true end users and customer of workplaces.



An *implicit* issue is the shifts in power and control over what facilities and services are provided. The current trends driven by these tensions can be described as follows: centralizing control while outsourcing; decentralizing or devolving facility management; devolving facility management functions into core business units; devolving control to core business units while outsourcing the functions; choosing preferred providers; drastically reducing the number of providers; and so on.

How to provide and manage Workplace Services

Based on the result of a survey of senior executives conducted by the International Centre for Facilities, we developed a set of seven diagrams to represent how large organizations are setting themselves up to specify, provide and manage workplace services, facilities, and other support functions. These diagrams are reproduced on the following pages. The underlying issue is whether the people who provide workplace facilities, services and support should be in a separate, central unit, or should be integrated into the core business processes of a company or government. If the latter, how is professional and technical expertise to be available, to support and enhance the value of those core processes? What tools can the in-house managers use to state their requirements and monitor the quality of the delivered services and products? And, what will be the most appropriate measurements? The corporate paradigm is shifting from command-and-control hierarchies to teams that drive processes. Expertise in providing and supporting workplace facilities and services will be a necessary and accepted component of those teams, as today's CEOs recognize the corporate

Model of Relationships in buying and providing Workplace Services (WS)

by Gerald Davis and Françoise Szigeti, International Centre for Facilities © 1995 – Sheet 1

Definitions:

Executive: = Committee of inside executives, or government analogue, that sets policy about workplace facilities and services.

Each Core Business = One of the main processes or components of the overall or parent organization that produces products and/or services for external customers or the public. May be in private, institutional or public sector.

DWS = Distributed Workplace Services = support units, each attached to one of the main core businesses. DWSs provide (with their own staff), or buy (from the marketplace), the work-place facilities, services and other infra-structure support, internal and external.

CWS = Central Workplace Services = centralized support unit, reporting directly to the executive, e.g. head of finance and administration, or direct to the Chief Executive Officer (CEO) or Chief Operating Officer (COO). In many corporations, CWS functions as a component of corporate headquarters. CWS provides (with its own staff) or buys (from the marketplace) the workplace facilities, services and other infrastruc-ture support, internal and external, for the core business(es). Unlike the Distributed Workplace Service Units, a CWS also administers policy and may include a policy development group.

CWP = Central Workplace Policy unit, usually a small unit which develops and administers policy. If a CWS exists, it may include the functions of CWP.

Facility end user = occupant or user of facilities, i.e. internal customers of CWS or DWS.

Ultimate customer = buyer, or recipient, of products or services from the core business.

Stakeholders = taxpayers, share-holders, financial institutions, visitors, public, etc.

Marketplace = Building and real estate industry: external providers of corpo-rate real estate (CRE), facility manage-ment (FM), and other support services.

Status vis-a-vis Marketplace:

At the top left of each column, preceding the names of organiza-tions, is a number, from 1 to 4. That number corresponds to the organization's response to question 41 of ICF's questionnaire, which reads:

'CRE/FM group's STATUS vis-a-vis marketplace:

1=group is inside core business and provides or buys for it;

2=group has separate identity but is sole provider to core;

3=core units have option to use group or buy direct from marketplace;

4=group is an outsource.'

Arrows:

Heavy arrow = *control*, i.e. control of the decisions over what is provided, where, and by whom.

Thin arrow = *policy* direction over main business units and over workplace services, including facilities.

Heavy dashed arrow = *money flow*, according to policy for workplace services and support.

Thin dashed arrow = *provide services or support*, i.e. the flow of workplace services, including facilities and other support.

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For Best Value Added to Core Business:

Value Added for Core Business Units most easily gets high priority when those Core Business Units participate in tradeoff decisions, as in five of these models. Which model is best for an organization depends on:

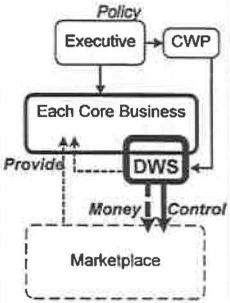
(a) excellence in the top levels of in-house DWS and/or CWS management;

(b) dedication of DWS and/or CWS to the mission of the overall organization (vs. priority for CRE);

(c) which "cautions" it can most easily cope with;

(d) existing in-house capabilities (expertise and staffing of DWS and/or CWS); and

(e) understanding of WS issues by the CEO and/or COO, to whom the WS unit(s) should report directly.



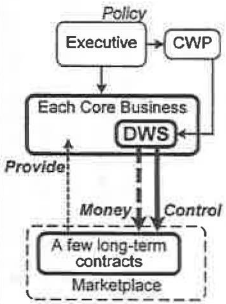
A. DWS both provides and buys direct from many providers

KEY BENEFITS:
Business units have full control over tradeoff decisions about cost and functionality of WS.

CAUTION:
Achieving optimum balance requires that DWS professionals understand main business programs and have high expertise in facility manage-ment, services and real estate.

Risk that DWS professionals believe their expertise to "know what is best" justifies imposing their view about what facilities and services the BUs should receive.

Need coordination among BUs lest they compete with each other in marketplace.



B. Small DWS buys from a few tied "prime" suppliers and their subs

KEY BENEFITS:
Use entrepreneurial expertise of marketplace for cost control.

CAUTION:
Need high-level in-house capability for contract performance management, to negotiate with senior officials of outsource companies, and to achieve appropriate tradeoffs among:

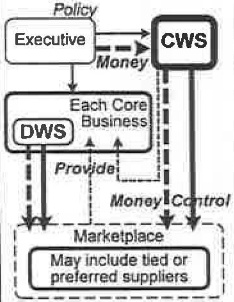
(a) support of business units,

(b) low cost of WS, and

(c) management of real estate asset values. For strategic facility planning, outsource provider needs some priviledged information. Quality management needs to be a team effort with outsource provider.

Models of Relationships for buying and providing Workplace Services (WS)

by Gerald Davis and Françoise Szigeti, International Centre for Facilities © 1995 – Sheet 2



C. CWS provides or buys, and obtains money from Executive. Small DWS can buy up to set amount

Key Benefits:
CWS likely to have expertise, and and to exercise consistent control over Business Units.

Caution:
CWS staff typically believe that their professional expertise to "know what is best" justifies imposing their view about what business units should have/receive. If this culture conflict is misunderstood as a corporate power conflict, then tensions or clashes are inevitable and CWS becomes the unit others love to hate.

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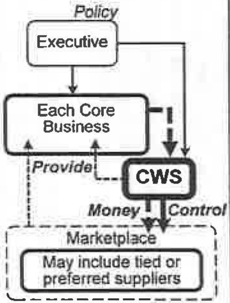
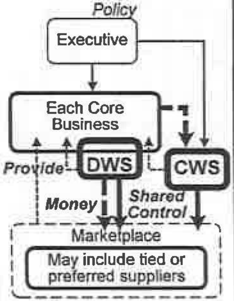


D. CWS provides or buys, and obtains money from BUs

Key Benefits:
Chargeback imposes a discipline on Business Units and gives them some indirect control over WS they receive.

Caution:
Does not resolve inherent culture conflict between CWS units and Business Units.

Achieving balance depends on informal negotiation, and informed leadership in the main business.



E. CWS provides or buys large projects, and selects providers that DWS may buy from

Key Benefits:
Use entrepreneurial expertise of marketplace for cost control.

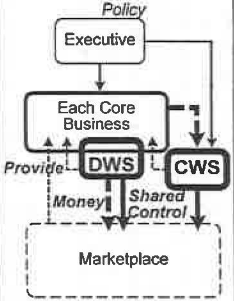
Caution:
Need high-level in-house capability for contract performance management, e.g. to negotiate with senior officials of external companies, and for appropriate tradeoffs among:

(a) support of business units,

(b) low cost of WS, and

(c) best real estate asset values.

For strategic facility planning, external provider needs some priviledged information. Quality management needs to be a team effort with outsource provider.



F. Optionality being introduced. CWS acts as owner of some property

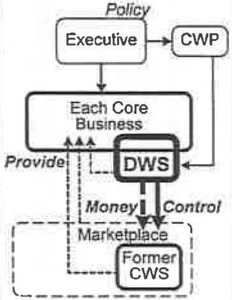
Key Benefits:
BUs control trade-off decisions via funding control.

CWS unit provides consistent quality control over procurement, and avoids BUs competing against each other in the marketplace.

Caution:
Because control is shared between DWS and CWS, tension is inevitable.

Does not resolve inherent culture conflict between both Workplace Service groups and Business Units.

Requires leadership on both sides, and CWS to focus on main business programs and customer functions.



G. DWS both provides, and buys from many providers, including optionally from own former CWS

Key Benefits:
Former CWS unit may be a preferred supplier because it has in-depth knowledge of BUs and their workplaces.

Caution:
Need strong in-house DWS professional expertise to manage the relationship, and strong in-house technical knowledge of own workplace facilities.

Also need high in-house capability and understanding of DWS at senior levels to get best balance among:

(a) support of business units,

(b) low cost, and

(c) best real estate asset values.

advantage in their interconnected information processes. The watchword will be adding value to core business processes. Therefore, some strategic information about the core businesses cannot and should not be shared with outside service providers. By the same token, strategic business decisions that involve the workplace, central to corporate competitiveness, cannot be left in the hands of outsourced providers.

Impact of changes in work patterns, and in concerns about ecology and health on Workplace Services

In a world where work will be done anywhere, anyplace, anytime, Workplace Services providers, whether in-house or outsourced, will need to think about facilities as one of the elements in a global support system. Ecology and health concerns are also transforming construction, and recognition of these concerns, as part of the overall range of performance of facilities, is gaining currency. Procurement processes need to take these changes into account and ensure that all those dimensions are taken into account. The best projects will occur when both the industry and its clients converge on a shared view of what is required. It is not a case of one or the other.

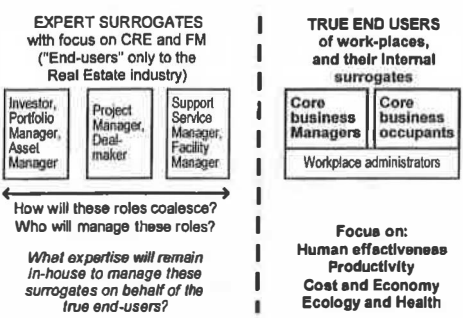
Has outsourcing gone too far? What to watch out for

Comprehensive outsourcing of the provision of workplace facilities, support services and building operations by public and private organizations to one or more private sector external companies is becoming typical. In Canada, Public Works and Government Services Canada (PWGSC) is in the process of implementing a new policy called "Alternative Forms of Delivery (AFD)". Canada Post Corporation (CPC) did it in 1995, though CPC has retained in-house a core team with expert capability both in the professional side of managing workplace services and facilities, and high-level management competencies. For quality management, these outsourced contracts require performance indicators. For CPC, some of those indicators are quoted directly from the new ASTM/ANSI Serviceability Scales. For PWGSC, the Serviceability scales have been government policy since 1993.

In other organizations, however, we see some of the potentially serious problems when the process of outsourcing is not well managed. Several companies with which we are familiar failed to retain adequate in-house expertise, corporate memory about workplace management, or mastery of the computerized facilities database. Often, performance indicators are either non-existent, counterproductive, or meaningless. With neither side having adequate human or knowledge resources, quick impacts loom for the bottom line of these organizations, and for their core operations.

Some companies realize, after implementing an outsourcing strategy, that the expertise needed to manage the external providers is no longer available to them. Points to keep in mind include: (a) Newly appointed outside providers won't know and understand the core businesses. (b) When business units of a single organization each have separate outsource providers, and these providers are not centrally coordinated, the units or their providers could bid the prices up in a single geographical area. (c) Business units have less buying power when they go to the market separately for professional services, furniture systems and supplies, although some strategies are explicitly addressing this question, etc.

Who will provide the needed expertise?



	Centralized at HQ	Distributed by function	Distributed by geography	Devolved to core BUs
WS by own in-house staff				
Mixed: in-house plus some out-task, as needed				
Out-source managed by in-house expertise				
Total out-source: no in-house expertise				

Which box fits your organization best?

Building occupants, the internal customers, are coming to appreciate, and value, their facilities support group, and the need for skilled surrogates when buying from the marketplace. The need for an "institutional memory" about what works, and what works less well, in the organization's facilities is getting recognized. Indeed, in some places the drive to retain expertise and experience is being driven by the core business units.

CRE and FM groups will likely not "do" in-house what they used to, but they will need to know much more about the organization they serve and about how to specify, buy and manage facilities overall. And, they will need to know more about their internal customers.

USING THE NEW ASTM/ANSI STANDARDS TO IMPROVE THE PROCUREMENT PROCESS

The quality of the building product (supply) depends on how the customer, intending building owner or occupier (demand), defines the functional requirements for the project, and on whether there is a way to assess the capability of the end-product to meet the stated requirements. This applies whatever procurement method is used, and applies equally to existing buildings and to new constructions, to "green field" designs and to retrofits, and to purchases or leases. Therefore, functional requirements are at the core of the procurement process. These include a definition of the level of quality expected.

In order to improve the quality of the end-product and foster innovation, building owners and occupiers need to become less prescriptive in their specifications and more performance-based. To do that, building owners and occupiers need better tools to help them define their requirements and rate whether the end-product delivers. Senior management needs new tools to address front-end planning issues, to evaluate the performance of the outsourced providers and of the products and services delivered, and to assemble the information necessary to make sound strategic decisions.

This is where the new ASTM/ANSI standards on Whole Building Functionality and Serviceability (ASTM 1996) can play a crucial role. The serviceability standards, and ST&M, are useful for design-build and for more traditional forms of procurement. ST&M can be used to assess the suitability of properties on offer for lease, investment or purchase, as part of the review processes for design, construction, commissioning, and use, or for assessing a whole portfolio of properties. This standardized approach has been used inside and outside North America to define the capability of a property to meet the functional needs of present and future occupants and tenants, with respect to existing buildings as well as new construction. (Davis, *et al*, 1996, and Szigeti and Davis, 1996)

Building owners and occupiers ultimately pay the bills. Therefore, wittingly or unwittingly, they set the tone for the building process during the procurement process. Our view is indeed that the procurement process does determine the limits imposed on the delivery process. Developers who take the short view and build speculative buildings for a quick sale, or lenders who consider buildings as a short term investment to shelter cash while waiting for a better opportunity, have different objectives, and the long-term performance of the buildings is not part of their equation. Yet, they need to buy into a better procurement process also and be convinced to pay attention to these questions.

Improving the definition of the functional requirements for the facility to be procured, and sorting out the strategic decisions about functionality, will have a major impact on the quality of the end-product. This essential step is often misunderstood or ignored altogether. Yet, as we have shown above, it is at the core of the strategic decisions that need to be made by the intending building owner or occupier at the start of the procurement process, whatever the size of the project, regardless of building type, independent of the nature of the project, whether as new construction, renovation, or retrofit. It is imperative to get those who ultimately pay the bill to understand that THEY drive the quality of the end-product. If they demand it, the industry will provide it.

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DESIGN AND BUILD FOR A COMPLICATED RE-DEVELOPMENT PROJECT IN HONG KONG: THE HAPPY VALLEY RACECOURSE REDEVELOPMENT.

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Abstract:

"Design and Build" has become accepted by the construction industry of Hong Kong in the last few years. It is a new procurement system in Hong Kong although its name has existed for decades. "Design and Build" has been proven successful in small scale projects with standard designs in which the quality of design and construction is not a big concern. However, its application to a project worth HK$1.2 billion (US$153 million) had not been tested in Hong Kong.

This study aims to investigate the benefits and difficulties encountered in applying "Design and Build" in Hong Kong for a large scale complicated construction project from the point of view of an owner. A case study on the project "The Happy Valley Racecourse Redevelopment" will be used to illustrate the application, performance, advantages and disadvantages of the Design and Build approach.

Keywords: Design and Build, Performance, Contract, Large Scale Complicated Projects

INTRODUCTION

Hong Kong has developed into a major commercial centre of Southeast Asia, the world's fastest growing economic region (Chan, 1991). The contribution of the property and construction sectors to GDP amounts to 22% (Walker, 1990). However, the construction systems are still very conservative. People in the industry are quite reluctant to change and less inclined to accept new ideas unless they are well tested in other regions. Hence, the procurement method used in Hong Kong is still very traditional. Traditional procurement methods typically involve employment of an architect to produce a design, followed by the appointment of a contractor and overseeing the administration of the project. There have been only a few records of management contracting or design and build contracts In Hong Kong (Rowlinson et al, 1993). Hence, the traditional competitive tendering is still the predominant procurement system in Hong Kong.

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DESIGN AND BUILD

The CIOB (1988) gives a comprehensive definition of the design and build method:

> "The client deals directly with the contractor for the complete building and it is the contractor who is not only responsible for, but also coordinates the separate design and construction processes, including engagement of the design team who are, therefore, contractually linked with the contractor and the client. The construction process, whilst linked, is still separate from the design process, leaving the consultants free to concentrate on their own roles. The client may, however, directly appoint either in-house staff or a separate consultant to check that the product the contractor is providing the value for money and that content and quality are satisfactory."

The use of "Design and Build" purports to be bearing the following advantages:

Single contact point

Under the traditional method, the client needs to deal with several professional consultants and contractors. He has to put in more effort to motivate and communicate with them in order to obtain the expected outcome. On the other hand, under the design and build method, the contractor is responsible for the communication with the professions and subcontractors. The client can concentrate on other more important aspects such as sales and marketing issues. Further, the client's liabilities and responsibility are all shifted to the contractor.

Shorter project development period

In an extremely competitive and dynamic property market, time is of essence. If the client can procure the building faster than the competitors, he may get a quicker capital return. Design and build can satisfy this requirement because the overlapping of design and construction stages will shorten the duration of the project. In addition, shorter duration will lead to:

Less interest payment

During periods of high interest charges, this is particularly important. This is particularly crucial in Hong Kong as the land values are extremely high.

Quick utilization of capital

The client can make full use of his available capital by quickly converting inputs into outputs.

Avoidance of market uncertainly

By procuring buildings earlier, the client can minimize the effect of long term market uncertainty.

Less impact by inflation

With a shorter procurement duration, the effect of inflation can be minimized and the client can be more certain on the cost of construction.

Reducing disputes and likely arbitration

Using the traditional approach, many disputes can arise due to the ambiguity of the contractual and management relationship among various parties. Under the design and build, the client can distance himself from the contract and the subsequent liabilities by passing them to the contractor. The number of disputes and recourses to arbitration can be reduced.

Providing better value for money

Clients can select from a number of development proposals offered by competing contractors.

USE OF DESIGN AND BUILD IN HONG KONG

The construction industry in Hong Kong can be described as an international market as contractors from all over the world can enter and leave the Hong Kong market without any hurdles. However, the competition is keen. The profit margin has become thinner and thinner due to high inflation rates, rise in labour costs, and more stringent environmental and safety control. The quality of work and completion times are thus adversely affected. Meanwhile, the performance of architects is decreasing due to the booming construction market that strains the resources of architectural firms. The quality of design has created great impacts on variations, delays, and claims. This, coupled with the use of inexperienced young architects and the consequent lack of buildability, has lowered the performance of the industry.

Hence, the industry, supported by most large construction firms, strongly advocates the use of innovative procurement systems such as Design and Build in which contractors offer to package projects from design to property management. Design and Build brings the designer and the contractor together to develop detailed designs that can improve buildability and minimize the possibility of the project manager going wrong.

THE HAPPY VALLEY RACECOURSE REDEVELOPMENT PROJECT

The old Happy Valley Racecourse was developed more than 100 years ago. Its narrow race track and sharp turning angles have caused a number of accidents and complaints from the horse trainers and jockeys.

The Hong Kong Jockey Club, hence, started investigating the possibility of extending the racecourse in 1991. Since the racecourse was located at the core area of Happy Valley, it was surrounded by tall buildings, parks and roads which were owned by different land owners.

The project was possible only with exchanges of land with its neighbours: the Urban Council, the Highway Department, the Hong Kong Football Club and the Royal Hong Kong Regiment. The development area was 24.8 hectares. The estimate was 0.9 billion and the final cost arrived at 1.2 billion. It consisted of the following activities:

a) to dismantle existing premises of the Hong Kong Football Club, provide a temporary club house during the construction stage of the racecourse and provide a permanent one at a new location.

b) to dismantle an existing Jockey Club administration building and to construct a new administration building with a gross floor area of 19,000 m^2.

c) to re-locate Sport Road northwards.

d) to re-organize the road network and junctions in the vicinity of the racecourse.

e) to dismantle existing premises of the Royal Hong Kong Regiment and provide temporary facilities.

f) to re-layout and construct new parks and soccer fields at the racecourse periphery and infield respectively for the Urban Council.

g) to construct a carpark which can accommodate 325 vehicles under a portion of elevated race track.

h) to re-construct the grass race track by widening it to 30 metres to meet the international standard and smoothening the turning radius at bends.

i) to construct a new race-day stable block which can house 126 horses.

j) to renovate an existing nine storeys office building into a member betting lounge.

k) to green up the periphery of the racecourse by planting huge amount of trees and plants.

Reasons for adopting Design and Build

- Tight schedule

The Hong Kong Jockey club received the government's endorsement to proceed with the project by the end of 1992. However, there was a proviso within the approval contract that the project needed to be completed before handing over the sovereignty to China in 1997. This tied down the project duration to be within 4 years to complete the whole project. The management of the Jockey Club lacked confidence to complete the project if adopting the

traditional procurement system. As Design and Build allows the contractor to be involved in the project at an early stage and proceed with the design works in parallel with the construction activities, the project re-development time could be reduced. This was preferred by the management.

- Complexity of works

The project was huge and complex in nature. The use of traditional procurement might result in many disputes and contractual arguments.

- High level of coordination

The project involved land exchange. It was necessary to negotiate and coordinate with the Urban Council, Highways Department, Lands Department, the Hong Kong Football Club, the Royal Hong Kong Regiment and the Jockey Club's internal end user departments.

One of the major coordination problems was that the contractor needed to ensure that the normal racing of the Happy Valley during the redevelopment stage would not be affected. The racecourse needed to be opened for race meetings throughout the entire redevelopment period. The race tracks could only be closed for 10 months at most.

Form of Contract

New Engineering Contract (NEC) by the Institution of Civil Engineers with a major design and build element was selected because it offered the following benefits:

- Flexibility

The contract allows a choice of six payment options which enables the employer to choose the payment mechanism best suited to him. A range of secondary options is provided which allows any combination of core and main conditions; e.g., fluctuation clause and retention, etc. A range of possible contractor design responsibility from 0-100% is permitted. And, a range of possible subcontracting levels from 0-100% is also possible.

- Clarity

The use of simple language, concise sentences and avoidance of legal jargon of the contract was favoured by the client. The clarity of the contract is enhanced by defining activities using flow charting diagrams.

- Retention of client's management input

The NEC allows the owner to manage his project, to spend his own money of his project in the way he chooses, to use the same form of contract for all aspects of the project, either civil,

building mechanical or electrical, to choose the parties to carry out the conceptual design and the detail design, and to allocate contractual risks at his own will.

RESULTS OF THE PROJECT

The Happy Valley Racecourse Redevelopment was completed on time. It took about four years to complete approximate HK$1.2 billion values of work. In this redevelopment project, the client has experienced the following benefits:

- The client needed to deal with one organization only and hence communication was efficient and effective.
- There were no disputed responsibilities. In the event of defaults, the contractor took the sole responsibilities.
- The contractor could use the most efficient method in construction. He could have flexibility in carrying out design work to fit the site circumstances and the approach encouraged creative thinking. For example, precast units for structural members were largely employed in this project to speed up the construction time.
- The client could obtain a firm price for the project at the outset.
- Construction time has been shortened. If the project were carried out in the traditional procurement approach, it would take more than 5 years to complete as estimated by the project manager of the client.

Having said that, the client has also experienced the following problems:

- The client had to commit himself at the early stage. Any slight changes created variations. This was reflected by the fact that numerous claims have been submitted by the contractor. The original tender price was at HK$0.9 billion but the final account was settled at HK$1.2 billion.
- A clear and absolute specification needed to be defined at the outset as contractors tended to use the cheapest materials if the works information did not specify the brand name of such material or products clearly. This trick has been played by the contractor on a number of occasions in the project.
- Although the client kept chasing after the contractor for construction drawings for site supervision and control, he always obtained construction drawings after the construction work has been executed.

As the project was started in a rush, there was limited time for the client to define clearly its detailed requirements. The requirements specified in the Works Information were very

conceptual. Exact details should be developed at the later stage. Such arrangements created a lot of grey areas which engender different interpretation of the requirements by the contractor and the client. The differences always took a long time to discuss, argue and resolve. Claims and variations were comparatively higher than that of the traditional contracts.

An example was the argument on the height of the peripheral steel fence of the racecourse. There was a statement in the Works Information stating that the contractor had to provide and install steel fence at the periphery of the Racecourse but without specifying its height. However, there were a few conceptual pictures drawn by the client's landscape consultant showing the conceptual height of the fence. One of the picture showed it reached an adult's head but the other showed it reached the chest of an adult. The contractor therefore submitted a 1.3 high steel fence for the client's approval. The client's end user departments and the Urban Council both commented the fence height should not be less than 1.6 m due to security reasons. The client then asked the contractor to revise the height. However, the contractor submitted a claim for the variation and he did not start the work on site before this had been settled. Finally, this item was settled by a commercial wrap-up.

EXPERIENCE LEARNED FROM THE CASE STUDY

The use of Design and Build has been proven to be effective in cutting construction time. The other side of the coin is that this would result in the increase in disputes and claims if details of the client's requirements were not fully elucidated at the outset. However, a full set of detailed specifications and drawings may consume a lot of front end time, resulting in the loss of its major benefit.

The construction industry in Hong Kong tries to resolve the above problem in two different ways; one practised by private firms and the other by public organizations. Private firms tend to hire an architect to carry out the conceptual design and subsequently novate the design team to the contractor. Public organizations incline towards preparing a very detailed conceptual design and specifications which, in turn, restrict the flexibility and freedom of the contractor in design, but can reduce many disputes and claims. These two approaches cannot fully exploit the benefits of Design and Build. A third approach, which is becoming popular in Hong Kong, is to hire an experienced project management consultant to prepare the client's brief and specification. This approach has been proven to be effective in some small scale Design and Build projects in Hong Kong while its applicability to large scale and complicated projects still awaits verification.

CONCLUSION

In recent years, competition in the construction industry of Hong Kong is very keen. Clients' requirements on construction time, costs and quality are becoming more stringent. The traditional procurement approach cannot satisfy these needs. The potential use of Design and Build becomes increasing as it can offer the clients the following:

- Shorter project delivery duration.
- Single point of contact.
- A firm price at the outset of the project.
- Minimum risks.

However, its wide use is limited by the generally weak design capability of contractors. They have to rely on external consultants. The lack of past experience in Design and Build also confronts the clients with uncertainty. The lack of experience of the local contractors may not allow them to fully capitalize the advantages of Design and Build. Finally, the high initial tendering costs restrain local contractors from becoming involved in this procurement system. Both contractors and clients need to cooperate in making the system work.

Experiences from the above case study have shown that Design and Build can reduce the construction time; however, with the sacrifice of increase in disputes and claims. Modified approaches have been suggested to overcome the shortfalls of the "pure" Design and Build model. The various approaches have their pros and cons. Their application needs to be verified when the construction industry has gained more experience in using Design and Build models.

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CONTRACTORS OFFERING TOTAL PACKAGES TO CLIENTS: CHANGING CULTURE OF CONTRACTUAL RELATIONSHIPS

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Abstract

As part of a larger research-project, this paper especially focusses on experiences of contractors, when offering specific added-value to their building-projects. One described way is to deliver not only the project itself, but also to add a certain period for maintaining (other than the normal guarantees) the building in case of change of use, etc. This way of working is in fact a *Build-Transfer-Maintain* approach, *BTM*. The contractor has to enlarge his scope of attitude from purely building and/or development-activities to a complete supplier of full service for the building including its life-cycle period. When broadening the scope of activities from developing and construction to the phase of e.g. maintainance, one can get more long-term profit and continuity, although there have then to be quite good possibilities for risk-reduction in the project organisation. Assuming that the total costs of a building project are higher in the total period of exploitation than in the period of construction, this approach could become of much interest for clients and contractors, nowadays and in the near future. A recent case study is described briefly. Results are mainly focussed on the way contractors should develop their strategy regarding this approach, and are accompanied by recommendations and descriptions of specific advantages and disadvantages for them and for their clients with this way of working.

INTRODUCTION

During the past years the construction industry is changing. Especially in Europe one can see more internationalization due to the development of the European Community, etc. National borders are diminishing in importance, and parties in the construction industry realize their projects more and more in an international scope. At the same time this results in larger competition within the several local and regional construction markets.

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Therefore these parties involved (e.g. contractors and project developers) have to change their attitude: from purely delivering building projects towards a broader scope of activities concerning the building projects. This paper describes such a change of attitude in the present situation, especially in the case of contractors in the Netherlands.

BACKGROUND

When contractors are active in realizing building projects in construction markets, they are more or less "following" the actions of the client and/or the architect involved. In the (1)*Traditional* way an architect is the central coordinatior for designing the building, and organization of e.g. the tendering phase. Contractors can only make an offer according the specifications of the client and the architect. This way of working is being changed by using the so called (2)*Building-team.* Contractors get a more advisory role in such projects, because they are being consulted in the design-phase, and they give their recommendations regarding constructability of the design, etc. [Tijhuis, Maas and Spekkink, 1992]. Another way of organizing is (3)*Turnkey.* Contractors and/or e.g. project developers are offering completely specified building plans to clients. The clients only have to choose the required specifications in some detail, a so called "Brochure-plan" [Bender, 1973; Tijhuis and Bakker, 1984]. Some contractors use them by working on standard projects with standard solutions. Or for tailor-made projects with standard solutions [Tijhuis, 1996]. Of course there are alternative ways of organizing possible, or specific minor variants to these three main types of construction-organizational forms, e.g. Design and Construct as De Ridder described it [De Ridder, 1994]. However, in general the three mentioned types *Traditional, Building-team* and *Turnkey* can be considered as the main types, at least in the European situation.

In one of our research projects, it was pointed out, that in the building of office buildings in the Netherlands between the period 1986 and 1989 the share of the use of the traditional way was quite high, which can be seen in figure 1 [Tijhuis, Maas and Dowidar, 1994].

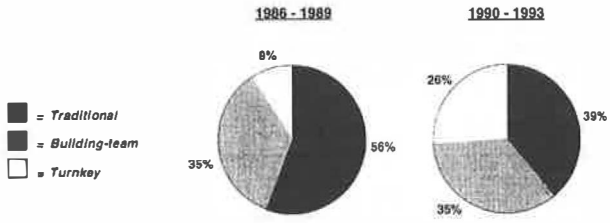

Figure 1. Utilization of types of construction-organization in building Dutch office-projects [Tijhuis, Maas and Dowidar, 1994]

The second used way was the building-team, and the turnkey was the third. In comparison, the situation between 1990 and 1993 showed that the traditional way was being used in a decreasing number of projects, whereas the turnkey way was used more and more. The building-team way showed a quite stable use in these samples, as figure 1 repesents.

The described ways of organizing the construction process cover more or less all the phases from initiative to delivery of the project, either totally or partly. What in fact is ignored are the phases after delivery: the use, and maybe re-use or even recycling of the building. And these phases could become of specific importance for both contractors and clients. Although the realization and delivery of the building play important roles in its life-cycle, the use and re-use or even recycling of the building will play a quite strong role in the next future. The following part of this article will describe some aspects of contractors entering these phases.

CONSTRUCTION PROCESS AFTER DELIVERY OF THE BUILDING

Holding control on contractual parties involved

When the construction process is being analyzed, one can see that there are in fact four main general phases or stages:

(a) Programme;
(b) Design;
(c) Elaboration;
(d) Realization.

All of these phases can be divided into parts, especially emphasized in relationship to the moments of control and optimization in the whole process. The phase of *Design* consists e.g. of *Structural design, Preliminary design* and *Definitive design.*
Independent from the several parties involved or the way the process is organized, these phases are being "processed" when realizing a building project. Therefore it seems at first glance that the parties involved (contractors, subcontractors etc.) have finished when they have delivered the project to the client. And as far as the above mentioned four phases are concerned, that is more or less the case. But it is increasingly pointed out that a construction project is not finished when one has delivered it! After construction the risk does not end for these parties, although it can be calculated and foreseen in a quite certain way [IMSA, 1981]. Think for example about the guarantees the parties involved do have to give, e.g. for hidden defects, etc.
These guarantees are mostly secured by the last amount of the contract-sum: a client does not pay it to the contractor, but puts it on a special blocked account. This way of working is being used as a pressure for contractors to stay serious with the repairs of defects, etc., after delivery of the building; so that only after the repair and gurantee-period they will get their money. The mentioned system is being used quite generally in e.g. Dutch and German building contracts [UAV, 1989; VOB, 1993].

Building projects and their use

Realizing building projects is only one part of the whole building process. In addition to the mentioned four general phases, one can distinguish other subsequent phases:

(e) Maintainance;
(f) Re-use.

These two phases are becoming more important, as the management of the building-process does not end with the delivery. Indeed, its a far larger part of costs is being spent on the completed building during its use [Tempelmans Plat, 1984]. In these phases important decisions about maintenance, re-using and/or recycling of the building and/or its components have to be taken. As e.g. Henket and Choukry have mentioned, an influence on these issues already exists in the (a) programme, (b) design and (c) elaboration phases [Henket, 1989; Choukry, 1994]. And also during materialization in the (d) realization-phase. It is obvious that in these phases the contractors are quite deeply involved, and their work indirectly influences several aspects of the building during use. This is especially the case when contractors are offering projects in building-teams or turnkey concepts. However, when they are taking part in a traditionally organized construction project, this is mostly not the case: they only prepare their offer in the way the client has asked for it. Nevertheless it is quite strange to see that in general contractors do not offer the work and services for the total life-cycle of the building (realization and maintainance). Directly related to that is the fact that clients maybe do not realize the positive effects when demanding a so called "total package" for their building-project. With regard to how much contractors should be involved in the tendering phase for getting an economic bid [Wilson et al, 1987], or what is the client's risk for getting discordant bids [Crowley, 1996], we would like to emphasize that it is especially important to decide for which construction phases and for what work a tender procedure is being started, and with which organization type in mind.
Therefore it is interesting to look more closely into these specific aspects, represented in figure 2.

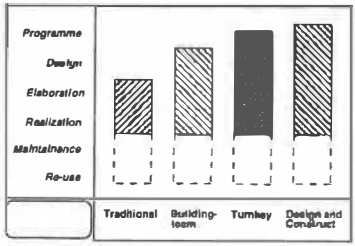

Figure 2. Phases in a construction process and their relationship with the tendering practice in the various organization types

Looking from the viewpoint of the client to obtain a clear situation regarding the total (building) costs during use of the building; and from the viewpoint of the contractor to assess a longer involvement period, not only with guarantee aspects, but also and especially with activities for maintainance and re-use of the building. Figure 2 schematically present these phases in a construction process and shows their relationship with the tendering practice within the various organisation types.

CLIENTS AND DEMANDS

Clients and contractors: Matching of interests

It is quite difficult for parties for parties involved in the construction process quite to know what their clients really want, as even the clients themselves do not always realize what they really want for their building-projects. What is the real budget? For which specifications? And in what quality-level? Focussing on these demands especially means, that in some cases contractors may not be a suitable choice for realizing the demands of the clients for their building projects. Clients who still ask for an offer from these contractors could expect possible problems during the construction processes. Therefore the demands of the clients should match with the technical and organizational capacities of the contractor. Huska and Palenik call these aspects a *"compatibility testing of the interface between supplier and customer fields"* [Huska and Palenik, 1987]. In addition to that, we emphasize the importance of matching cultural habits between contractor and client, especially in relationship with the phases of *Naming, Blaming* and *Claiming* in construction conflicts [Felstiner, Abel and Sarat, 1980]. A comparative research between the Dutch and German construction processes also pointed in that direction [Tijhuis, 1996a].

Demands and risks

A client in fact asks for a building-project which he can use, not for a construction process with many problems. For reducing possible risks and introducing guarantees, contracts including (standard) items are being signed for a certain (construction) period.
But why should a client not equally stipulate a contract period, which also covers the period of using the building? The guarantee period only covers the risk for hidden defects; what to do with aspects of maintenance? Such technical and maybe even functional defects constantly have to be repaired. In these circumstances a professional client normally has his own people for such tasks, although it is not his core-business.
In relationship to the call for "back-to-core-business" it could be interesting to tender also these works to a contractor, especially in relationship and addition to a "normal" tender of the construction of the building itself. A contractor can then offer a total package, although he has to know of course for which period he will be active in the maintenance of the building. In that way he is broadening his scope of activities in the building process. And for the near future that could be one of the strategies for creating (and especially continuing) competive strength in the construction market.

Being active in the development of construction projects and focussing on total project control and related activities could be parts of it, as e.g. Hasegawa et al and Atkins et al mentioned [Hasegawa et al, 1988; Atkins et al, 1993].
This implies another important aspect. When a contractor takes on the risk for this maintenance, he should have some influence in the choice of the materials in the design-phase, since these choices directly influence the way the maintenance is needed. Consequently, building-team and turnkey-concepts could then be good types of construction organizations. For the traditional way it is more difficult, since it implies a possible larger risk for the contractor for unforeseen costs in maintenance activities. When a client only wants to tender the maintainance activities of his project in a traditionally organised way, he therefore has to reckon with a possible higher risk for the contractor, because the contractor cannot influence the design phase. Therefore this will result quite surely in a higher offer by the contractor, which obviously will not be the wish of the client.

CONTINUING INVOLVEMENT WITH ADDED VALUE: A CASE-STUDY

Introduction

Working with total packages can be seen as a BTM-approach: *Build, Transfer* and *Maintain.* In relationship to the BOT or BOOT-approach (Build, Own, Operate and Transfer) which are forms of concession-contracts [Smith, 1994], the total package does not bear the (temporary) direct risk (or advantage) of ownership of the building. In addition to that, on one hand the client transfers the maintainance risk to the contractor for a certain period. On the other hand the contractor "stays close" in relationship to the client. And not only for aspects of guarantees when he has completed the building. He therefore can create a commercially interesting continuing involvement with added value to the client. The total package therefore is an interesting form of spreading risk-of-use, and creating a more continuous work-flow for certain periods for the contractor. Although the client pays a certain amount for a certain maintainance period, he has a more clear view of costs to be calculated for use of the building.
Besides that, getting more knowledge and understanding of each others' "culture" during such long-term relationships, influences positively the way of working together: a balance of interests (win-win-situation) can be introduced effectively, resulting in an efficient construction process and period of building-use. An example of a recently completed Dutch project with the BTM-approach is worked out in the following case-study.

Project characteristics

The project is an office building in the east part of the Netherlands. It consists of circa 19,000 sqm, and includes offices, a restaurant and a parking-garage. It has parts with about five floors, and also parts with eight floors. The shape of the building is not quite rectangular, but also has circular floor-plans. As a part of the design, the building is divided into two main parts, separated by an opening, where local traffic can pass through. The project belongs to one main client, and is being used by several companies who rent their part of the project.

The contractor detached during the contract-period a "project-maintain" manager in the building. This employee is coordinating the various activities, and acts in fact as a facility-manager for the building.

Contracts

The project is realized on the basis of a turnkey-contract. The project-developer developed the project and also constructed it by himself, as a contractor. Normally he only worked as a developer and contractor, not including contracts for maintaining the project. In this specific case it became quite interesting to also include the maintenance. Especially since it is quite a large building with quite a lot of different users. The client therefore expected that there would be several tasks associated with keeping the building up-to-date, according the wishes of the users. And not only for the "pure" maintainance activities, but e.g. also for changing partition-walls, solving installation-changes, etc. For these activities, the contracts with the developing contractor were signed as a whole for a certain period, and for a certain amount of work.

Some consequences for the client

When a client has to manage the building he owns, it can mean quite a lot of contacts and meetings with possible (sub)contractors for maintainance activities. This takes a lot of time, and can be interesting for getting a competitive offer for these activities. Nevertheless, one can see that in several cases the client comes back to the contractor which worked in a comprehensive way for him; a more or less strong relationship is growing, resulting in fact in one contractor for maintaining the realized project. But why not already make a contract at the early start of the project? At that moment the contractor can influence the design of the project, and can give advice in choosing materials, according e.g. to the functional and economical use of the building.
So, on the one hand the client in fact does not have a real opportunity for getting a competitive offer for maintainance-activities during a certain period afterwards when using the building.
But on the other hand he can already get insights into the total costs of the building, in the design or even in the programme-phase. And not only do these insights concern construction costs, but also quite clear information about costs for maintaining the building. In such situations it is important to describe the period, and the total amount of expected work-activities. The client pays for reducing his risk for unexpected cost during the use of the building, and creates a more long-term relationship with the contractor.

Some consequences for the contractor

When the contractor offers a total package, it gives him the opportunity for getting long-term activities at the project, not only during realization but only during use. But these opportunities result in a possible higher risk for him: he cannot see in detail which maintainance activities he will be encountering, especially the change of e.g. partition-walls and installations which can result in quite high costs.

These risks can be reduced by describing in a detailed way to what level the activities are being carried out, and during which period. The opportunity lies especially in the fact that the contractor stays involved in the project. So, a balance of interests between the contractor and the client can be established. In the case a (professional) client has planned to realize another building, the chance for getting involved in it is quite high for the contractor, especially since they know each other during the present project.

COMPETITION AND CONTRACTUAL RELATIONSHIPS

The way of using the total package results more or less in the fact, that during the realization and use of the building the competition for getting an offer by contractors decreases for the client. That can result in a higher total price, especially when looking at direct costs. But when a higher price results in a better and smoother process for realization and use, the indirect costs will be lower. And besides that, the client gets more insight into the total expected costs for the building. For the contractor the total package can also function as a marketing instrument, while the relationship with the client can become more durable and effective in this way. Comparing aspects of *"closing the gap"*, as Grant and Schlesinger mentioned [Grant and Schlesinger, 1995], it can be seen as an increasing need for the contractor to know who his possible clients are. And also of course a client needs to know which contractor fits best for realizing (and maintaining) his projects.

CONCLUSIONS AND RECOMMENDATIONS

Offering total packages needs to be considered as an opportunity for contractors to add more specific value to their offered activities and/or projects. That can cause a need for a "cultural change" for contractors and clients regarding their relationships:

(a) Contractors getting really focussed on the demands of the clients;
(b) Clients getting focussed on long-term relationships with contractors.

And there are important reasons for realizing the best project: not only regarding the price, but also regarding quality, which can be of a positive impact for both the contractor and the client.
The need for a good descprition of the focussed period and specific work-packages, prices and qualities will then be important, resulting in a clear contract. But more important is to know what the client really wants, as stated by Van Randen [Van Randen, 1993]: *"Quality is that what the client wants, and not that what experts say the client should want"* (translated from Dutch). An important lesson from this statement is that the clients and their demands should be the central issue for contractors when they want to offer their construction process (capacity), particularly in these special ways of offering total packages. Besides that, the clients should turn to team-work with contractors, already in the design-phase. That can result in an optimization of technical and economical decisions when realizing and using the building project. In that way a total package can be seen as a serious marketing-instrument for creating or continuing activities, *both for contractors and for clients.*

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QUASI-FIRMS FOR REAL INNOVATIONS

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Abstract

The construction industry is notorious for its (lack of) innovativeness. Many papers, reports and articles have been written on this subject already for more than three decades. The explanations presented can be summarized by such terms as fragmentation, segmentation and segregation when referring to the industries' structure and by qualifications such as opportunistic, hostile, antagonistic and conflictive when referring to its culture. In this paper it is argued that the main reason for the innovation status quo is the fact that the construction industry, when compared to other industries, lacks real producers- producers who develop products and compete with each other in terms of these products. It is particularly this kind of competition which is identified as a source to stimulate innovation. In construction, *production* capabilities are tested on the market and not *product* capabilities. As a result, design decisions are not tested on the market. It is this flaw which is examined in this paper, and possible improvements are suggested. Endurable strategic alliances, as quasi-firms, are proposed as the equivalent of producers. Essential herein is the pivotal position of design. An organizational innovation as such could change the way business is done in the construction industry. It would alter its structure as well as its culture.

KEYWORDS: Construction industry; Innovation; Producer; Quasi-firm.

INTRODUCTION

Innovation in the construction sector is seen as beneficial and at the same time problematic. The theme of the conference illustrates this perspective. To enhance the innovativeness of the industry, the relationships between procurement and innovation are addressed. Two hypotheses have been put forward to canalize the discussions: one hypothesis concerns the role and action of the building owners, and the other pertains to the behavior within the industry. The way in which these hypotheses are presented, one might think that the lever to stimulate innovation would be found either on the demand side (the owners) or on the supply side (the industry). Holding on to this contraposition however would be an unfortunate misunderstanding. Owners and industry co-exist. Procurement sets the rules that bind them together and regulate their interactive behavior. It will be argued in this paper that

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both sides are needed to attain a long term sustainable change in this construction business environment in order for innovation to thrive. The exploration of the problematic nature of innovation in construction industry will be approached by contrasting with trends in other industries (especially shipbuilding). The lessons learned indicate that owners as well as businesses in industry should both change their respective roles and change their outlook on each other's role; ergo both have to redefine their businesses.

CONSTRUCTION INDUSTRY LACKS REAL PRODUCERS.

What can be said about the innovative capacity of the construction sector when measured up against other industries? Factors often suggested as important differences are the fragmented nature of the construction industry, the project-based production, the production on site, and the production by altering ad-hoc coalitions; these factors have frequently been put forward and for quite some time now[2]. But one important factor may well be overlooked. The most significant distinction might be the absence of the dominant producer in the construction industry; a producer who as an economic agent, selects markets, develops products, attaches a trademark (branding), tries to influence demand, bears the risk of production and other investment costs, and is held liable for defects in the final product. This producer invests, develops a product, and sells it on a market. In a competitive state, failing to innovate, while the competitors do, may put this producer out of business. Therefore innovation becomes an important factor in the producers' survival strategies.

For the construction arena, the above mentioned activities and responsibilities are usually attributed to owners, but there is a striking difference. Owners do not compete with other owners as producers do with other producers. Owners do not place their facilities on the market for sale. Although owners perform a producer role, they generally do not intend to sell their newly built facilities, and they therefore operate on the demand side of the market instead of the supply-side (as producers typically do)[3]. Hence owners do not feel market discipline, and subsequently miss the straight market incentive to innovate.

Since owners enter the market on the demand side, knowing what they are looking for and specifying their needs in extensive documents, the construction industry is forced to compete on production capabilities, instead of product characteristics[4]. As a result, the companies on the supply side of the market hardly feel any compulsion to actively influence the mechanism of supply and demand to their advantage in terms of products. These businesses

[2] Just think of publications as the Emmerson report [1962], the Banwell report [1964], the work of Marian Bowley [1966], Koskela [1992] and Latham (1994) Dutch counterparts by Haselhoff and Rijlaarsdam [1988], Jacobs et al. [1992], Van Tongeren [1996].

[3] Unless the projects are in the hand of project developers of course. Much of the project development in the Netherlands concerns housing; since there is a shortage, especially a lack of building locations, this can be characterized at the moment as a sellers-market.

[4] In the Netherlands, over 95 percent of civil engineering works are procured in the traditional way (design-bid-build).

are capacity and capability driven, trying to innovate their production tricks, because their tricks are their products. Furthermore, owners are often reluctant to act as guinea pigs for new production tricks. Because there is too much at stake for them, they urge the contractors to stick to proven technology. Since they cannot accept any eventual error, they prefer to avoid the attempt. The contractor-competitors have to subordinate their behavior to the clients' wishes and corresponding product specifications, doing what one might call 'old tricks' better (cheaper and faster) than before, rather than offering new products. If not they may bring themselves into the bankruptcy danger zone. Profit margins are often too small to allow experimention.

THE INNOVATION STATUS QUO

In explaining the innovativeness of the construction industry, when comparing it with other industries, this producer elision seems to be the most significant difference. It explains the absence of the innovation incentive. On the one hand the owner acts as the producer, but a very specific one; a producer who operates on the demand side of the market and does not experience direct competition (with other clients). On the other hand, a supply side consisting of businesses which are forced to compete on production capabilities in response to the clients' prescribed needs. Only in limited segments of the construction industry are products developed and brought to a competitive market (predominantly referred to as project development). In the construction sector most companies are condemned to occupy to reactive market positions.

We see that owners, through their procurement behavior, express little trust in the product development capabilities of construction companies, by only involving them after the design is finished (the design having been contracted out to specialized design and engineering firms. We also see that construction contractors, by defining their core business as construction, express little trust in their market possibilities as product developers; only very little design and engineering (if at all) is permitted within their companies. Since firms dedicated to design and engineering thrive on this situation, one might deduce that the construction market, and the players within it, find themselves in a status quo - a status quo without a real producer, without competition in terms of products, and subsequently without the market incentive to innovate.

CONTROLLING MARKET POSITIONS

In the traditional industries such as consumer electronics, and the automotive and the aerospace industries, markets are dominated by a relatively small number of producers. The market dominance is generally determined by a number of factors. First and foremost, certain financial characteristics (equity) count. Market power is normally held by the party in the value chain which directs the flows of material, equipment and work force - in other words where the large turnover and/or high added value is achieved. These large producers

develop a financial base on which they can afford to invest heavily in the development of new products. They stay ahead of competition by being able to allocate more money to new products, and by utilizing better networks to distribute them. Through their size, they can 'sweat out' fierce competition longer than smaller competitors.

After a certain time, concentration occurs on the supply side of these markets. The number of producers decreases. Smaller players step out, or are taken over by the big players, bigger players may merge. In all these cases, the producers possess the capabilities of responding to the needs of the customers primarily through the control of the design process, combined with control of the logistics processes. Segments of production and assembly may be brought in or contracted out, but design and marketing are concentrated and concerted, to meet and further develop according to customers' demands.

These industries are so-called self-creating industries. Here the design process lies at the heart of product development. This design can be described as an iterative process, interacting with other disciplines such as production, marketing, purchasing, research and distribution. Generally these different disciplines all belong to one hierarchy, the organization of the producer. Information is sucked in from, and pumped out to, other organs of the same company. Although back-to-core business and down-sizing strategies have changed the face of industry, the crucial position of design has not shrivelled. Large molochs are broken down; instead, networks of producers and co-makers have grown up in industry. A project-related approach is more often being chosen for product development. The management of these projects is the task (and responsibility) of the producer. The producer who at the end of the day will have his trademark on the product, is held liable and bears the large part of the market and financial risks. Therefore the conceptual design, being at the heart of product development, also has to be the responsibility of the producer, who may call on support in the form of co-design and co-engineering, but may not delegate control of the development process. Without control of design, a producer will certainly lose control of his market position.

At present, design and engineering provide more than solely form and function to the product. Thanks to CAD-related software development, the entire production process will also be directed from the design process (CAM, CAE, CIM). Product and production process are co-designed, in a concurrent manner. This apprises a second important condition for dominance: the control of the conceptual design and consequently control of the product development. Controlling the design process implies controlling decisions concerning the characteristics of the product, and therefore the interplay with customers' demands and values. A producer will not achieve dominance through financial power alone; a producer needs to command the design process. This producer may be a single "one firm" entity, but may also be a quasi-firm[5], a cohesive network of firms working together orchestrated in a certain product-market-technology niche.

[5] This term was first used by Robert Eccles in 1981. He introduced this term to describe contractor-subcontractor relationships. This type of strategic alliance is also referred to as *virtual-organization*. One might argue that virtual *firm* or virtual *company* might better capture the essence of the phenomenon.

SHIPBUILDING AS PARALLEL

A case of shipbuilding poses an interesting example of this quasi-firm phenomenon. Shipbuilding is the industry which, from the production and operations standpoint, has the most resemblance, or the least difference, with the construction industry: project based production, on client specification, high cost per product, small number of products per producer, labour intensive, design intensive, production lay-out by fixed position. The main difference is that ships are built on a producer selected site, and delivered to the client when finished, while the construction industry distributes the production apparatus to a site selected by the client.

These shipbuilders, together called The Central Industry Group, located in Groningen in the north of the Netherlands, form a co-makership network of 17 shipyards. These companies are organized to be lean and mean and to develop added value through market development, purchasing and subcontracting. Two design/engineering firms participate in the network as well as a software supplier, a steel production company, mechanical and electrical engineering companies, a timber company, firms of painters and material suppliers. Internal supplies account for approximately 40% of the turnover, a large part of which is generated through exports. The shipyards help one another in production and they work together in sales. Between 1975 and 1995 they were able to reduce price levels, on an indexed basis, by a half. This implies a tremendous increase in productivity. A number of improvements (innovations) lead to this impressive advance in productivity.

The organizational improvement, which required a great deal of effort, was based on the introduction of 3D-integral design and engineering. The 3D-form and -structured database provided opportunities, from both a design and a production perspective, to arrive at a much better designed vessel as well as a vastly improved construction and assembly process. Improving interaction and coordination of customer, yard and suppliers proved to be necessary. Because 3D-engineering defines a complete production design of the vessel more quickly, production activities could be brought further forward in the development process. Sub-assembly in standard units came within reach and welding robots could be used more effectively.

Of course this process took some time to build up new experience, because traditional demarcations changed, including the commercial process. Even so, each of the players in the network had to produce, in the awareness of the market discipline, and strive to expand his market share. The management spokesman of the shipbuilding network in question expressed it as follows:

> "A great advantage of the network is that the companies are so attuned to one another that a relatively large amount of work can be done without extensive paperwork. However, at this point I should mention that I am not trying to paint a romantic picture of idyllic business relations. Day by day the hard rules of economics dominate this network. Every company partaking in this network is striving to be the best every day and in every project. If you are not the best the project will be awarded to the competitor. It

is precisely this mechanism that keeps the network of the shipbuilding industry in the North of Holland so extremely sound, efficient and innovative" (Tienpont 1995).

This exciting development in the shipbuilding industry underlines the view that the design process lies, and must lie, at the heart of the business. It is on the one hand a rich medium for supporting pro-active market development, and on the other hand it serves as a basis for the further improvement of the efficiency of the production process. Furthermore, the co-makership atmosphere means that the disadvantages of the ad-hoc project coalition (such as ineffective communication, opportunism and disputes) are better mastered. Compared to ad-hoc contracting, transaction costs are reduced substantially (less paperwork). Through better communication, better co-ordination and resource pooling, productivity is further improved. This quasi-firm model has indeed turned out to be feasible in the shipbuilding industry.

LESSONS FOR THE CONSTRUCTION INDUSTRY

Reflecting on this shipbuilding case, let us consider what lessons can be distilled for the construction industry. Remember, production only starts in both shipbuilding and construction after the product (on paper) has been sold. Since the entry barrier in construction is very low, it is (and will continue to be) very difficult to gain and defend market dominance through sheer financial strength. In order to create a maintainably strong position on the market, it is necessary to satisfy the condition of control of the logistical and construction process, and even more important the control of the design process. After all, it is the design process which is the linking pin between the concept development process, in accordance with owners' demands, and the efficiency-oriented development of the physical construction process. The design process is at the heart of the total development-production chain. In the context of the analogy with the human body, we can also refer to this function as a heart with two chambers; a design chamber and an engineering chamber, the design chamber to feed the circulation of the market development process, the engineering chamber to feed the circulation of the construction process. The design process is implicitly the heart of product development at company level. Control of the design process is therefore a requirement for market development in the construction sector. Here we see the predicament of today's construction industry. There is no connection between market, product design and production (again: absence of the producer).

The diversity and range of products also demands management and control of the design process in order to establish an efficient scale of production. Through scale economies as well as learning curves, entry barriers can be obtained and market positions can be maintained. Only then can we imagine a producer who will lend his trademark to his products and will consequently be liable for those products. However, in the construction industry at present, design is usually carried out by the owner, or in his reign by an independent party (with its own business objectives). These production conditions therefore deviate significantly from the conditions outlined for industrial product development. While the design firm can derive market power in the position which has been provided through the agency

function, the innovation power remains very limited. In construction, the design function therefore does not act as an integrating component of an enterprise-oriented industrial product approach.

Productivity improvements are essential for the industry. These improvements will have to take root in the design process. The opportunities that information technology and data communications are providing us with, will have te be gradually explored in the design domain. After all, design is the most integrating activity in the development and value chain. The example from the shipbuilding industry shows how change in the integrated design process at the quasi-firm level can be the start of dramatic changes in the logistical and production process. Firstly the process had to prevail over structure so that the technology-embedded information 'blood' circulation could commence. The logistic and transaction structure had to be adapted to the desired course of the process. This has resulted in significant improvements in productivity. The construction industry has its complications, such as widely dispersed production facilities and substantial design diversification, but these complications are not expected to be permanent barriers to the type of developments found in the shipbuilding industry. In the Netherlands, we see some examples of this new trend: long-term maintenance contracts which establish long term cooperation and coalitions, and off-the- shelf coalitions for certain cautiously-developed and niche-marketed products, such as refurbishment of homes for the elderly.

QUASI-FIRMS MAY CREATE A NEW INNOVATION CONTEXT

The Dutch civil engineering contractors opt for the role of producer. But the Dutch procurement practice forces them to do so predominantly outside the Netherlands. In those cases, the design/engineering is construction-driven, applied mainly to supporting the construction activities, and not aimed at creating more value for the owner. The influence of design on the companies' culture is therefore limited. The companies still breathe a typical contractors' atmosphere. What continues to be missing - compared with industry - is a fully integrated approach to design and construction at a company level. In a market-driven enterprise, this integration must implicitly be a part of the complete product development process and penetrate throughout the entire hierarchy.

In a rapid changing society, such companies are needed. New concepts for living, working, transport, energy and recreation will emerge. The construction spectrum associated with these aspects ranges from high-rise to underground construction. Shortening the life cycle of structures and reducing production lead times can easily conflict with durability requirements. Add to this the current developments in materials as well as advances in information technology and data communications and it will be clear that technology must be at the heart of product innovation. This area of tension enforces the combined product and process development.

It will also be true for the construction sector that the capacity to innovate will largely depend on the mutual strengthening of the two cycles, namely of market (concept) develop-

ment and production (process) development. Both processes are elements in a double blood circulation. The design of the end-product has to answer the needs of consumers and the client. The producer must therefore secure design power. Using this integrating design capability, the producer can in turn articulate the demand for product development by the supply industry. Experience with the prefab industry has shown that there is much in the interactive innovation process which can be improved. The producer with such a professional design function also has the capability to give substance at a professional level to the functional integration with the external architect.

These days, industry usually organizes production, with reduced vertical integration, through a quasi-firm as a collaborative form. Inevitably the mechanism of the production process for an innovating construction industry needs more integration of design and construction at a company level. Because the financial risk makes the holistic "all-functions-in-one-firm" improbable, the quasi-firm is expected to develop under pressure from productivity as well as from creativity and flexibility requirements. Here the design function will supply the central function.

The contractors, installation firms and supply industry are the parties which control the logistics and the production process, and thus the high turnovers. Depending on the circumstances, any of these parties can develop the role of producer in this quasi-firm model. The opportunities for this can vary from one segment of the market to another. Firms of consulting engineers, while they have modest `financial power', can also follow a growth pathway starting from `design power' in view of the rapidly increasing complexity of the public-private concept development processes. When it comes to the actual development of structured dominance, in terms of capabilities combined with financial power, it seems to me that the construction company is in the best position to co-ordinate the quasi-firm.

CAN QUASI-FIRMS BECOME A REALITY?

The emergence of quasi-firms will depend on their role and position towards the owner, and even more crucially on the position the owner takes towards this new type of supplier. Who will act as producer? Will the producer act from the demand or from the supply side of the market? After all, the owner/client retains the financial power. In our opinion however, innovation requires a producer on the supply side. What about the clients' role then? Despite contracting out functions in the field of planning, design and management, the client can still aim to maintain expertise in these areas. Moreover professionalism can be developed in contract definition, project management and product development. The innovation status quo for the sector will thus only be stimulated when new definitions of the roles of the client/game-maker and the contractor/game-maker are simultaneously developed. The chicken and egg situation and the subsequent innovation status quo, must be resolved through combined action. It will, on both sides, be a matter of selecting and sharing.

For the time being, however, there are still countless obstructions before this can occur. The construction market is very specific. The functional role which architects need to fill

in society, the diversity among public and private clients, the intertwining with political and administrative decision making, the dependence on the regulating complex and, last but not least, the variety of financing strategies, all make the construction industry an economic sector in which industrial structures have not developed, at least not to any appreciable extent. All parties are participating, as capacity driven companies, in short-term coalitions at project level all the time. A 'polygamous' economic sector will have difficulties with partnership at a company level! It is by no means straightforward to turn a capacity driven construction company into a producer. The most important impediment to innovation, however, lies in competition on price, which the sector still keeps within its grip. This imperfection needs to be eradicated. Quality and innovation must become order winning criteria.

CONCLUSIONS

In this paper several issues are discussed. First it was stated that, at present, the construction industry finds itself in an innovation status quo. This was primarily due to the ambivalent position of the owner. The owner performs the role of the producer, but does so without being exposed to the discipline of the market. As a consequence, the industry, primarily capacity-driven, is forced into a reactive market position. Both lack the incentives to innovate. The control of product design and production process design are distributed over separate entities, and are not linked with market development processes. In such a scattered situation, none of the entities in the construction industry can develop the dominance needed for combined product and process development. Since products do not compete for the owners' favor, innovation only limps forward. As it is not expected that market dominance can be reached by concentration on the supply side, other strategies have to be pursued. A case history taken from shipbuilding showed that strategic alliances may plot a way forward: the quasi-firm, a network of companies, a quasi-firm with the design process as a pivot, aimed at serving a specific product-market-technology niche in a design/construct design/build manner. In this niche it will compete and subsequently must innovate. Due to financial and thus liability constraints, contractors are in the best position to commence, coordinate and direct such quasi-firms.

Will the construction industry develop in such a direction? Not by itself. Such a shift requires that owners and contractors redefine their roles and positions. To overcome the status quo, the current inertia of the industry, it is expected that coordinated effort of owners as well as industry is required. Best suited for this task seem to be the professional public clients/owners, the larger and mid-size construction contractors, and the associations of contractors. In the past this has proved to be a fertile coalition[6].

Referring to the two hypotheses formulated to direct the discussions for this conference, owners must create the opportunities for the industry to develop towards a situation in

[6] Examples of this are the standard documents which were originally developed by the ministries and by now are used throughout the industry.

which (quasi)-firms can develop their markets in terms of products. Competition must be focused on quality and innovation. The industry cannot afford to lose this opportunity. The industry has to rearrange its priorities and surpass its current antagonistic and production-oriented culture. Product champions must supersede the production champions. Both sides of the innovation status quo have to be addressed. Strategies for the supply and demand side have to be discussed, but discussing one side of the market, the effects and actions for the other side must not be ignored. After all the construction industries' clients are never anonymous.

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DIGITAL PROCUREMENT: A STEP TOWARDS THE INTEGRATED INFORMATION SYSTEM OF CONSTRUCTION

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Abstract

To procure a building in the information era, an information system - *intranet* - is proposed to serve a project-dependent and tentative organization. The core of the *intranet* system is the model of building design. Based on advances in the solid modeling technology, a new approach to modeling the building design is developed such that objects in the model are distinctively defined from others meanwhile they are topologically connected with those both at the same level and at the upper- or lower levels. The model of design serves two objectives in the procurement process: a) assisting the owner at the initial stage of the project; b) the desired design information can be retrieved which has significancy for all parties involved in designing and constructing the project. It is suggested that such a model of design will facilitate the establishment of the *intranet* for a building project in the future.

Keyword: information system; intranet; model of design; 3D object; material constituent

INTRODUCTION

From the initiation of a building project by the building owner, through designing and constructing, till completion of the project, a number of professional teams are involved in working on the same project - the building. During this process, the owner works closely either with a design team or a construction contractor to ensure that the desirable outcome of his/her project can be obtained. In either cases of procurement, it is desirable that an information system be established such that it enables interested parties to supervise process with the project being procured on the system.

With the emergence of *intranet* technology, an information system enables all parties within an organization to share the progress of the project and to coordinate their tasks. The core of an *intranet* system for a building project is the model of the design. It is the foundation upon which diverse design teams make and evaluate their contributions and on which contractors schedule the construction. The following objectives are within the frame of an *intranet* system for building procurement:

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1. It is in the owner's interest that he/she can be assisted by a model of design as the project is initiated. Such a model of design can be generated by the following possible means:

   - A model of a building can be generated by giving a few inputs (provided either by the owner or a consultant who interprets the owner's intention into architectural terms). For example, a few axis planes;
   - Alternative models can be generated by giving constraints on details. For example, specific requirements for wooden elements;
   - A few initial design criteria, considered as estimates at that stage, can be processed upon the model generated, and the design information of interest such as volumes and spaces can be retrieved.

2. The methods developed to model a building design can further be employed in the design phases when diverse design teams are involved. It aims to establish a single model of design which can be shared and detailed by all parties to the design. In the long term, it provides facilities to establish the computer-integrated construction system which ultimately eliminates the current phenomena of 'islands of automation'.

3. It is also our purpose that such a model be integrated into a broader information system for the construction. Ultimately, an *intranet* for the procurement of building can be established.

In this paper, we focus on fulfilling the first objective by presenting our approach to the modeling of building design.

CHARACTERISTICS OF A DESIGN MODEL

A model of building design is the major factor in establishing an information system of construction. It is the base upon which all related activities are taken place. Facing the 'fragmentation' problems existing both in a design process and in a building process, a new approach to modeling a building design is proposed by attempting to provide an unique and complete description of a design. It has been argued that less conflicts and inconsistencies would appear and parties involved in designing and constructing may better coordinate with each other, if the description of design is more complete and the information flows are under control (Mohsini and Davidson, 1992). In the solid modeling technology it has been attempted to provide a system which is capable to describe complete information of an object it describes (Mantyla, 1989; SGDLsoft, 1995; Rotge, 1996; Rotge, 1997). In architectural and building design, it has been advocated to establish a single model of design for the purpose of information management (Parisel, 1992).

To fulfill the objectives outlined above, it is attempted to develop a model of design with the following characteristics:

First of all, the model shall be *unique*. It is a *single*, three-dimensional model which describes all information about the design. Two-dimensional projections such as plans, elevations and sections are generated as specific views of the model so that they are consistent in terms of the design it describes. The perspectives and axonometric are also views of the model which are specifically placed in space or in a scene. Figure 1 shows that all specific views of a design are generated from a single model of the design.

Second, the design elements or objects should be *connected* each other so that changes can be propagated through the entire model. In another words, it shall affect to the whole model of the design once any change occurs.

Third, the objects in a design model are to be *distinctive* from others so that the information of interest can be retrieved from the model. In fact, the retrieved information is also specific "views" of the model.

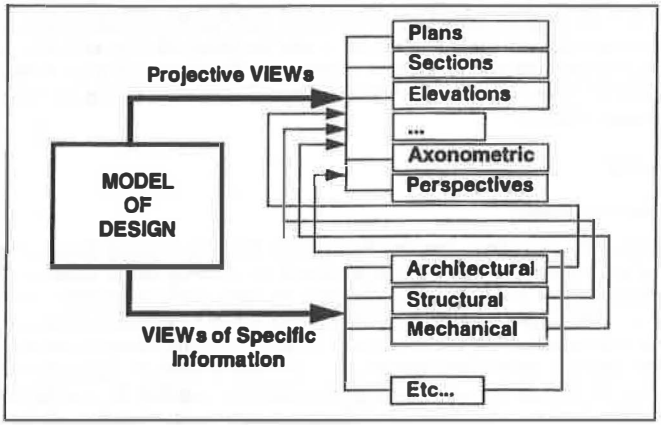


Figure 1 The *uniqueness* of a design model

FRAMEWORK OF DESIGN MODEL

Principles

The model of building design is composed by means of *3D Objects* and *Material Constituents* (Wang, 1994; Wang, 1997a).

3D Object

By a 3D object, we mean a three-dimensional volumetric object which can be used to represent any object in a design. It can imply a design element such as the wall, a physical component such as a stud, or a void such as the space inside a building or the opening. It is *abstract* in nature and can be referred to any design element by a designer. The model of design is composed of hundreds or thousands of such 3D objects. The model itself is therefore three-dimensional while two-dimensional projective views and three-dimensional view can be generated from it.

Material Constituent (MC)

It is common to approach a design in the 'Top-Down' way, progressing from abstract concepts to physical details. To meet such a requirement, the notion of *material constituent* is proposed to distinguish different objects in a complex design model.

MC is the material constituent of an object. As the *object*, it is also *abstract* in nature and can be referred to any kinds of material constituent which including the physical material constituent of a design element. Since it is abstract, it can be distinguished by arbitrarily assigning simple integer numbers to it, such as 1, 2 and so on. The assignment of values of *MC* is depended on the designer's intentions, which will later be used for operations on objects and for information retrievals.

Methodology

Topological composition

To accomplish the generality in that any change can be propagated through the entire model, the *topological composition* approach is developed to modeling design elements (Wang, 1997a; Wang, 1997b). In this approach, all objects are topologically connected to their adjacent objects or their upper- or lower-level objects. The *axis-plane* is used to develop a model of design which can be compared to the *axis-line* in conventional design representation. It *abstractly* represents main design elements such as walls or roofs. It is precisely because of this capacity to cope with changes in an integrative manners that the approach is eminently suitable for the early stages in building preliminary design. It is through this capability that we may provide the assistance to the owner at the initial stage of project to represent his project intention in terms of a 3D design model with given specification of details.

Heterogeneous composition

For objects to be distinctive from each other, we have developed the *heterogeneous composition* methodology in modeling designs (Wang, 1997a). An object at a certain stage, whatever it is, possesses a certain degree of *MC* in terms of design abstractions. The value of *MC* will be represented by *weight* which is a simple integer number. It is in this way that different design objects are to be distinguished from each other.

The assignment of *MC* values depends on the designer's specification for further operations of

objects. For example, all spaces can be regarded as one compound object *SPA00*, at a certain stage, which has the same *MC* value so that it can be retrieved for architectural or engineering analysis. Similarly, all enclosures of a building can be designated as *ENC00*. At a more detailed stage, *SPA00* is expected to be decomposed into two or more lower-level objects which may represent e.g. the main space, the secondary space and the circulation space. *SPA00* evolves into *SPA01* which composed of decomposed objects. The decomposed objects can be assigned with different *MC* values so that each of them can be distinguished from others for retrieval. The same is true for *ENC00*, which may need to be decomposed under different criteria, such as parts of the enclosure with the same or different material compositions.

MODELING DESIGN

Composition Defined by *Axis-Planes*

The *axis-plane* is used to develop a model of design. Assume that a house building is composed of 7 *axis-planes*, as shown in Figure 2. Let H be the house, S_H be the set of planes which define the house H and p_i be any of the *axis-planes*. We see that H is defined by S_H, which is composed of 7 *axis-planes*:

$$S_H = \{p_1, p_2, p_3, p_4, p_5, p_6, p_7\}$$

It is observed that S_H can be varied in the following two alternatives:

- The planes in the set S_H can be substituted for by others when there are changes;
- The set S_H itself can be changed by adding/deleting elements for design variations

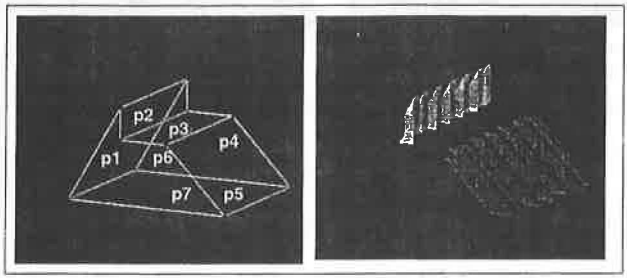


Figure 2 A design composition defined by seven planes

Change of Axis-Plane

Assume that the house H_1 is made of *four* walls, *one* roof and *one* floor. The set S_{H1} is com-

posed of 6 *axis-planes*, that is,

$$S_{H1} = \{p_1, p_2, p_3, p_4, p_5, p_6\}$$

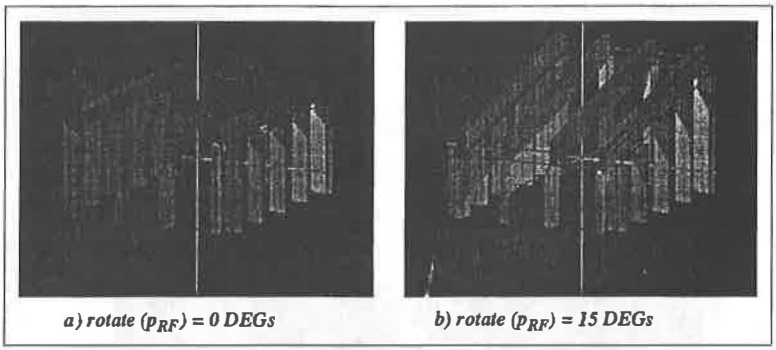
Let the plane of roof be p_{RF} which is one of elements contained in the set S_{H1}, say p_6. If p_{RF} is rotated by α degrees (Assume $\alpha = 15$), p_{RF} becomes p_{RF}'. That is,

$$rotate\ (p_{RF}\ \alpha) \rightarrow p_{RF}'$$

where

$$S_{H1}' = \{p_1, p_2, p_3, p_4, p_5, p_{RF}'\}$$

We observed that the whole composition H_1 changes correspondingly (Figure 3). H_1 is changed into H_1', which is defined by S_{H1}'.



a) rotate (p_{RF}) = 0 DEGs *b) rotate (p_{RF}) = 15 DEGs*

Figure 3 Planes as inputs to generate design variations

Change of the Set of Axis-Planes

Similarly, if we substitute p_{RF} or p_{RF}' with p_{RF1} and p_{RF2}, S_{H1} or S_{H1}' is changed into S_{H2}, which is composed of a set of 7 axis-planes instead of 6 in S_{H1}. That is,

$$S_{H2} = \{p_1, p_2, p_3, p_4, p_5, p_{RF1}, p_{RF2}\}$$

Correspondingly, H_1 or H_1' is derived into H_2, which is now topped by a two pitch roof. In addition, planes for two pitches can arbitrarily be modified as we have done with p_{RF}.

Construction of a Plane

A plane can be simply constructed. For example, we can define a few basic axis planes: *xy*-, *yz*- and *xz*-plane in a coordinate system by applying Euclid axiom that three points define a plane (Figure 4). From these basic planes, planes can be derived by either displacing a known plane *p* by a distance *dis*, or rotating *p* by an angle α. If we displace *xy*-, *yz*- and *xz*-plane by half of *length*, *width* and *height* in two direction, respectively, we obtain *Pxy01*, *Pxy10*, *Pyz01*, *Pyz10*, *Pxz01* and *Pxz10* which may represent design element at *left*, *right*, *back*, *front*, *top* and *bottom*, respectively. They can be used in generating compositions as shown in Figure 3.

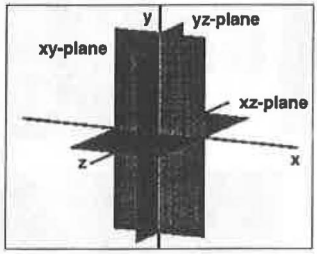


Figure 4 Three axis planes

Theoretically, the *axis-plane* can be expanded to any design elements in a design composition such as both inner and outer axis-planes. In general, let *S* be a set of axis-planes which defines the composition of building. A designer or an owner can input any values to *S*. With such *flexibility* and *generality*, an owner can be assisted to start a few specifications for further evaluation and assessment.

Detail Modeling

The composition of building is defined by the input of a set of axis-planes to which any types of detailed objects can be attached. An axis-plane can represent a wall made of wooden objects as well as a wall made of steel or concrete, depending on the designer or owner's specification. The significance is that the modeling of details is separated from the upper-level *geometrical composition*. It is free to be implemented with any specific detail requirements as long as each object is attached to a principal plane *p0*.

In the paper, we have presented one of such detailed objects - the point object of rectangle section (Wang, 1997a; Wang, 1997b). It can be used to represent wooden elements such as the stud, the plate and the joist. It is implemented with no interfering to any specific design compositions. The point object is attached to a principal plane *p0*, *i.e.* an axis-plane and is of *generality* in 3D space. It can be instanced in *any position* in space. Stud, plate, lintel and joist are some of instances of the point object of rectangle section.

Information Retrieval

The model of building design is composed of a number of objects which refer to design elements, physical components or voids, as the case may be. To be retrievable, the objects must be *distinctive* from other objects in two ways: a) be distinctive from objects at the same level; or, b) be distinctive from objects at the upper- or lower-levels.

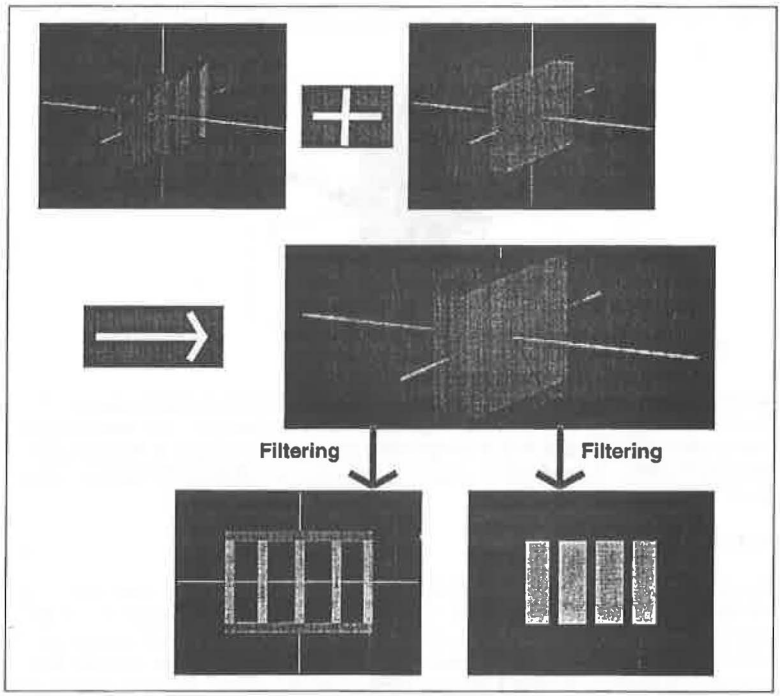


Figure 5 Information retrieval

Such distinctions can be achieved by applying the *MC* notion and assigning specific values to each of the objects. Let O_{FRM} be the object which representing a wall made of wooden elements - studs and plates, and O_{WAL} be its parental object which refers to the design element as a wall before details are modeled. It is shown that the compound object O_{COM} is obtained by operating on two operands: O_{FRM}, and its parental object O_{WAL}, that is,

$$O_{COM} = op\ (O_{FRM}\ O_{WAL})$$

where *op* refers to a logical operator.

We observed that the *void* part within the wooden frame, designated as O_{ISO}, is logically obtained by operating on a *significant* object O_{FRM} and its parental object (Figure 5). It may be referred to as the isolation part of the wall. It is interesting to see that:

- The object is *explicitly* defined rather than implicitly contained in a design in the conventional representation (design documents);
- The object is *free* to be assigned with *any* attributes to meet requirements (e.g. thermal requirement), which provides flexibility in developing design solutions.

Similarly, the *opening* or *space* can be explicitly retrieved for architectural analysis.

The order of value can be decided according to the relationship of objects (Wang 1996). Let d_{FRM} be the MC value of O_{FRM} and d_{WAL} be that of O_{WAL}. We assign d_{WAL} is *less* than d_{FRM}. By applying *DLmax* operation, O_{FRM} takes part of the region of O_{WAL} in space. Since the MC of O_{FRM} is superior to that of O_{WAL}, it is interesting that O_{FRM} is not affected in the logical operation of objects. If $d = d_{FRM}$ is set for retrieval, the object O_{FRM} re-appears since it still exists in the model.

$$op\ ((assign\ (O_{FRM}\ d_{FRM})\ (assign\ (O_{WAL}\ d_{WAL})) \rightarrow O_{COM}$$

where *op* is the logical operation (*DLmax* in this case), *assign* is a function which assigns a value of *MC* to an object, and $d_{FRM} > d_{WAL}$. In the compound object O_{COM}, we can obtain O_{FRM} if d is set to be d_{FRM} and O_{ISO} is d is set to be d_{WAL}.

CONCLUSION: AN *INTRANET* FOR BUILDING PROCUREMENT

The tide of the information revolution has provided us with the necessary computing facilities, the Web, the Internet and numerous CAD and analysis programs. The concept of an *intranet* is emerging to be applied within an organization to facilitate the sharing and flowing of information. We argue that such a system will be particularly interesting in the organization of building process, following from the adoption of a procurement strategy.

It is still in question who would be responsible for facilitating an *intranet* system for a project regarding the provisional and project-dependent organization in construction industry. However, it is certain that the improvement in accessing to the information and in controlling the flow of information will enhance the performance of the operations of organization [Mohsini and Davidson, 1992]. It is with this vision in mind that we have presented a new approach to describe building design information. It is particularly suited for circumstances (such as the initial stages of design) where there are many changes and frequent requirement for information retrieval. The proposition is based on the observation that the conventional documental

representation is not adequate to facilitate information exchange when an integrated system is predicated.

It is shown that this approach of design modeling may assist the building owner from the very beginning of the procurement process in a way that enables him to see how the building would look like. He is also provided with the flexibility to alter any project intentions. It is also possible that some provisional assessments can be made, i.e. evaluating the proposed building project. More implementation work is required to fulfil the objectives.

It is proposed that an *intranet* system for a project may better serve the owner, the designer, the engineer and the contractor by enhancing the overall coordination that follows from the adoption of an appropriate approach to building procurement. It is argued that the model of building design is the key for such an integrated system for construction. It is predicted that the new modeling approach will better fit the integrated system than the conventional one, since it has taken the system as the point of departure and the approach is more inherent to recent advances of information technology.

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INNOVATIONS IN PROCUREMENT - WHY, AND TO WHERE ? QUESTIONS FOR RESEARCH

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Abstract

The past 25 years have seen many innovations in construction procurement in North America and the UK. The paper questions whether we understand how owners/clients choose between alternative procurement strategies, what problems they intended to solve, whether they have really done so, or whether their results are due to the Hawthorne effect.

Construction; procurement; contracts; partnering; concessions

TRADITIONAL CONTRACT SYSTEMS

Traditionally in North America, the UK and other industrialised and developing countries, one main contractor is employed to construct a project. The contractor is given a design, is supervised by the owner/client's representative, and is paid on the basis of unit rates bid competitively. The owner/client's representative is the architect/engineer responsible for design, either as an internal service function or employing an outside firm. This has been the practice for most public and private projects. Turnkey contracts have been the principal exception to this traditional procedure.

This traditional system which separates design decisions and their implementation is unique in industry to building and civil engineering. It may have evolved because aesthetic design was in great demand in the XIXth century and architects were therefore busy in that market and could leave construction to the new breed of contractors who were becoming specialists in employing labour and machines on a large scale. Similarly, the independent engineer emerged as expert in using applied mechanics in the design of structures. Though the histories of the two professions do not correspond exactly, this common separation of design decisions and their impementation may therefore have been a response to demands for innovation in the product. It may also have been supported by and have supported the great status of professions in the 100 years following the Industrial Revolution. The UK professional societies became established as qualifying bodies, and with this they did not allow their members to be principals of contractor companies.

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One consequence was the role of 'the Architect' and 'the Engineer' as administrators of the contracts between client* and contractor for the construction work for projects. Did this occur to maintain quality by establishing the designer with power to ensure that his intentions were carried out ? Or to establish independent certification of payments to contractors, particularly the payment from public funds for design changes and exceptional site risks ? The choice was not made collectively for agreed reasons. This system evolved. For 100 years or so in the Anglo-Saxon World it was considered to be the one right system. Its current international form of contract is the accepted model for projects funded by the World Bank, the European Bank for Reconstruction & Development and others. So why have clients been actively interested in alternative contract systems ?

THE TURNKEY ALTERNATIVE

The turnkey system and its related 'all-in', 'package deal' and design-and-build types of contract can avoid the separation of design from planning and directing its execution.

If the client wants price-competitive bids for such contracts, she has a choice whether to leave the prospective contractors to base their offers on their own design ideas, or whether to require compliance with a defined basis of design, viz project scope, required capacity, location, and operating standards, or both, in two stages of bidding. Do clients use such contracts because they expect them to be of advantage to them when:

- the project is urgent, innovation is not required and the design is a standard or repeat work ?

  or

- the client wants competitive innovation in design and construction ?

- the client wants the contractor to finance the project until handover ?

The first of these possible reasons may explain why turnkey contracts are more used for private projects. The second why more used for industrial projects. The third why more used for Third World projects.

The first two possible reasons for using a turnkey contract are alternatives, but either is compatible with the third. They could apply to many projects. Is the turnkey alternative little used for public projects because judging between competitive designs can be politically contentious ? Or because these contracts do not provide clients' representatives with a role linking design, construction and costs ? Or because clients and their advisers prefer not to change from systems they know, warts and all ?

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* The term 'client' is used rather than 'owner' in the rest of this paper as the contractor is the owner of construction completed for BOOT and other concession projects

MANAGEMENT CONTRACTS, 'CONSTRUCTION MANAGEMENT'

In traditional contract systems a main or lead contractor takes many of the cost risks of construction, including the performance of his sub-contractors*.

The alternative role known as 'construction management contractor' usually means that this contractor is employed to bring contracting experience into the client's team, to provide construction advice to design and to place the sub-contracts jointly with or on behalf of the client at limited risk to the management contractor. (The 'sub-contracts' are then more accurately called 'works contracts'). The works contracts can be planned in a series, for instance when design information or funds are available. Do clients use the construction management system because it is of advantage to them if:

- the project is urgent and design depends upon innovation ?

- uncertainty of the market, funding, public approval, site conditions or other reasons may affect proceeding with the project ?

How does this differ from the employment of a consultant architect/engineering firm in the traditional system ? Their titles imply differences in the expertise required, but both systems are means of providing a project team for the client, either augmenting her permanent resources or providing a complete temporary team for a project or series of projects. Management contracting has been established for 50 years or more. Do clients use it because they expect that:

- the management contractor's experience is valuable early in design and planning ?

- placing a series of works contracts only when sections of design are final avoids disputes between client and contractor about design delays or changes (of particular concern in the UK and Australian building industries) ?

- incentive payments linked to project outcome motivate the management contractor to anticipate construction problems rather than exploit them for contractual advantage ?

These reasons for using management contracting appear to be valid for all projects, not just those which are urgent or subject to risks of innovation or other uncertainties ? So why hasn't this system displaced all others ?

CONCESSION CONTRACTS

Design-Finance-Build-Operate (DFBO), Build-Own-Operate-Transfer (BOOT) and other forms of concession contracts to contractors are linked in recent history with privatisation of what were public services. In principle they are separate.

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* Except for sub-contractors nominated by the client or her representative

Often the contractor is a consortium of construction, finance and other parties and an employer of an architect/engineer organization. This body is the promoter of the project and either legally or effectively the owner until the concession period has matured. Once given the concession, the contractor has in turn to choose a strategy for procurement of design and construction.

The essence of the concession is the liability to finance not only design and construction but also operation and maintenance, again until the concession period has matured.

Do clients let concession contracts because:

- it is their political or business policy that as clients they should buy all possible services by contract rather than employ their own operational staff ?
- to minimise their capital investment ?
- to contract out all possible risks ?

or to break away from established habits and their perceived disadvantages ?

TERMS OF PAYMENT

Traditionally for many public and some private projects the contractor was paid on the basis of unit rates bid competitively and quantities of work completed, usually monthly. Turnkey contracts more typically paid for milestones of progress, or simply a lump sum on completion.

Larger traditional and turnkey contracts have often also included cost reimbursement terms of payment for unexpected or emergency work. These are flexible terms of payment. They are regarded as bad practice. Is this because they can be used for work which could have been foreseen and planned, and therefore included in the scope and specification when inviting the bids ? Does this lack of discipline actually occur, or is it an administrator's academic anxiety ?

Completely or mainly cost-reimbursable terms of payment are certainly not considered good for the public client. The resulting project cost may well be greater than the total cost of detailed competition in the traditional system, but is there evidence to support that ? Is this the reason for clients' preference for target-cost incentive terms of payment ? And do the complications of agreeing and managing cost targets deter other potential users ?

NEW FORMS OF CONTRACT

One recent innovation in the UK has been the development of the New Engineering Contract system (NEC). It separates the role of client's Project Manager from the roles of designer,

construction supervisor and disputes adjudicator traditionally all the role of 'the Engineer'. The NEC is being used by a serious number of clients in the UK and other related countries. Are clients using it as an experiment or for the reasons for which it was designed:

- to facilitate good project management ?
- to have a compatible set of contracts for all roles for building, civil engineering and other engineering capital projects ?
- to be clear to non-lawyers ?

A research group at the University of Birmingham under Professor John Perry is independently analysing feedback from users of the NEC system and may soon be able to answer some of these questions.

PARTNERING AND ALLIANCES*

Partnering between client, main contractor and sometimes sub-contractors has been the subject of much study and discussion over the past ten years. Do clients choose to add partnering to their procurement of construction for the stated reasons given by CII (1991):

- client and contractor benefit from reduced overhead ?
- client and contractor benefit from workload stability ?
- competitive advantage is enhanced through improved cost, quality and schedule ?

Why don't clients think this system is appropriate for their smaller contracts ?

Discussions in the UK indicate that some clients expect the rate of improvements in cost achieved in the first time of partnering with a contractor will be repeated on every successive project, as if the learning curve can be linear. This is likely to be an illusion. But what is the actual form of the learning curve ? Does it consist of asymptotic steps decreasing in value project by project ?

CONCLUSION

This paper does not summarise the potential advantages and disadvantages of the what are called traditional procurement systems and the alternatives for construction projects. Many papers, books and reports provide those comparative and prescriptive views.

* An 'alliance' is the term used in Europe for single contract partnering

The purpose of the paper has been to ask how far there is data on how clients choose between the variety of procurement routes available. Given this data, all forms of lessons from completed projects and advice for future ones could be much more effective.

The assumption must be that clients choose what they expect will help achieve the objectives of their projects. Many may therefore prefer to repeat a familiar arrangement which they believe they can use successfully. They may be deterred from change for fear of its possible costs, financial and psychological, but do some continue to suffer a problem for lack of data that living with it is costing more than it would cost to cure ?

Clients who have tried alternatives may have found them to have been effective because they altered responsibilities and made better use of expertise in ways suitable for the nature and risks of the projects and the abilities and resources of the players.

Or these alternatives may have been effective only because the clients who chose to try them wanted improvements in performance and therefore gave more attention to their procurement policies and subsequent contract management. The cooperation which partnering should establish has probably always been a recipe for success whatever may be the terms of a contract.

Or partnering (or any change of practice) may have been effective only because it stimulated one or all parties to think differently about their risks, responsibilities and the use of resources.

A Hawthorne effect is not bad in itself. For an emergency project the temporary stimulus may achieve all that is needed. For longer term benefit, we need to know procurement strategies can continue to deliver better results for all parties. Partnering in particular is now in question. It may be that more clients will have to use other motivating systems, for instance sharing longer-term financial interest by concession contracts or joint venturing with contractors.

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TECHNOLOGY PROCUREMENT - AN INNOVATION TOOL FOR MORE EFFICIENT CONSTRUCTION SOLUTIONS

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Abstract:

The construction sector is characterised by large fragmentation and often very short-term planning for extremely long-lasting projects. Collaborative work initiated by major future-oriented buyers and users (property owners, private and public organisations) can create challenges if concrete goals and performance requirements are formulated.

Co-operative and technology procurement **are powerful tools to inspire innovation. In some energy and refurbishing projects, important results achieved are: reduction of energy or cost by half, and substantial speed-up of innovation as well as realisation. Building-up new networks in split-up situations and combining the efforts with different support activities will accelerate the process. Internationally accepted new contract combinations and other rules with better defined performance responsibilities are needed. International work on performance criteria is an important but time-consuming effort, which will open possibilities for development of more efficient solutions in the construction sector.**

INTRODUCTION

Possibilities

Reduction of energy use by half, reduction of total costs almost by half, and/or speeding-up both the development process and the realisation of individual projects are results achieved by using *co-operative or technology procurement*. With this market-demand process major buyers and users articulate their needs in functional terms, aggregate their purchasing power, and accelerate the innovation and diffusion process. Through parallel work and early involvement of leading buyers and users, the risks are reduced for manufacturers. Table 1 is an overview of the results achieved in some technology procurement projects.

Table 1. Overview of results, Technology Procurement

Project Area	Result
Lifts for existing buildings	Cost reduction by 48%
Refurbishment of bathrooms	Reducing total time from weeks to 2 days
Energy-efficient products/systems	Energy reduction 30-50%

General problems in the construction sector

Many low-efficient, existing technical solutions, consuming large resources of energy, cost and time, are the results of a rather split-up or fragmented process. The building process is characterised by fragmentation into phases and branches, and it is also dispersed in geographical space. Manufacturers or contractors do not really know the final and total cost or energy use, and they very seldom meet the end users - being facility managers, maintenance personnel or consumers. Real needs are not articulated in functional terms.

Working on a long-term basis has not been easy. It is the present project that is the companies' main concern. To protect their own, newly developed solutions has also been a difficult task. The problematic general situation in the construction sector and future changes in the construction process required for accelerated, yet reliable innovation, have been treated in the Atkins reports about different European countries (Atkins, 1992).

The World Trade Organisation Agreement on Government Procurement (WTO/GPA) will increase foreign competition for the previously more domestic construction sector.

Figure 1 illustrates the different stages and fragmentation of the construction process.

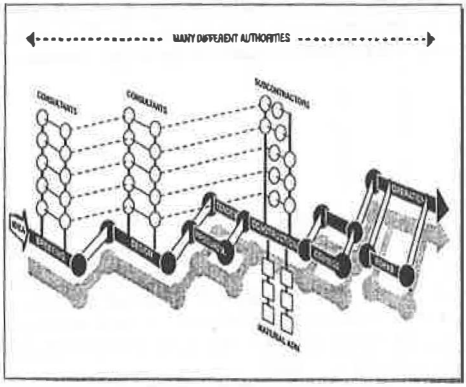

Figure 1. Fragmentation of the construction process - Division into stages and occupational groups (Source: Westling, 1991)

Project Earth and operating costs

The impact of energy production and CO_2 emission on the possibilities of a sustainable situation in the world and the risks of a climate change has come into focus more during recent years. The part of the total operating costs which relate to energy, heating, ventilation and cooling has

increased. In some systems, the operating cost is the largest by far of the total life cycle cost (LCC).

The right choice of more energy-efficient components with consideration of life-time costs will be crucial for the total project economy and also for the environment. Procurement methods that stress the long-term impact with the operating costs and open up for efficient new solutions would give all involved organisations competitive advantages.

The International Energy Agency, IEA, with twenty-five important industrial countries as members (including Switzerland) has set up a special programme in order to facilitate the development and diffusion of more energy-efficient solutions (Westling, 1996).

THEORIES AND DEFINITIONS

Innovation instruments

Over the years, researchers have consistently debated which *instruments* are most effective in producing *innovations*. (In this context, it is important to note the difference between *inventions* and *innovations*, meaning new products, systems and processes which have left the laboratory and been introduced onto the market). Some researchers have emphasised the supply side (technology push), others the demand side (market pull). The conclusion drawn in recent times is that initiatives are important on *both* sides, but that most innovations - some researchers say 75% or more - have probably materialised as the result of steps taken on the demand side. Several researchers are agreed that apart from demand-side initiatives, efficient organisation and communication are also important (Mowery and Rosenberg, 1978; Lundvall, 1988). A comprehensive OECD report found that future-oriented purchasing, like technology procurement (see definitions below), is the only sure way of speeding up innovation (OECD, 1978). Technology procurement is a method of working on the demand side (see Edquist, 1990, Memorandum on Technology Policy).

The importance for innovation of building up *networks* of long-term relationships (interactions) between buyers or consumers and manufacturers or suppliers, is emphasised for example by Håkansson (1987). The importance of simplified communications has been shown in a large number of investigations, e g by Allen (1977). The importance of involving the *customers or users* at an early stage, had previously emerged in studies from SAPPHO (Rothwell et al., 1974) and Rothwell (1977), as well as by von Hippel at MIT (1978). In later studies, von Hippel emphasised the importance of lead users (1986).

In many areas, the market is out of balance. There are many buyers, but they are not united. They may have valuable ideas but have difficulties imagining new products. Sellers and manufacturers are not well-informed about what their customers really want.

Interaction between users and producers and the organisation of the market have been stressed by Lundvall (1988 and 1991) and the importance of a "central co-ordinating agency" by Teubal (1991).

Definitions

Technology procurement may be characterised as an entire acquisition process aimed at directly stimulating innovation. It is not exclusively associated with any particular form of contract, though it is closest to design/build contracting with functional requirements and functional procurement.

Technology procurement has been defined in a memorandum from the Swedish Ministry of Industry as

> "a process, through which a commodity, service or system is procured, and for which development of new technical solutions is essential in order to meet the requirements of the buyer. The technical development work, being part of the process, may concern application of advanced technology, but also minor stages of development as well as product modifications. The development work may concern the product, the system or the production process, for which it is developed." (Industridepartementet Ds I 1982:4).

The procedure for inviting tenders is usually more selective than general contracting based on previously prepared documents. In the case of technology procurement, the buyer is looking for competence in the relevant fields.

Co-operative procurement includes both

- technology procurement (of something not yet existing on the market), and
- acquisition of existing products/systems in some organised ways (for instance among the 25 per cent "best", - most energy-efficient, or best in some other aspects)

where, in both cases in this paper, the most influential buyer or a number of *buyers combine* their efforts and, to a varying extent, work jointly with the formulation of requirements, invitation for tenders, evaluation and actual buying, and influence the market transformation by the use of support activities (rebates, information, labelling, awards, etc.).

In many cases, the buyers may only represent public organisations, but they may also be private companies, individuals, or combinations of public and private organisations.

Technology procurement has strong similarities with current methods of *simultaneous* and *concurrent engineering*, the aim of which is to reduce lead times before introduction to the market. Specialists in different fields, e.g. construction, manufacturing, service, research and sales, participate in the development work simultaneously. Technology procurement takes place in different stages of development, by way of several prototypes and series of tests, to ensure quality.

We know that innovation and product development today is carried out in circular or spiral loops and with parallel work, instead of in a process with different stages following one after the other in a linear way.

EXPERIENCES - EARLY AND LATELY

Historical examples

Competitions have often inspired significant innovations. There are some well-known historical competitions and challenges in which clear goals were established. A classic instance where technology procurement was used is the Rainhill Trials in England in 1829 that brought a breakthrough in development of the railway locomotive. Functional requirements were laid down, including minimum speed and traction capacity. The buyers had guaranteed a small first order of 5 locomotives to the successful winner. But, of course, to acquire fame was the most important factor for the winner. Of the five entries, Robert Stephenson's Rocket (Figure 2) won and he subsequently also supplied five locomotives at a fixed price. With that, the old technique of hauling coaches by rope from one section of the line to another, was superseded.

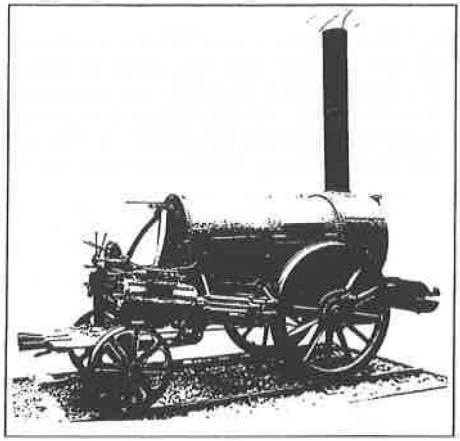

Figure 2. Robert Stephenson's locomotive "The Rocket". (The Science Museum, London)

Thus it was shown early on that a competitive element and functional requirements inspired progress by opening the way for innovative ideas.

Early projects in Sweden

Technology procurement has been used in developing the most extensive railway electrification scheme of its time - the iron ore line between the Norwegian port of Narvik and Riksgränsen on the Swedish border - to development of Asea Brown Boveri's X 2000 high-speed train as a result of requirements specified by the Swedish State Railways, SJ. Performance requirements by buyers have inspired development in Swedish energy-supply and telephone projects. For the Asea Group,

now in ABB, and Ericsson Telecommunications these efforts have been of great importance. In each case, as in the defence establishment, the work has proceeded on a long-term basis with the customers making demands, but there has also been an awareness of the competitive situation. The solutions that emerge must be highly competitive in an international market.

Construction and energy end-use projects

In some construction and energy areas it has been possible to reduce the use of resources or increase the efficiency in a relatively short time by 30-50% using performance criteria, formulated by an influential group of buyers. In all the cases, the formation of buyer groups, consisting of leading housing companies with different owners, has been one important element. Special efforts are needed in the fragmented construction sector to get buyers to collaborate.

Lifts and bathrooms for existing buildings

The Swedish Council for Building Research project "Lifts for existing buildings" resulted in solutions that were clearly more cost-efficient in total, cutting the original overall cost of *construction and lift* to 58 per cent (Figure 3). At the same time, it was possible to reduce the disruption to residents, installation taking a few days instead of several weeks or months as before. The project also resulted in one of the main suppliers, KONE, receiving very large international orders through its subsidiaries, e.g. 250 lifts in one project in The Netherlands.

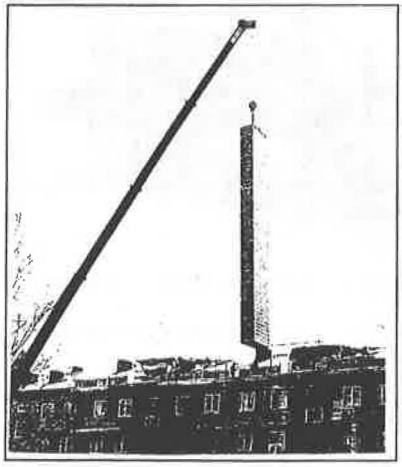

Figure 3. Rapid lift installation - Completely prefabricated lift shaft. (Source: Westling, 1991)

Bathroom-rebuilding projects have offered better working solutions for elderly and disabled people. It increases their chances of staying in their own homes. The possibility of carrying out

a complete conversion in a few days with the aid of well-designed components and good organisation, has also been demonstrated. The trial projects were completed within 48 hours.

In these cases, it has proved important to build up new networks across trade boundaries and establish cooperation between several large buyers.

Energy projects

A number of energy end-use projects have been fulfilled recently, using the technology procurement method. In Sweden, large energy reductions of 30-50 per cent have been achieved as a result of these projects. Table 2 illustrates the results from some technology procurement projects.

As far as ventilation for example is concerned, it was possible to achieve a reduction of the energy use by half. A project in Western Sweden concerned the replacement of 59 fans in a residential area owned by the co-operative organisation HSB. One of the competitors, Fläkt AB in the ABB Group of companies, succeeded beyond all expectation. The electricity requirement for ventilation was halved from 750 kWh to 380 kWh per apartment and year. It is estimated that there are about 50,000 similar units in the country, resulting in potential savings of over SEK 100 million for the country's entire stock of apartment buildings. The next step is now being taken. 2,000 fans are now going to be renovated.

Table 2. Results obtained from some technology procurement projects in the energy field in Sweden. (Source: NUTEK, 1993)

Project area	Result	Energy reduction
Refrigerator/Freezer	From 1.2 kWh/litre comparable volume per year to 0.8	by 33%
Clothes washers & dryers for laundry rooms	From 2.6 kWh/kg of laundry to 1.2	by 50%
Ventilation. Replacement of fans in residential area	From 750 kWh/apartment and year to 380	by 50%
Heat pumps	Two different suppliers have been chosen for further development and deliveries	by 30 %

INTERNATIONAL EXAMPLES

Similar methods have been used internationally, e.g. by the French organisation HLM, the Association of Municipal Housing Companies, in developing control systems for apartment houses, "Domotique", a form of intelligent buildings (HLM et al., 1990).

In a project in Germany for ventilation and cooling equipment (RWTUV, 1991) it has been possible to reduce energy consumption by more than half, down to 40 per cent of the earlier consumption. An important factor in this project was that there was one, strong customer, Deutsche Telekom, the German Telecommunications Administration, pointing at a large market of several thousand units.

In the United States, the method has been applied e.g. in the space and defence field. An enquiry into innovative contracting practices aimed at achieving more competitive solutions in the bridge, road and transport field (Transportation Research Board/National Research Council, 1991). The US Energy Policy Act (1992) and Climate Change Action Plan (Clinton and Gore, 1993) contain a number of initiatives, which have been followed by concrete actions in a number of different areas with Federal and State Agencies as important buyers. In the United States, a "Golden Carrot" programme was first used for energy efficient refrigerators with 30-35 per cent energy reduction, and it is now being followed by the Consortium for Energy Efficiency, CEE, in a number of fields, such as ventilating and cooling systems. One additional example is a project for a 30 per cent more efficient incandescent HIR lamp initiated by the Department of Defense, DOD, the Department of Energy, DOE, and the Environmental Protection Agency, EPA. This initiative is now supported by collaborative International Energy Agency efforts in April 1997 from European countries, both in the lighting and drier fields.

After experience gained in Israel, Teubal has also suggested technology procurement and emphasises the importance of a collaborative organisation (Teubal et al., 1991).

LESSONS LEARNED

To a large extent, the success of co-operative buying and technology procurement depends on the individuals involved. It is indeed very important to engage *future-oriented buyers and users* - organisations and persons who can see the long-term goal and who are ready to accept difficulties along the way. Very much preparatory work should be fulfilled at the beginning of the project, so that everybody will agree on common goals and objectives. Characteristics are shown for projects suitable for technology procurement (see Figure 5 below).

It is important to formulate the requirements in *functional terms*. Appropriate *test methods* and facilities have to be identified, and often also new methods achieved. The projects, like all development projects, will run into difficulties. It is important to assure *support at top level*.

For the dissemination of new products and systems it is also important to *combine technology procurement with the use of other support or control mechanisms*, like standardisation,

information, economic incentives and labelling (Westling, 1996). A central purchasing body for each project should be identified, being a federal agency using the federal purchasing power, or, for instance, a central agency owned by a number of different housing companies.

Market
1. Coming adequate demand, i.e. market
2. Interest on the part of the community

Support
3. Expressed support at top level
4. Cooperation of major buyers
5. Involvement of lead users
6. Cooperation of different authorities

Goals
7. Early formulation of clear objectives
8. Initiation of initial studies of problems and needs
9. Formulation of functional requirements

Development work
10. Good potential for increasing efficiency
11. Creation of project organisation with dedicated individuals and leadership
12. Maintenance of competition
13. International considerations permitted to influence
14. Existence or development of good measuring methods
15. Prototype testing in a realistic environment
16. The project concerns a subfunction with sufficient repetitive opportunities in different buildings

Financing
17. Financing guaranteed for preliminary studies, cooperation groups, prototypes and test series

Figure 5. Characteristics of projects suitable for technology procurement. (Source: Westling, 1991)

The method described here may accelerate the innovation process. Creating a *network* means that links and communication channels will be established. In technology procurement projects with buyer co-operation, manufacturers involved in development work are assured that they are working with real requirements which have been formulated based on the users' needs.

In the United States, "innovation" was the theme for the conference in February 1996 in Washington D.C. organised by CERF, the Civil Engineering Research Foundation (CERF, 1996). The shaping of a construction process for sustainability in a global world was the prime topic. The formulation of performance criteria was one of the important suggestions for future international work, which should be shed further light on at the next CIB-congress in 1998 in Sweden.

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BUILDINGS MAINTENANCE SERVICE PROCUREMENT: JUST IN TIME MAINTENANCE

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Abstract

Keywords: Maintenance, Facilities Management, Just-In-Time Maintenance (JIT), Life Cycle Costing (LCC),

Recently, Facilities Management has grown as a function/profession/industry providing or procuring services relating to the care of buildings beyond their construction. Traditionally, construction companies' interest in building projects was restricted to the period from tender to completion.

Very rarely have building contractors developed long-term relationships with clients. Clients have become increasingly aware of the running costs of buildings and the scope for reducing these by appropriate design and construction. Skilful design can reduce maintenance needs and make it easier to carry out the work. Contractors are well-placed to offer 'cradle-to-grave' services in relation to buildings, but are not presently capitalising on this potential, indeed they are yielding existing markets to operators from other fields. Security and cleaning companies are providing 'Just-in-Time' (JIT) maintenance services, albeit generally by outsourcing (or subcontracting as we have long called it) generally to local small builders.

Maintenance by 'handymen', direct labour forces employed by public clients and small builders, especially where small scale adaptations have accompanied repair works, has generally been carried out on an 'ad hoc' basis, often with relatively light contractual arrangements. Maintenance is still the 'Cinderella' of the construction industry.

The Private Finance Initiative is giving impetus to Build and Operate, or Design/Build/Operate contracts whereby contractors and/or their financiers will gain or lose projects and profits according to how well they can forecast and contain running costs. This is likely to give rise to increasingly sophisticated maintenance planning and procedures. Clients are recognising the need for professional consultant and contracting services in these areas.

INTRODUCTION

This paper addresses approaches for the procurement of building maintenance services, traces their development and identifies possible directions for the future. It stems from a study of the supermarket sector in the UK that identified "Just in Time Maintenance" (JIT) (Smyth and Wood, 1995). Contractors other than constructors, for instance from the security and cleaning industries, have been reconfiguring the building maintenance market as discussed in a paper presented at the first UK National Construction Marketing Conference (Smyth and Wood, 1996).

BACKGROUND

Maintenance of buildings and estates has long been portrayed as unattractive, a "Cinderella activity", a "slightly inferior branch of the industry" (Seeley, 1976; Milne 1985; How Son and Yuen, 1993). Attempts to address this situation have focused on anticipating maintenance needs, bringing together otherwise small, minor, one-off, ad hoc works into more standardised better defined packages for letting as larger contracts.

Planned preventative maintenance (PPM) was described by Noble (1980) as "the ideal maintenance situation in which the condition of the property is kept within predetermined limits by a pre-planned programme of preventive work, is never achieved in practice and is in fact unattainable except at an impossibly high cost". He continued "some industries, eg commercial aviation, have maintenance services which more nearly approach the ideal because the revenues lost during downtime and the consequences of failure are such as to make reliability of prime importance: high maintenance costs are therefore acceptable. In buildings, defects are more readily tolerated". Lee (1987) describes PPM as "a concept which is probably more applicable to plant and equipment .... but there are certain building elements which justify this treatment".

Bushell (1979) suggested that PPM is worthwhile if:-

1. it is cost effective;
2. it is needed to meet statutory requirements;
3. it meets clients' operational needs;
4. it will save running maintenance;
5. there is work for the craftsman rather than pure inspection.

In 1980, the RICS produced its Practice Note No. 4 on Building Planned Maintenance, revised and reissued under this latter title in 1990. The institution argued that ".... the design and maintenance processes in the construction industry need to be more closely allied as in the motor industry where design and subsequent maintenance frequently have an equal consideration. Early discussion between the design and maintenance organisations can result in a building with lower maintenance liability at a marginally increased initial cost, the economics of which can be easily demonstrated".

At the same time some building professionals have been looking at maintenance as part of the total cost of a building over its life, developing the concept of life cycle costing (LCC). Brandon identified "a cyclical interest in techniques which view the total cost of an asset over its lifetime as opposed to the cost of its initial provision, and that with each cycle there has been a change of name and a slight change of emphasis" (Brandon cited by Spedding, 1987). He also cites Stone (1967), 'Building Design Evaluation - Costs in Use', Southwell (1967), 'Total Building cost Appraisal', RICS (1983 and 1986), RIBA (1985) and the Society of Chief Quantity Surveyors (1984); these latter having produced publications on Life Cycle Appraisal or Life Cycle Costing.

More recent work has tended to focus on what Ferry and Brandon (1991) have called the 'disadvantages' of LCC assessment, "which explains why this technique has been seen more often in the examination room than in real life". Flanagan et al. (1989) refer to the belief that "any calculations that involve some degree of mathematical manipulation must be accurate" and Ashworth (1994) describes LCC as "a combination of calculation and judgement".

The 'scientific' approach suggested by PPM and LCC however has often failed in practice as insufficient funds were available, and because maintenance managers have been lowly valued. In-house maintenance managers and staff were not rewarded if they endeavoured to pursue the PPM ideal because the benefits could take some years to show through, if indeed they can ever be quantified. There has been an absence of criteria of evaluation for in-house staff. More substantial maintenance and refurbishment work has typically been put out to construction companies. For contractors, the source of work was similar to new building work, although anecdotally it could be argued that there was a higher incidence of repeat business.

While the concept of PPM has not been realised in practice, there have been some signs of change. Towards the end of the last decade a greater commercial awareness of the role of maintenance upon the asset value of companies, and hence on gearing, ability to borrow and stock market rating. This was coupled with the sale of surplus land holdings. The more recent business philosophy of returning back to 'core' business has led to a shedding of in-house expertise and a growing sophistication in "out-sourcing", which in construction terms is subcontracting. Most commercial companies have been characterised as having little property expertise at key decision making levels. In Britain it was estimated that only one in six organisations had property expertise at board level or at a senior management level on which it could draw (Smyth, 1990).

However the recent creation and growth of Facilities Management [the first International Congress of the International Facilities Management Association (IFMA) took place in 1989] and the increase in interest of the 'traditional' building professions represented by, for instance, RICS, CIBSE and CIOB has elevated debate about maintenance management. As Michel put it in the CIOB Handbook of Facilities Management (Spedding, 1994) "...facilities management has begun to be recognised as a key element of an organisation's strategic plan, with responsibility for its effective pursuance firmly located within the boardroom".

These changes in management outlook have taken place against a background of opportunities created by information technology and communications networks. Lee (1987) wrote that "few technologies have developed at the speed of computer design or are as likely to have such a fundamental effect on our everyday lives". He reminded us that "the first electronic computers were huge contraptions requiring special air-conditioned rooms...then, in the sixties... computers the size of one or two filing cabinets...now, the desktop microcomputer and even smaller portable models". Lee gave six pages to describing computers and four to their uses, preceded by 37 pages focusing on paper-based systems and complex alpha-numeric coding hierarchies.

Since then speeds and capacities of computers have increased even more, to the point where information on whole stocks of buildings can be accessed across extensive networks, updated by inputs from handheld and other remote devices. Advances in technology have brought devices which reduce costs while improving operational performance; computer-based systems enabling the detection of faults before severe difficulties occur, e.g. sensing devices to monitor factors such as machine vibration, local temperatures, pressures, consumption of lubricants. Changes in such factors tend to indicate changes in condition of equipment and can give timely warning of approaching failure. Muhleman (1992) calls this approach "predictive maintenance".

The incorporation of systems including such devices and connections into properties has realised the possibility of the Intelligent Building. Computer-based systems that will identify a tap running or light left on when the building should be empty are already common, sensors are automatically recording and transmitting data perhaps to a Security HQ at another location. The intelligent building (McClelland, 1988; Atkin, 1988; DEGW and Teknibank, 1992) is here, even if the full technical potential has still to be implemented. A range of building users is already applying a high degree of 'smartware', and its application to other less 'high-tech' building types may be expected, particularly when extending across a client's perhaps mixed estate. Costs as low as £10 per person per annum for the installation of cabling in a typical new office development have been indicated (Smyth and Wood, 1995).

The technologies available, especially if built into the building, and management systems which may be directed by building owners, now play large parts in the procurement of building maintenance services. The market is very much customer-driven, and building contractors and consultants need to respond to this. Recent years with their gross ups and downs in the construction market have shown much innovation in contractual arrangements for new-build projects including for instance construction management, management contracting and design-build. In the maintenance sector Measured Term Contracts using either standard (eg. National or PSA Schedule of Rates) or bespoke pricing and payment systems have become a common arrangement, particularly for institutional clients and for large contractors, and allow for the development and nurturing of mature, trusting relationships between the parties. Nahapiet and Nahapiet (1985) in comparing a range of contracts found that "it was not the form of contract.... but rather the way in which it

matched the needs of the project that was the significant factor in relation to project performance".

This tends to confirm the value and importance of greater collaboration and harmony between clients and contractors as expounded by Latham (1994) and the Nordic School of Marketing (see for example Grönroos, 1990; Gummerson, 1994; Storbacka et al., 1994) in their extolling of relationship marketing. The purpose is to avoid the common adversarial arrangements and through repeat business to enhance both client satisfaction and contractor profitability.

THE SERVICE CONTEXT: BUILDING RELATIONSHIPS

"The contractual arrangement adopted determines not only the relationship of the various design, construction and advisory organisations with the client but also their relationships with each other" (Nahapiet and Nahapiet, 1985). Clear contractual arrangements and associated documentation with obligations of all parties spelled out, should enable risks to be clearly assessed and costed. Higher levels of uncertainty generally generate higher levels of pricing. This has given rise to the development of standard forms of contract particularly the Joint Contracts Tribunal (JCT) series, designed to cater for as many problems as could be anticipated, providing mechanisms for resolution, and amended periodically as new 'case law' is generated.

Traditionally for new-build projects, the lump sum contract awarded by single stage selective tender has been the common procurement route. A short-list of contractors each ascertained as being capable of carrying out the project to the quality and in the time-scale required is invited to tender - typically six, of which all but one will be 'losers'. Of course it is also quite likely that the "winner" will become a loser if that tenderer has seriously underestimated the cost of the work or was desperate for more work, in which case the client will also be a loser, if the contractor fails.

Negotiation, serial contracts and other forms noted earlier have all been tried as attempts to reduce contractual risks, but there is still great reliance on the traditional relationship. Institutions particularly with their standing orders are often constrained to use selective tendering in the pursuits of openness and value-for-money (often misinterpreted as cheapness). By contrast, with maintenance work, because of its inherent uncertainties in terms of scope and scale of the work, the unpredictably of when emergency work may arise, and complications of access, often involving disruption to occupants and their operations, contractual arrangements have often been much looser. Maintenance "projects" may be as small and short-lived as the repairing of a leak or replacement of glass, with a "contractor" identified by the householder by reference to "Yellow Pages", with the "contract" being little more than acceptance of a verbal "estimate". In essence these "callouts" are being dealt with as "daywork", generally favourable to the contractor, with the client having little control over cost, quality or time-scale.

Surprisingly perhaps, systems not very dissimilar from that have existed either "in-house", within organisations of various sizes as "direct labour" or "direct service organisations

(DSO's)", or client organisations having developed relationships with contractors to provide such "call out" services as and when required. These arrangements have developed because they made sense. Why go "outside" to contractors, contributing to their profits when these could be retained "inside"? Why incur the costs and delays of selective tendering for every job? Such arrangements thrive when there is trust between the parties; they die when trust is abused or accountability is questioned. It is not the purpose of this paper to suggest that these "cosy" arrangements are corrupt, or that they represent poor value, but that a developing "professionalisation" together with the changing managerial context of organisations working through concepts such as "return to core business", "re-engineering", "downsizing" and "outsourcing" have brought the cost of property, including maintenance, into the spotlight.

Term contracts have brought benefits of scale to clients and contractors, though often at the expense of voluminous paperwork in their preparation and execution. Speakers at a recent meeting of the Construction Industry Computer Users Group (CICUG, 1996) bemoaned the tendency of clients, especially local authorities and large commercial companies, to devise their own systems with bespoke Schedules of Rates using individual definitions, conventions and specifications. This has made it difficult for contractors to price, even when they have built up good records of costs to inform unit pricing. While term contracts offer the benefit of continuity of work for contractors, and for clients, the larger contracts of themselves mean fewer opportunities to bid for work, especially for smaller firms, and a bigger "downside" to losing contracts with existing clients. This points up the increased importance of creating and sustaining good client-contractor relationships.

Building contractors generally have low levels of repeat business of around 20 per cent, compared with levels of 60-80% in other industries, and tend to practice vigorous sales strategies focusing on price cutting to achieve competitive advantage (see Porter, 1980) rather than relationship marketing (cf. Grönroos, 1990; 1994). Loyalty and trust do not feature prominently in construction; partnering is a recent phenomenon (Bennett and Jayes, 1995) which is being implemented with variable degrees of coherence.

Contractors are also seeing building maintenance work being awarded to companies based in or coming from other sectors such as security, cleaning or catering (Smyth and Wood, 1996) with clear customer-orientations, and used to service quality and reliability not always associated with "builders". It may be that construction companies able to differentiate themselves from the rest will be able to generate market share and repeat business based on sound business relationships.

JUST IN TIME MAINTENANCE

The development of the intelligent building, including highly serviced offices and supermarkets for instance has brought with it the potential of Just In Time Maintenance (Smyth and Wood, 1995). In the supermarkets, for instance, the electronic connection of the checkouts direct to headquarters means that information on how a particular line is selling is known almost instantly, and decisions on buying, pricing, positioning and so on can be taken accordingly. These electronic links enable the passage of further information -

about the building and its fittings - to be received centrally or transmitted remotely. It is thus possible for central management or contractor to know that the temperature of a particular refrigerated cabinet at a particular store is rising. By combining this information with parameters derived from commonly collected and assessed performance data, it is possible to determine when an unacceptable situation may be reached, and remedial JIT action ordered. A precondition for the emergence of JIT maintenance was therefore the centralisation of control for this function.

JIT maintenance may be characterised by features such as:-

oinclusive (all-in) service;
ocustomer focus;
oservice level agreements;
ocontractor input;
omodularised equipment.

In essence JIT maintenance is defined as getting the maximum life from each building component and piece of equipment, leaving repair or replacement until the component is broken or fails to function, yet taking action prior to it having a serious affect upon the performance of the organisation. In the retail case this is prior to it affecting customers, stock and hence profit detrimentally. It is achieved through a rapid and flexible response from the subcontractor.

A maintenance system, whether JIT or not, is capable of producing mountains of information on performance, reliability and response, which can inform decisions on specification and purchasing of equipment. Feedback data on cost-in-use provides input to future life-cycle costing exercises, if it were not based on equipment which may already be obsolescent and where standards for the future may differ.

The research on supermarkets has shown that prediction is becoming increasingly good, or good enough - that inspection can be reduced or eliminated and service intervals be tuned in the light of specific equipment experience in-service - and that warning can be received in time sufficiently in advance of failure for an appropriate response to be made. This has produced the maintenance contractor with the remit and resources to meet the whole of a store's maintenance needs, each job within a specified response period from time of 'order', and for a known sum. Contracts have moved from specifying service *intervals* to specifying *performance* standards.

Furthermore, contractors are able from their experience on such contracts, to negotiate the setting of appropriate and achievable standards of performance, and to influence future equipment provision. Install-maintain, or design-install-maintain, may be expected to become common. It was also found that where contractors were unable to provide a full service from their own resources, it is common to sub-contract, just as in building work, and that for some specialist elements of service, such as maintenance of weighing equipment, nomination is the norm. Increasing use of modularised equipment, such that parts may be readily replaced, maintaining or restoring service as quickly as possible, is helping to

eliminate the downtime and reduce disruption, which is unacceptable in the supermarket sector. These are stringent demands with seven-day trading, and long opening hours.

A problem identified with the system arises from its very efficiency. There are situations where the speed of response called for in the contract documents may be inappropriate, for instance around a Bank Holiday, or where there is "manual intervention" for instance from a Departmental Manager or Regional Engineer and conflicting or repeat requests are received at the service desk. Someone needs to negotiate priorities. It may be useful to have a limited range of response times from the lower limit of two hours for outsourced JIT maintenance to a maximum of seven days. Thus control is centralised while the response is decentralised.

IMPLICATIONS FOR BUILDING CONTRACTORS AND CONSULTANTS

Changing maintenance needs and procurement systems brings both threats and opportunities to the traditional suppliers of services. The study of practices in supermarkets showed that maintenance services were being provided by organisations from a range of backgrounds:-

- obuilding contractors
- oservices engineering contractors
- oequipment manufacturers
- osecurity and cleaning companies

Analogies were drawn with the growth of the facilities management industry, with a common feature being the "one stop shop", the single point of contact, with a growth in larger, longer term contracts in which small firms or individuals may provide services "as and when required" on sub-contract. There are thus implications in terms of seeking, winning and sustaining contacts and contracts over a long period of time. This prospect of continuous workflow brings with it the possibility of creating, and the means of providing a highly disciplined workforce, in some ways similar to the opportunities offered by prefabrication. In manufacturing industries these would be termed long production runs and would be highly sought and valued.

There are implications in terms of marketing and investment. Contractors particularly need to be able to present potential clients with a certainty of delivery that the client may be confident of service in turn to their tenants. This trust takes time to build, though it can be quickly eroded by under-performance or over-selling. Clients will also want to be assured that the contractor is committed to them - this will need investment particularly in the service infrastructure. Building contractors are already facing competition in the domestic market from trusted organisations like the Automobile Association and Green Flag Insurance using their communications infrastructure linked to certified, trained personnel and guaranteed delivery.

It may be that contractors will be able to secure maintenance work for themselves by "building it in" at the design or construction stage, not by the creation of defects but by

suitable specification and contractual agreements. The Private Finance Initiative is giving impetus to "Build and Operate" or "Design/Build/Operate" contracts whereby contractors and/or their financiers will gain or lose projects and profits according to how well they can forecast and contain running costs. "A skilful design can reduce the amount of maintenance and also make it easier to carry out the work" (How Son and Yuen, 1993). Contractors will also have opportunities to specify and install equipment and systems that they will find easy and economical to maintain, from suppliers with whom they may develop long-term relationships; installations may require maintenance by "approved firms". By contract, more clients, and consultants may require contractors to install systems specified by the security, cleaning and catering companies.

Consultants may also find roles in setting up and monitoring service contracts and at the design stage in specifying appropriate "smartware" systems, performance standards and response times.

IMPLICATIONS FOR BUILDING OWNERS AND USERS

Building owners will need to review their briefing procedures for new buildings, their management and maintenance. It is now both practical and desirable to adopt a holistic approach to the building. Design, specification and construction can reasonably be expected to take full account of the maintenance requirement, and subsequent upgrading needs. There may be real benefits to be gained by engaging a contractor who will take on a "life-time" role in which case the building owner will need to weigh his relative power, including purchasing power, against potential contractors or building suppliers. The contractor may be offering a building equipped by his or her preferred suppliers with systems not fully compatible with systems already in use or planned in other buildings in the client's portfolio. The building owner may be tied into systems and suppliers that are or become expensive to maintain or to upgrade.

Maybe purchasing decisions for the intelligent buildings of the coming millennium will not be dissimilar from those relating to today's computing, where hardware, software training and support need to be considered very much together. This implies a high level of technical, project management and financial skills in the building, property or facilities manager of tomorrow as recognised in the study of surveying needs by Stacey and Wood (1996). These surveyors will also need to have and maintain good working knowledge of contracts and contractors, their strengths and weaknesses and decision making abilities as to which to use, when and for how long. At present skills are required in estimating the scale of repair work and attributing priorities and likely costs. Monitoring devices and decision-support systems (formerly known as expert systems) will increasingly "automate" these processes, moving the focus of surveyor's skills to budgeting, so that sufficient funds are available for the Just In Time maintenance works, and to the creation of a contractual 'milieu' which is conducive to high quality service.

For users there are implications in terms of control. Studies have shown that the imposition of remote control systems can be poorly received by building occupants. For instance, Haves (cited by Roaf and Hancock, 1992) in the context of Building Energy Management

Systems (BEMS), has shown a preference for occupants to be in control of their environment, rather than have their heating, lighting, and occupation rates and utilisation controlled or monitored remotely by sensors or "the controller"! There are implications for loss of privacy - "Big Brother" is watching.

CONCLUSIONS AND RECOMMENDATIONS

The study has shown that growth in IT systems for managing building maintenance has been paralleled by the development of devices and systems for managing the buildings themselves. Computing power is such that it is possible to forecast when building services or fabric are likely to fail, and to facilitate, indeed order appropriate Just In Time Maintenance action.

A significant requirement for the success of JIT maintenance is the provision and sustaining of an infrastructure of suitable systems and personnel. This provides the opportunity for building contractors to develop long-term relationships with clients based on procurement methods and service qualities with which they may be relatively unfamiliar. Providers more familiar with the terminology and practice of service delivery are already operating in this field, having developed their skills in the security, cleaning and catering industries.

Building contractors presently providing maintenance services need to consider their market and take both more proactive and more responsive action to identify and meet the needs of their present, past and future clients. All participants, clients, consultants and contractors have the opportunity to propose and ultimately impose procurement methods most appropriate to them. Further research could give rise to guidance on the development of appropriate maintenance service delivery standards and of model procurement procedures.

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Résumés

ÉVALUATION DES RISQUES PAR LE SECTEUR PRIVÉ QUI FINANCE DES PROJETS DE CONSTRUCTION DU SECTEUR PUBLIC

Akintola Akintoye et Craig Taylor (page 1)

La création de la 'Private Finance Initiative (PFI)' est une initiative récente dans le Royaume-uni pour permettre au secteur privé de financer des projets du secteur public. L'équivalent de cette initiative en dehors du Royaume-uni inclut plusieurs approches, entre autres (i) design, construction, financement et fonctionnement, (ii) construction, possession, fonctionnement et (iii) clé-en-main. L'objectif de cette initiative est d'attirer le financement, les capacités de gestion et l'expertise du secteur privé dans des projets qui devraient être normalement entrepris par le secteur public. Pour qu'un projet puisse bénéficier de cette mesure, deux considérations importantes sont requises: premièrement, le projet doit assurer une optimisation de ressources, et deuxièmement, le transfert des risques au secteur privé doit être adéquat. Cet article, qui repose sur une enquête sous forme de questionnaires, illustre les réactions des maîtres d'ouvrage, des entrepreneurs et des institutions financières à l'égard des risques associés à l'initiative PFI. Une analyse montre que les risques associés (i) aux changements du design, (ii) au niveau d'information sur les fonctions, la performance et les exigences finales des projets PFI, (iii) aux mecanismes de paiement et de structure des coûts et (iv) aux coûts de la préparation des soumissions, sont des préoccupations importantes pour toutes les parties impliquées dans ce mode de maîtrise d'ouvrage.

UN MODÈLE D'ÉVALUATION DE LA PERFORMANCE D'UN PROJET D'HABITATIONS POUR FONCTIONNAIRES AU QATAR

H. Al-Derham, P. Hibberd et F. Mustapha (page 11)

Cet article illustre des recherches en cours à l'Université de Glamorgan. Ces recherches examinent la performance générale de deux grands projets d'habitation dans l'État de Qatar connus respectivement sous le nom de 'Senior Staff Housing (SSH)' et 'Private Housing (PH)'. Les auteurs proposent un modèle afin de comparer la performance des deux projets mentionnés. Ce modèle prend en considération la performance des deux projets objectivement, en fonction de la durée et du coût de construction, et subjectivement, en fonction de la qualité du bâtiment et de la satisfaction des usagers. À l'origine de cette recherche on découvre le besoin de définir comment l'application des mesures gouvernementales a pu influencer l'ensemble de la performance de ces deux projets.

Cet article présente le modèle et définit son processus de développement; les résultats des tests seront communiqués ultérieurement. Les stratégies du SSH au Qatar et les modèles existants pour choisir les différentes méthodes de maîtrise d'ouvrage sont passés en revue.

Les auteurs considèrent que le modèle sélectionné permettra de mieux comprendre comment la

performance d'un projet d'habitation peut être affectée par les mesures stratégiques adoptées et comment le paramètre 'performance' peut être amélioré. Il faut noter que le modèle utilisé a été développé pour répondre aux conditions et aux besoins culturels des ménages au Qatar, quoique ce modèle, correctement modifié et adapté, pourrait fort bien s'appliquer à un ensemble de conditions différentes et par conséquent avoir une application quasi-universelle.

LE PARTENARIAT CONCURRENTIEL - UN LIEN ENTRE L'ENTREPRENEUR ET LE SOUS-ENTREPRENEUR

Tony Baxendale et Darren Greaves (page 21)

Cet article examine l'hypothèse suivante à savoir que les entrepreneurs généraux et les sous-entrepreneurs peuvent bénéficier du partenariat concurrentiel. Ce type de partenariat se définit comme «un mode de concurrence limitée entre des sous-entrepreneurs sélectionnés qui ont satisfait les exigences rigoureuses d'un entrepreneur général et qui se sont engagés à réduire les coûts pour le client de l'entrepreneur tout en améliorant leurs services». Dans cet article, les causes de cette nouvelle approche sont étudiées en soulignant comment l'industrie conçoit le concept de partenariat. Les modes de partenariat couramment employés sont examinés ainsi que les effets éventuels qu'ils peuvent avoir.

Les auteurs indiquent que les principes du partenariat ne sont pas nouveaux dans l'industrie de construction. En 1964, Banwell recommandait déjà l'adoption de plusieurs principes du partenariat et en 1996, Latham allait encore plus loin en suggérant plus spécifiquement que le partenariat est un des moyens qui pourrait rendre l'industrie plus compétitive. Dans le Royaume-Uni, plusieurs entreprises ont déjà déclaré qu'elles ont adopté, ou qu'elles adopteront, des relations de partenariat avec leurs sous-entrepreneurs afin d'améliorer leurs services et de réduire les coûts. En conclusion, les auteurs mentionnenent la question de savoir si l'industrie est prête, ou non, à adopter cette approche. Mais, puisque la méthode du partenariat consiste à travailler en équipe pour perfectionner des objectifs communs sans hostilité, toute la question dépend, en fait, de l'attitude de l'industrie à l'égard des méthodes de maîtrise d'ouvrage innovatrices.

DOSSIER INITIAL ET INTÉGRATION DU DESIGN ET DE LA CONSTRUCTION: LES DERNIÈRES TENDANCES DE LA MAÎTRISE D'OUVRAGE EN AUSTRALIE

Rick Best et Dennis Lenard (page 29)

Pour que la construction respecte l'environnement et soit en mesure d'assurer à sa clientèle un bon niveau de satisfaction de ses besoins, le processus traditionnellement linéaire du design et de la construction devra subir un certain nombre de changements. Les innovations naissent d'une intégration totale du design et de la construction grâce à la participation de tous les experts le plus rapidement possible. Toute solution satisfaisante repose sur le dossier initial qui

définit clairement les paramètres cruciaux dès le début du processus de la maîtrise d'ouvrage.

Jusqu'à présent, la coutume voulait qu'on présente un projet architectural très détaillé aux ingénieurs et aux entrepreneurs, et qu'on leur demande de le 'faire fonctionner'. Cette approche n'est pas appropriée, surtout si l'on veut tirer profit au maximum du design proposé. Il serait préférable, dès la phase initiale du processus, de mobiliser une équipe pluridisciplinaire regroupant non seulement des professionnels du design mais aussi un économiste et un entrepreneur. Au préalable, cependant, le dossier initial devra clairement formuler tous les aspects du projet; ceux-ci devraient inclure les exigences fondamentales relatives à l'enveloppe du bâtiment, notamment le transfert de la chaleur, la protection contre le soleil, la masse thermique, la faisabilité de la construction, etc.

Cet article discute le besoin de changements dans le milieu de la construction, et il décrit une approche holistique au design et à la construction qui commence à émerger en Australie pour respecter l'environnement. Il suggère que l'intégration d'une bonne équipe d'experts et l'efficacité des décisions stratégiques initiales peuvent avoir un impact significatif sur la naissance d'innovations fructueuses.

L'EFFICACITÉ DES SYSTÈMES DE MAÎTRISE D'OUVRAGE POUR ATTEINDRE LES OBJECTIFS DES CLIENTS

P.A. Bowen, R.D. Hindle et R.G. Pearl (page 39)

Le choix d'un processus de maîtrise d'ouvrage approprié est crucial pour parvenir à la réalisation des objectifs du client en ce qui concerne les délais, les coûts et la qualité. Des recherches révèlent que la façon dont un grand nombre de clients et leurs conseillers professionnels choisissent leur méthode de maîtrise d'ouvrage, peut être l'objet du hasard, mal planifiée dans le temps et sans logique cohérente. Par ailleurs, il est clair que le choix inapproprié d'un système de maîtrise d'ouvrage est une des principales causes de l'insuffisance de la performance de l'industrie de la construction. Cet article examine les résultats d'une étude empirique sur la nature, l'utilisation et l'efficacité des méthodes de maîtrise d'ouvrage en Afrique du Sud par rapport à la satisfaction des objectifs des clients. Une enquête nationale sous forme de questionnaires a été entreprise auprès des clients, des architectes, des métreurs-vérificateurs, des ingénieurs, des gestionnaires de projets et des entrepreneurs généraux. La discussion porte sur les différences identifiées entre les différents groupes de répondants.

LES LIENS ENTRE LES INNOVATIONS DANS LE DOMAINE DE LA PERFORMANCE ET LA FOURNITURE DE BÂTIMENTS PRÉSENTANT DES TECHNOLOGIES INNOVATRICES

Jan Bröchner et Alf G. Johansson (page 51)

Mettre en évidence les préférences des usagers puis les traduire en des exigences de performance utiles au maître d'ouvrage peut être un processus à la fois compliqué et peu fiable. Les

principes de gestion orientés vers des services sur mesure offrent la possibilité de traiter des situations dans lesquelles certains aménagements inclus dans le bâtiment sont par la suite difficilement commercialisables. L'interprétation des suggestions ou des plaintes de la part des usagers et leur traduction en exigences contractuelles n'est qu'un aspect du problème. De plus, des considérations d'efficacité économique suggèrent que les critères de performance devraient tenir compte des coûts supportés à la fois par les maîtres d'ouvrage et par les entrepreneurs pour prévoir et contrôler la performance. C'est pourquoi encourager l'emploi de technologies innovatrices dépend aussi de la place attribuée aux innovations dans le domaine de la technologie utilisée pour mesurer leur performance.

L'EMPLOI DES DEVIS DE PERFORMANCE POUR L'ACQUISITION DES COMPOSANTS DE CONSTRUCTION

David W. Cheetham (page 61)

Bien que la construction dans le secteur public ait été très réduite dans le Royaume-uni, des tentatives entreprises par des architectes de ce secteur pour améliorer la performance des bâtiments en usage, ont stimulé l'apparition de nombreux développements valables et utiles. L'un de ceux-ci, connu sous le nom de 'Method of Building' de la Property Services Agency du Ministère de l'environnement est un système de construction ouvert qui offre la flexibilité pour le design et le choix des composants; de plus, du fait de la réduction de la gamme de composants disponibles, cette méthode permet de faire des économies sur la durée du design, d'améliorer les niveaux de performance et de réduire les coûts à l'usage du bâtiment.

Le développement des devis de performance, des méthodes de tests appropriées et la façon dont les fabricants ont répondu à cette approche sont décrits. Les ententes légales portent sur les conditions contractuelles, les devis de performance, les spécifications des produits et les bordereaux des prix. Une série de manuels regroupe une collection de détails d'exécution, des guides pour le choix des composants, des informations techniques sur les composants, des données sur les produits et sur les coûts qui leur sont associés.

Suite aux changements de politique du gouvernement, la décision de vendre la Property Services Agency et de contraindre les services du gouvernement à engager des consultants indépendants pour tous les services professionnels, a gaspillé la majeure partie de tous ces développements.

PLANIFICATION DE LA RÉSOLUTION DES CONFLITS DANS LES CONTRATS DE CONSTRUCTION

Sai-On Cheung (page 71)

Le but d'un contrat est de rendre les transactions formelles. Les contrats de construction ne font pas exception. Un contrat est un outil essentiel pour re-définir les intentions des différentes

parties à l'égard de la transaction en question. Les intentions en rapport avec l'attribution des obligations et des risques sont d'une importance majeure et nécessitent une planification soigneuse. Les prévisions concernant les imprévus constituent un autre élément clé de la planification d'un contrat. Cependant, revendiquer une actualisation parfaite est futile. Le terme 'actualisation' se réfère aux efforts qu'il faut faire pour adapter un contrat en temps et lieu; autrement dit le terme 'actualisation' se réfère à des causes qu'il faut pressentir ou réaliser dans le moment présent. Un certain degré de flexibilité, notamment en relation avec la performance du contrat, est de ce fait nécessaire. Cette constatation est particulièrement vraie pour les contrats de construction. Des clauses se rapportant à la résolution de conflits sont comprises dans les contrats de construction pour traiter des situations difficiles, entre autres, lorsqu'il y a des désaccords à propos de l'interprétation ou de l'utilisation de la flexibilité mentionnée ci-dessus. Cet article examine les caractéristiques de différents types de contrat que l'on rencontre couramment dans le processus de construction. La maîtrise des structures et le recours éventuel à des méthodes alternatives de résolution de conflits sont également discutés.

L'APPROCHE 'FAST-TRACK' POUR UNE ANALYSE DE FAISABILITÉ EN IMMOBILIER

Tony Collins (page 81)

Cet article étudie un modèle d'analyse de faisabilité dont l'objectif est de promouvoir une prise de décisions rapides et justes à la phase de maîtrise d'ouvrage. Ce modèle tire profit des techniques de flux monétaire actualisé et inclut tous les revenus et toutes les dépenses qui affectent la valeur actualisée du bâtiment, la réversion à la fin de la période de détention, le calcul de toute la gamme de décisions concernant la propriété en termes de ratios, de capitalisation du revenu et des calculs de la valeur marchande par comparaison avec les coûts de développement et des coûts des capitaux empruntés. Ce processus nécessite l'apprentissage et l'entraînement d'analystes de l'immobilier et de la construction en ce qui concerne la théorie et l'application de l'analyse de la faisabilité et des chiffriers électroniques.

La vitesse et la flexibilité des programmes de calcul disponibles et des ordinateurs modernes facilitent une prise de décisions rapides et justes, tout en permettant également, à la phase de maîtrise d'ouvrage, la comparaison d'une grande variété de propriétés qui pourraient être développées. Au cours de ce processus, on peut aussi faire une comparaison des variations dans le temps, de la somme et de la certitude de la réception des rentrées de fonds pendant la période d'exploitation de différents types de propriétés. De plus, l'utilisation d'une imprimante rapide et de bonne qualité permet au client et à l'analyste d'imprimer une variété d'options pour une propriété particulière ou pour divers autres solutions. Ces possibilités pourraient tenir compte, entre autres, des modifications des taux d'intérêt, des loyers et des coûts de construction pour calibrer les effets de ces facteurs sur la faisabilité du projet à l'étude.

LA MAÎTRISE D'OUVRAGE ET LA SOUS-TRAITANCE: LES DROITS DE L'ENTREPRENEUR GÉNÉRAL FACE À L'IRRÉVOCABILITÉ D'UNE OFFRE DE SOUS-TRAITANCE

Ron Craig (page 91)

Cet article examine la situation causée par la révocabilité d'une offre de sous-traitance après que l'entrepreneur général s'est fié à cette offre pour proposer sa soumission. À la recherche d'une solution commerciale qui confirmerait l'intégrité du processus de soumission en réponse à un appel d'offres, l'auteur présente les différents points de vue que des experts ont proposés en Angleterre, en Nouvelle-Zélande, aux É.-U. et au Canada.

LA SOUMISSION: ÉQUITÉ, ÉGALITÉ ET INNOVATION

Ron Craig (page 101)

Cet article examine des jugements rendus par des tribunaux de Nouvelle-Zélande et du Canada concernant d'une part le respect du droit d'équité pour tous les soumissionnaires de la part d'une autorité publique, et d'autre part la violation de ce droit lorsqu'on accepte une 'soumission alternative' qui ne conforme pas au code de maîtrise d'ouvrage en vigueur. Dans ces cas, la soumission acceptée dépassait de beaucoup les objectifs de l'appel d'offres original. Les auteurs étudient ensuite la façon dont les systèmes de maîtrise d'ouvrage internationaux essaient de résoudre ces deux questions, mais ils ne sont pas parvenus à trouver une réponse réellement appropriée. En conclusion, ils donnent donc des directives sur la façon de traiter les soumissions innovatrices d'un entrepreneur sans violer les obligations à l'égard des autres soumissionnaires.

EFFICACITÉ DES CONTRATS INTERNATIONAUX DE CONSTRUCTION FONDÉS SUR LA RELATION PERFORMANCE/PARTICIPATION DU CLIENT: UNE ÉTUDE COMPARATIVE DES SYSTÈMES BRITANNIQUE ET FRANÇAIS

Dee Davenport (page 111)

Cet article fait une évaluation des résultats d'une enquête par questionnaires pour estimer initialement d'une part l'attitude des industries de la construction britannique et française à l'égard des attentes des clients et d'autre part l'effet de l'implication et des compétences des clients sur la performance de la maîtrise d'ouvrage. Cette étude inclut (i) une analyse de distribution statistique pour examiner les relations entre les priorités ou les exigences des clients, leurs compétences, leur satisfaction de la performance, leur niveau de participation et leur mode préféré de maîtrise d'ouvrage, et (ii) la construction d'une matrice de corrélation à l'aide du système de Spearman afin d'étudier la corrélation entre les cotes de performance attribuées par les clients et celles de leur satisfaction générale concernant la performance.

Une hypothèse nulle soutenant qu'il n'y a aucune différence significative dans les résultats non paramétriques des relations mentionnées ci-dessus entre les deux pays a été testée en utilisant la formule chi-carré pour les variables non chiffrées et le test U de Mann-Whitney pour les données ordinales. L'objectif de cette étude comparative était de découvrir si des tendances similaires peuvent transcender les frontières nationales, et si ces mêmes tendances pourraient avoir une signification universelle en ce qui concerne l'application d'une stratégie de maîtrise d'ouvrage centrée sur le client de façon à atteindre une certaine harmonisation à une échelle plus globale.

Cette étude a été faite d'après une enquête auprès d'entreprises industrielles et commerciales en tant que maîtres d'ouvrage. Des questionnaires ont été envoyés à 500 organismes publics et 500 organismes privés, choisis au hasard dans les annuaires de la compagnie Lotus au Royaume-uni et en Europe. Les résultats ont été analysés à l'aide du logiel SPSS.

UNE STRUCTURE POUR GÉRER LA QUALITÉ DES MULTI-ORGANISATIONS TEMPORAIRES

Colin H. Davidson et R.A.Mohsini (page 123)

La qualité s'exprime à l'intérieur d'un contexte de survie du plus fort, autrement dit, elle équivaut à la survie à long terme d'une entité particulière dans son environnement. Un certain nombre d'attributs peuvent être identifés pour définir, mesurer ou évaluer la qualité, mais le plus important reste la longévité de l'entité. Les arguments sous-jacents en faveur de la qualité en tant que fonction de la longévité/continuité d'une entité particulière s'expriment de différentes façons, telles que par exemple 'quand une firme réussit à long terme, elle a connu le succès au jour le jour' ou bien encore 'quand une entreprise livre un produit de qualité jour après jour, elle devient le symbole du succès à long terme'. Mais que doit-on penser des situations qui sont temporaires ou des organisations qui peuvent être catégorisées comme des 'multi-organisations temporaires' comme la plupart des équipes qui se forment pour délivrer un projet de construction? Se qualifient-elles pour adopter les définitions de qualité qui présument une existence à long terme d'organisation? Par opposition à la survie du plus fort, cet article propose un cadre gagnant-gagnant comme paradigme pour exprimer, évaluer et maximiser la qualité des organisations chargées des projets de construction.

UN MODÈLE DE CONTRAT DYNAMIQUE

Richard S. Dawod (page 133)

À l'heure actuelle, la plupart des contrats et des bons de commande ne sont pas en harmonie avec la gestion de la qualité totale - GQT (en anglais TQM) et la gestion par activités - GPA (en anglais ABM). Ces types de documents qui scellent une promesse de contrat sont des modèles statiques, sortes de clichés instantanés qui authentifient l'accord final une fois négocié entre deux parties - les représentants du client (l'administrateur du contrat ou l'acheteur) et l'entrepreneur (le fournisseur). Ces contrats correspondent à une forme de gestion repliée sur

elle-même et sont difficiles à administrer. Les difficultés les plus courantes dues à ce modèle de contrat statique sont les suivantes: le maître d'ouvrage peut subir des augmentations de coûts injustifées à cause de modifications sournoises du projet initial, ou bien l'entrepreneur peut faire face à des pénalités inutiles à cause du non-respect des délais prévus par l'échéancier.

Cet article propose et développe un modèle de contrat dynamique dont le support est assuré par la GQT et la GPA. Ce modèle correspond à une entente entre l'équipe technique (celui qui passe la commande ou l'usager), l'administrateur du contrat (le représentant du maître d'ouvrage) et l'entrepreneur (le fournisseur). Les différentes phases du modèle sont: la définition, le développment, la préparation, l'exécution, le contrôle et l'évaluation rétroactive. Ce modèle implique également le cycle de Shewhart qui comprend planification, action, vérification et correction pour améliorer la phase de rétroaction. L'auteur considère que ce modèle de contrat dynamique ouvre une voie prometteuse pour les contrats et pour les documents échangés entre les parties contractantes.

LA CRÉATION D'UN BUREAU DES PROGRAMMES

Beverly Stacy Dittmer (page 141)

Le Bureau des programmes peut être assimilé au moyeu d'une roue. C'est le cœur du programme général de la firme. Toutes les communications et la plupart des informations passent par le Bureau des programmes et sont dirigées vers les différents projets. Le Bureau des programmes dépend des projets individuels pour assurer son succès. En retour, les projets dépendent du travail et du bon fonctionnement du Bureau des programmes pour assurer leur réussite. Aucun programme général d'une firme ne peut réussir sans un Bureau des programmes efficace et parfaitement fonctionnel, mais il faut décider quand et comment organiser ce Bureau.

Cet article décrit les conditions qu'il faut évaluer avant de déterminer le moment où un Bureau des programmes devient nécessaire pour le bon fonctionnement de la firme. L'auteur mentionne les conditions d'embauche du personnel du Bureau, la durée de son implantation, la gestion des bases de données et des exigences techniques. La conclusion donne une description des différents centres fonctionnels, des postes et du personnel du Bureau des programmes.

UNE ENQUÊTE SUR LA PERTINENCE ET LE POTENTIEL DE LA MÉTHODE ALTERNATIVE DE RÉSOLUTION DE CONFLITS (MARC) POUR ACCROÎTRE LA PERFORMANCE D'UN PROJET DE CONSTRUCTION

Mohammed F. Dulaimi et James Player (page 153)

L'objectif de cet article est d'envisager le potentiel de la technique MARC dans le but d'accroître la coopération et d'améliorer les relations entre les différents participants d'un projet de construction. Le montage d'un projet peut renforcer la flexibilité, les ressources, les connaissances et la capacité d'innover, et de développer de nouvelles idées. Cependant, la gestion des conflits entre les différents groupes et/ou les membres du projet aura un effet fondamental

sur le succès de ce projet. Cet article présente les résultats d'une enquête sur la perception de l'industrie de la construction en ce qui concerne la pertinence et les avantages de l'utilisation de la technique MARC pour réduire l'ampleur du/des conflit(s) et bâtir des relations favorables entre tous les participants. Cet article décrit également d'une part la possibilité d'un emploi abusif de l'approche MARC et d'autre part les avantages d'une gestion capable d'adopter les mêmes principes fondamentaux de cette techniques pour la gestion d'un projet de construction.

POUR UNE MAÎTRISE D'OUVRAGE FAVORABLE AU CLIENT: ÉVALUATION DES RISQUES SUPPORTÉS PAR L'ENTREPRENEUR À L'AIDE DES RATIOS FINANCIERS

F.T. Edum-Fotwe, A.D.F. Price, A. Thorpe et R.McCaffer (page 163)

L'évaluation d'un entrepreneur par le client est un aspect crucial de la stratégie de maîtrise d'ouvrage pour l'acquisition des services de construction. La pratique courante a souvent recours à des facteurs directement reliés au projet. À cet égard, l'influence du coût de la soumission en tant que critère de sélection de l'entrepreneur est probablement la plus importante. En fait, dans le climat des affaires qui prévaut actuellement dans la construction, le besoin d'évaluer le risque de problèmes financiers dans l'entreprise est évident. Cette approche donnerait une vision plus claire des risques encourus par le client lorsqu'il engage les services d'une entreprise particulière. Cet article passe en revue plusieurs mesures et outils du domaine financier qui ont trouvé une application dans l'évaluation des risques que pourraient subir les entreprises. Il présente également des arguments pour illustrer l'incorporation de certains de ces outils d'évaluation des risques qui sont associés à l'engagement pris par le client lorsqu'il veut obtenir les services d'un entrepreneur particulier.

MESURE DE LA SAUVEGARDE DE L'ENVIRONNEMENT QUAND ON UTILISE LES MÉTHODES DE MAÎTRISE D'OUVRAGE TRADITIONNELLES

Colin Elliot et Angela Palmer (page 175)

Cet article décrit et évalue des études récentes sur l'impact environnemental, en se référant au type d'impact considéré, à l'emplacement du projet, à l'évaluation monétaire, à l'estimation des bénéfices éventuels et enfin aux effets préjudiciables. L'auteur analyse aussi comment les pratiques de maîtrise d'ouvrage existantes peuvent s'adapter à l'évaluation de l'environnement et il étudie la façon dont les organisations de l'industrie de la construction peuvent développer des stratégies reposant sur les études d'impact environnemental.

L'ARCHITECTE ET LE CLIENT - L'ADOPTION D'UNE APPROCHE SIMPLE AU PROCESSUS DE MAÎTRISE D'OUVRAGE

Stephen Emmitt (page 185)

Même si l'on admet généralement que le processus de maîtrise d'ouvrage dans le bâtiment est devenu plus complexe, il existe cependant quelques firmes d'architectes dans le Royaume-uni qui ont essayé de simplifier le processus en utilisant les techniques de gestion de la construction. Cet article présente un aperçu basé sur l'étude de cas d'une agence d'architectes et d'un client important, offrant régulièrement des contrats. Le rôle de l'architecte et du client qui ont adopté une approche innovatrice à l'égard de la maîtrise d'ouvrage est décrit en discutant particulièrement des questions importantes relatives au droit de propriété, à la réduction des coûts et à la qualité.

LA CULTURE DU PARTENARIAT

Richard Fellows (page 193)

Au cours des dernières années, des modalités plus formelles de partenariat se sont développées. Cet article montre que le partenariat a pris son essor d'une part lorsqu'on a compris l'intérêt latent de la collaboration dans le domaine de la maîtrise d'ouvrage, et d'autre part lorsqu'on a commencé à considérer cette façon de travailler en équipe comme la base de toutes les autres initiatives de co-entreprise. L'auteur souligne également que le succès du partenariat repose sur la prise en considération des facteurs culturels. Ceux-ci, en effet, doivent être abordés en conjonction avec les questions de gestion, d'économie et de droit pour 'forger' des résultats fructueux à partir du partenariat sur lequel on a tendance à 'miser gros'.

RHÉTORIQUE ET RÉALITÉ: UN PROGRAMME DE RECHERCHE SOCIO-CONSTRUCTIVISTE POUR LE PROCESSUS DE RÉ-INGÉNIERIE EN CONSTRUCTION

Stuart D. Green (page 203)

Malgré les revendications rhétoriques qui soutiennent que le processus de ré-ingénierie représente un tournant radical, l'importance que ce processus attache à la technique donne une impression de retour à la mécanique simpliste des métaphores du Taylorisme. Les techniques de représentation des processus qui caractérisent la ré-ingénierie n'offrent rien d'autre qu'une réhabilitation haut-de-gamme de l'organisation du travail. D'un point de vue socio-constructiviste, les processus de gestion n'existent pas en dehors de la perception des acteurs sociaux, et par conséquent ils peuvent être continuellement re-négociés comme une partie du flux sans fin du milieu organisationnel. L'originalité de la ré-ingénierie, mise à part sa rhétorique persuasive, a déjà influencé d'une façon significative les structures mentales des praticiens de la gestion. Les réalités de l'industrie de la construction moderne ne peuvent donc pas être com-

prises sans une bonne compréhension des métaphores sous-jacentes du processus de ré-ingénierie. La capacité de persuasion du processus de ré-ingénierie a aussi influencé les programmes de recherche subventionnés par le gouvernement et par l'industrie. Les universitaires qui s'intéressent à la construction subissent donc des pressions pour adopter ce type de langage afin d'assurer le financement de leurs recherches. Ceux qui résistent aux images simplistes de la ré-ingénierie risquent d'être accusés de ne pas 'être sur la bonne longueur d'ondes'. Bien qu'il soit important pour les universitaires de répondre aux besoins perçus par l'industrie, ils doivent également s'engager à développer des recherches à long terme complètement indépendantes de la dernière mode propagée par les gourous de la gestion. La recherche ne peut pas être évaluée uniquement en terme d'amélioration du rendement de l'industrie. Les universitaires ont aussi la responsabilité de développer le capital intellectuel de l'industrie de la construction.

DÉVELOPPEMENT DU CONTRAT CONCEPTION-CONSTRUCTION EN IRELANDE DU NORD

J.G. Gunning et M.A.McDermott (page 213)

Cet article a été préparé à partir des résultats d'une enquête récente (1996) sur le mode de maîtrise d'ouvrage de la construction neuve en Irelande du Nord; il met en évidence le fait que l'approche conception-construction est adoptée dans 30% des cas du marché local. Selon cette enquête, clients et entrepreneurs souhaitent qu'il y ait une plus grande utilisation de ce type de contrat.

La recherche mentionnée examine les causes potentielles de conflits dans ce type de projet du fait des changements de design et de la concurrence des prix. Des directives initiales mal formulées proposant de vagues spécifications de qualité, des programmes peu réalistes et un apport d'information insuffisant sont des facteurs qui contribuent au mécontentement causé par ce processus. Cette enquête identifie également une évidence qui s'impose de plus en plus, à savoir l'importance de la compétence de l'entrepreneur si l'on veut satisfaire totalement le client.

Parmi les recommandations de cette étude, il faut mentionner le besoin d'un guide de directives normalisées pour le maître d'ouvrage, et d'un code de pratique pour les designers et entrepreneurs qui adoptent la procédure conception-construction. Il faudrait des clauses incitatives, des procédures normalisées pour le choix des consultants, une meilleure définition des responsabilités pour chacun des participants et des services plus réalistes à l'intention des maîtres d'ouvrage. En conclusion, cette recherche identifie un rôle sans cesse croissant pour l'approche conception-construction fondée sur un plus grand professionnalisme de l'entrepreneur et sur une organisation telle que le client soit mieux informé et plus apte à prendre des décisions.

L'EMPLOI DU DEVIS DE PERFORMANCE POUR LA MAÎTRISE D'OUVRAGE DU LOGEMENT SOCIAL

Anthony D. Hall et David W. Cheetham (page 223)

La Corporation de développement de Northampton, un organisme de développement d'une ville nouvelle du Royaume-uni, a cherché non seulement à stimuler la concurrence dans le domaine de la production semi-industrialisée du logement social, mais aussi à améliorer la qualité (autrement dit, la performance à l'usage) des habitations qu'elle fournit. Cet article donne une description du devis de performance utilisé et en souligne les avantages. Suite à des programmes d'adjudication successifs, le choix a été fixé sur des constructions en béton banché, des structures de bois revêtues de contreplaqué ou des structures de bois revêtues de panneaux de fibres agglomérées collées avec du bitume. Chaque système satisfait les exigences de performance spécifiées pour un coût très compétitif. Les auteurs font un rapport sur les problèmes rencontrés et sur les leçons qu'on a pu tirer de ce projet.

L'INDUSTRIE DE LA CONSTRUCTION INTERNATIONALE, LA CONCURRENCE ET LA DIVERSITÉ CULTURELLE

Mark A. Hall et David M. Jaggar (page 233)

Depuis longtemps, on a coutume de considérer la diversité culturelle comme un facteur important pour le succès d'une entreprise qui œuvre au niveau international. Cette constatation se reflète de nos jours dans la formation intensive que le personnel reçoit sur les questions culturelles et sur les stratégies des entreprises quand elles travaillent outre-mer. Dans le secteur de l'architecture, de l'ingénierie et de la construction (AIC), il y a des organismes qui commencent à comprendre qu'eux-mêmes devraient se préoccuper de cette question pour que leur industrie devienne de plus en plus compétitive sur le marché mondial.

À partir de résultats relevés dans la littérature, cet article cherche à esquisser un certain nombre de préoccupations importantes pour l'avenir de l'industrie de la construction internationale. L'objectif de cet article est de démontrer qu'une approche stratégique est essentielle quand on travaille outre-mer et que la gestion des questions culturelles devrait être une partie intégrale de cette stratégie.

DIFFÉRENCES CULTURELLES ET ADAPTATION DES PROCÉDURES DE MAÎTRISE D'OUVRAGE AU NIVEAU INTERNATIONAL

Mark A. Hall et David M. Jaggar (page 243)

Les auteurs cherchent à illustrer des situations dans lesquelles les différences culturelles peuvent avoir une influence sur la maîtrise d'ouvrage des projets de construction internationaux. Puis ils examinent de quelle façon une organisation peut répondre à ces différences

culturelles et ils discutent quelques stratégies potentielles qu'une entreprise d'architecture, d'ingénierie et de construction (AIC) pourrait adopter pour tenir compte de la diversité culturelle dans le milieu de travail. En conclusion les auteurs proposent une discussion sur les implications de ces questions sur la maîtrise d'ouvrage.

LES EFFETS DE LA CULTURE SUR LA COMMUNICATION DANS LES ENTREPRISES DE CONSTRUCTION MULTI-NATIONALES: UNE ÉTUDE DE CAS AUSTRALO-THAILANDAISE

Mick Hancock, Khisada Vachira-Angsana et David Root (page 251)

Les auteurs font une étude d'un projet de construction entrepris par une co-entreprise australo-thailandaise à Bangkok. Cette étude identifie les méthodes, les voies et les modes de communication utilisés par les participants et examine les facteurs qui influencent les conditions des communications. Les communications, les organisations multi-nationales et la culture nationale constituent le contexte théorique dans lequel cette étude a été faite. Il en ressort que la culture nationale a un impact sur les méthodes, les voies et les modes de communication, et que cet impact influence le transfert et la réception de l'information. Les observations et les discussions avec les participants pendant une enquête de trois semaines sur le site permettent d'avancer que la connaissance de la culture nationale et du langage du pays-hôte est essentielle pour atteindre une haute performance dans les organisations multi-nationales de construction.

LE TRAVAIL GÉNÉRIQUE: LE MOTEUR D'UNE BONNE MAÎTRISE D'OUVRAGE

S. Harrup and P. Rickett (page 261)

Le travail générique, autrement dit le regroupement du travail qualifié, est une approche actuellement utilisée par divers organismes pour devenir plus compétitifs. Les organismes ont remis leurs stratégies en question pour adopter cette nouvelle méthode de travail; cette nouvelle stratégie devrait se refléter dans le design des bâtiments afin de donner plus de flexibilité à l'entreprise. Ainsi l'organisation des activités d'une firme aura un impact direct sur l'analyse fonctionnelle et les exigences spatiales réclamées par le maître d'ouvrage.

Dans les secteurs public et commercial, il existe de nombreux exemples de bâtiments dont le design innovateur est lié au mode de travail. Dans le secteur commercial, on peut trouver des cas nés de cette tendance qui veut que des équipes multi-fonctionnelles opèrent dans des bâtiments spécialement conçus pour leurs besoins. Dans le secteur public, le design des hôpitaux par exemple vise à minimiser le déplacement des patients entre des services éloignés. Les installations indispensables sont fournies dans un service hospitalier proche du patient dans une unité qui se compose d'un personnel dit générique, c'est-à-dire multidisciplinaire, capable de donner tous les soins nécessaires.

Cet article explore les principes du travail générique et la façon dont ceux-ci sont reliés au design de bâtiments. Les auteurs considèrent que cette méthode de travail, qui permet de satisfaire tous les principaux besoins, peut (et devrait) être le moteur de toutes les décisions qui mènent à un processus de maîtrise d'ouvrage de qualité.

LES CRITÈRES DU CLIENT LORSQU'IL CHOISIT UN SYSTÈME DE MAÎTRISE D'OUVRAGE - UNE EXPÉRIENCE EN MALAISIE

Maizon Hashim (page 273)

Dans l'industrie de la construction, l'incertitude est généralement due à des projets de construction qui ne respectent pas les délais et les coûts prévus. À une époque où les coûts de construction et l'emprunt sont onéreux, les clients ne sont pas disposés à tolérer l'incertain. Même si les coûts, les délais et la qualité sont les trois considérations les plus importantes, il faut reconnaître que la maîtrise d'ouvrage dans le bâtiment nécessite inévitablement des compromis ou tout au moins un juste équilibre des priorités mentionnées. Les maîtres d'ouvrage qui veulent avoir un contrôle sur le design et sur les divers changements qui surviennent au cours du projet suivront la voie traditionnelle de maîtrise d'ouvrage. Les maîtres d'ouvrage qui veulent avoir recours à une méthode relativement rapide choisiront la voie de la méthode de conception-construction qui réduira la durée totale des travaux puisque le design et la construction procèderont en parallèle, que le coût sera garanti et que la date d'achèvement sera respectée. Enfin, les maîtres d'ouvrage qui veulent modifier ou perfectionner les exigences de design durant la construction auront recours à la gérance de projet afin de pouvoir ajuster le programme et les coûts.

PEUT-ON OPTIMISER LES RESSOURCES QUAND ON UTILISE LE FINANCEMENT DU SECTEUR PRIVÉ POUR LA MAÎTRISE D'OUVRAGE DES SERVICES D'INFRASTRUCTURE DANS LE SECTEUR PUBLIC?

G.J. Hodgson et J.A. Davies (page 285)

En 1992, le gouvernement britannique introduisit une nouvelle reforme - l'Initiative de financement privé ('Private Finance Initiative - PFI'). L'objectif était d'améliorer les services et l'infrastructure du secteur public en stimulant l'investissement de capitaux et le rattachement des capacités du secteur privé au secteur public. Cependant, à l'époque et maintenant encore on se demande si la PFI assure vraiment une optimisation des ressources.

Jusqu'à présent on a fait beaucoup de spéculations, mais aucune recherche sur ce sujet. Le Bureau national de vérification des comptes du Royaume-uni a annoncé en novembre 1995 qu'on allait vérifier les comptes de projets réalisés grâce à la PFI. Ce faisant, on n'essayait pas d'étudier ou même de considérer l'optimisation des ressources impliquées par la politique du gouvernement mais seulement d'examiner quelques projets individuels en terme de l'investissement financier qu'ils avaient entraîné.

Cet article est basé sur une évaluation de la valeur des implications financières de la PFI en tant que politique gouvernementale. Cette évaluation repose sur des données qualitatives collectées au cours d'interviews et de recherches exhaustives dans la littérature. L'analyse de ces données se traduit par une estimation de l'économie, de l'efficience et de l'efficacité de la PFI. Les résultats indiquent que la PFI est économique et efficace, mais qu'elle n'est pas encore réellement opérationnelle. En fait il semble qu'elle pourrait avoir plus de potentiel qu'on ne le pense, puisque certains aspects introduits par la PFI prendront un certain temps pour se développer pleinement. Il est fort possible que l'efficacité de la PFI s'améliore avec le temps. En conclusion, les auteurs rappellent que la PFI, en tant que mesure gouvernementale, peut offrir une plus grande optimisation des ressources investies dans les services publics que toute autre solution disponible actuellement.

QUELS SONT LES SERVICES ESSENTIELS FOURNIS PAR LES CONSULTANTS EN GESTION DE PROJETS?

D.C. Humphries et D.H.T. Walker (page 295)

Il y a, en Australie, de nombreux professionels de formation très diverse qui offrent des services de gestion de projets dans le domaine de la construction. En terme de marketing de leurs services, ces conseillers de gestion peuvent être tentés de persuader leurs clients que certains services particuliers qu'ils sont capables d'offrir, sont en quelque sorte indispensables. Pour peu que cette stratégie s'avère fructueuse, ces professionnels augmentent leurs chances de tirer de plus grands revenus du fait même de l'expansion de leurs services. Ces services, en fait, peuvent dédoubler ou remplacer les services offerts par d'autres professionnels de l'industrie de la construction.

Cet article examine des recherches récentes portant sur la définition des services qui doivent être nécessairement fournis par des consultants en gestion de projets lors de grands travaux de construction de bâtiments ou d'infrastructures. Ces services sont classés selon diverses rubriques: 'fondamentaux', 'importants' et 'non essentiels'. L'avantage de cette classification est de permettre aux clients de décider rapidement les services qui doivent être fournis indépendamment par le consultant en gestion de projets et ceux qui pourraient être fournis par d'autres professionnels. Cet article devrait particulièrement intéresser les maîtres d'ouvrage qui doivent décider d'une part si les services de gestion doivent être traités par le personnel de l'entreprise ou par le consultant en gestion de projets et si, d'autre part, il y a de services qui pourraient être avantageusement fournis par d'autres conseillers spécialisés.

STRATÉGIES DE MAÎTRISE D'OUVRAGE DES SYSTÈMES DE GESTION DE L'ÉNERGIE DANS LES BÂTIMENTS POUR LES GRANDS PROJETS DE CONSTRUCTION EN AUSTRALIE

Shui-Cheong Kam et Heng Li (page 303)

Le Système de gestion de l'énergie dans les bâtiments ('Building Energy Management System - BEMS') s'est beaucoup développé durant ces dernières années. et pourtant très peu de recherches ont été faites sur les problèmes opérationnels et sur l'évaluation de ce type de maîtrise d'ouvrage. Plus de cinq cents organismes australiens ayant bénéficié de ce système incluent des hôpitaux, des institutions tertiaires, des sites commerciaux, des collèges techniques et autres établissements d'enseignement qui ont été inspectés au cours d'une étude centrée sur la configuration, la performance courante, les critères de sélection, les problèmes opérationnels et l'acceptation de l'approche 'BEMS' et du concept de partenariat pour la conception des décisions de maîtrise d'ouvrage.

Cette étude utilise la technique de distribution de fréquences pour analyser les résultats de la recherche. Elle indique le niveau d'acceptation du réseau des infrastructures et des réseaux d'automatisation et de gestion des différents projets de construction. Elle indique aussi les futures tendances que la recherche pourrait prendre pour améliorer les systèmes BEMS existants afin de mieux satisfaire les attentes des usagers. La plupart des participants préfèrent acheter à prix forfaitaire plutôt que de développer ces systèmes eux-mêmes, le plus bas prix étant généralement le critère de sélection. Des problèmes dus au design trop élaboré de systèmes qui ne seraient valables que pour des conditions extrêmes, surviennent encore dans certains cas. Dans la majorité des établissements australiens, les répondants de l'enquête n'acceptaient pas le partage des risques ou le partenariat. La recherche-action proposée a été conçue pour tester l'hypothèse qu'une approche stratégique puisse associée au concept de partenariat pour la conception de la maîtrise d'ouvrage; cette approche serait fondée sur un ensemble complet d'exigences de performance afin de réduire les risques 'd'over-design' mentionné ci-dessus. À partir de cette analyse empirique, d'autres recherches pourraient améliorer les sysèmes 'BEMS' existants pour satisfaire les demandes des usagers.

COMPRENDRE LES RISQUES DU MARCHÉ QUAND ON INVESTIT DANS DES PROPRIÉTÉS COMMERCIALES

Sujay Karkhanis et Chandra Bhuta (page 313)

La littérature sur la performance de l'investissement et sur la théorie du portefeuille implique que le modèle sur l'estimation des valeurs immobilières ('Capital Asset Pricing Model - CAPM'), avec quelques modifications, pourrait être directement appliqué à l'analyse de l'investissement dans des propriétés. La plupart des études sur ce sujet ont été entreprises dans le contexte américain et l'Australie accuse un certain retard dans ce domaine. C'est pourquoi l'objectif principal de la recherche mentionnée est d'analyser la relation qui existe entre les risques et les taux de rendement des placements dans les biens immobiliers dans le contexte australien à l'aide du modèle CAPM.

En Australie, les institutions et les banques en tant que titulaires de propriétés seront probablement les acteurs les plus importants au cours du prochain boom de l'immobilier. Cette recherche vise à offrir une structure qui facilite l'analyse des risques du marché en utilisant un modèle qui permet de déterminer la limite des risques ('Market Risk Boundary Layer - MRBL'). La nouveauté de cette recherche réside dans l'utilisation des pratiques et des techniques contemporaines employées dans le secteur de la gestion des finances et des placements pour analyser les risques de l'investissement dans des propriétés commerciales. Cet article souligne les progrès récents qui ont marqué l'analyse des risques associés à l'investissement dans des portefeuilles de biens immobiliers et en particulier le recours au modèle MRBL.

S'ORGANISER EN APPRENANT: LES RÉSEAUX

Constantine J. Katsanis, Dennis J. Cahill et Colin H. Davidson (page 323)

La maîtrise d'ouvrage dans le bâtiment est une activité stratégique qui établit la structure organisationnelle d'une entité temporaire constituée par plusieurs participants, qui aura finalement la mission de réaliser le design et la construction d'un bâtiment. C'est pourquoi les tendances en ce qui concerne le design des organisations et les pratiques courantes dans le monde des affaires sont essentielles pour formuler des stratégies de maîtrise d'ouvrage d'une façon appropriée et efficace.

L'avénement des réseaux organisationnels dans la littérature au cours de ces dernières années souligne l'importance de ce mode d'organisation dans un milieu d'affaires caractérisé par des changements rapides et marqué par des turbulences. Un examen de l'industrie de la construction révèle que, même si la structure de cette industrie est un archétype des réseaux, la nature adverse des relations qui prévalent depuis toujours dans cette industrie constitue un obstacle au développement des avantages qui sont inhérents à toute organisation en réseau.

L'organisation qui 'se forme en apprenant' est une organisation qui développe continuellement la capacité de créer son devenir en améliorant la qualité de la pensée, en élargissant le champ de la réflexion et en formant une équipe par le biais d'un apprentissage mutuel pour aboutir au partage de la perception et de la compréhension de problèmes complexes.

DOIT-ON LUTTER À TOUT PRIX POUR L'INNOVATION OU TOUT SIMPLEMENT BIEN DIRIGER LES PROJETS?

Pertti Lahdenperä, Lauri Koskela et Veli-Pekka Tanhuanpää (page 333)

Le type d'innovation le plus important - du point de vie de la maîtrise d'ouvrage - est probablement l'amélioration des processus. Cette constatation est due à l'énorme potentiel d'améliorations possibles à l'intérieur du processus de construction et par conséquent à l'intérieur de l'environnement organisationnel qui stimule l'innovation. Les auteurs examinent ces concepts en s'appuyant sur une étude de cas. Ils présentent le processus de construction d'un immeuble à bureaux et les données employées pour étudier - à l'aide de divers calculs - le

potentiel d'améliorations du processus de construction. Enfin, ils tirent des conclusions et font des recommandations pour le maître d'ouvrage qui doit organiser un projet de construction.

SÉLECTION D'UN MODE DE MAÎTRISE D'OUVRAGE POUR DES BÂTIMENTS HOSPITALIERS ÉQUIPÉS DE SERVICES SOPHISTIQUÉS

K.C. Lam, A.G.F. Gibb et W.D. Sher (page 345)

La maîtrise d'ouvrage des bâtiments hopsitaliers qui sont complexes et nécessitent des services sophistiqués entraîne toujours des problèmes coûteux et difficiles dus à une mauvaise coordination des services du bâtiment et des services techniques du milieu hospitalier. Ces problèmes portent préjudice au succès des projets hospitaliers et doivent être résolus par une gestion rationnelle et professionnelle depuis la phase de design jusqu'à celle de la construction. Un design détaillé est d'une importance cruciale, mais il ne peut pas résoudre complètement les problèmes dus à un manque de coordination. Les questions relatives aux intentions du client, aux conditions d'engagement des designers et des entrepreneurs, à la répartition des responsabilités, au partage des risques et à l'incorporation des entrepreneurs fournissant des services spécialisés, en un mot tout doit être considéré dès le début du projet à la même époque que le choix du mode de maîtrise d'ouvrage et de la forme du contrat. Les résultats des recherches indiquent qu'il n'y a pas de solution standard ni même un choix meilleur qu'un autre parmi les différentes méthodes de maîtrise d'ouvrage. L'emploi d'une stratégie de maîtrise d'ouvrage appropriée a une portée directe sur le succès d'un projet nécessitant des services complexes, mais la prise de décision concernant ce choix est toujours difficile.

MAÎTRISE D'OUVRAGE DE BÂTIMENTS NÉCESITANT DES SERVICES COMPLEXES: ASSURANCE DE LA QUALITÉ ET DE LA FAISABILITÉ DE LA CONSTRUCTION

K.C. Lam, A.G.F. Gibb et W.D. Sher (page 357)

La maîtrise d'ouvrage pour des bâtiments qui nécessitent des services complexes est une tâche énorme pour l'industrie de la construction moderne. Designers et entrepreneurs doivent satisfaire les exigences de leurs clients et produire des bâtiments d'excellente qualité qui correspondent à l'optimisation des ressources. Pour atteindre cet objectif, les professionnels de la construction devraient envisager le choix d'une stratégie de maîtrise d'ouvrage basée sur la gestion de la qualité totale afin d'arriver au niveau de qualité requis. Les auteurs discutent l'importance de considérer la relation entre l'assurance de la qualité et la faisabilité de la construction au cours de la planification conceptuelle du design et de la construction des bâtiments nécessitant des services complexes. De plus, ils proposent un modèle mettant en rapport qualité et maîtrise d'ouvrage qui permet de choisir une stratégie qui repose sur le concept de la qualité totale.

UNE APPROCHE INNOVATIVE POUR UNE RÉDACTION INTELLIGENTE DES CONTRATS DE CONSTRUCTION

Emel Laptali et Peter Hibberd (page 369)

L'objectif du projet de recherche des auteurs est de stimuler l'innovation dans le processus de formulation des contrats afin d'améliorer l'efficience et l'efficacité au cours du processus de construction en tenant compte des objectifs du maître d'ouvrage. Cette recherche inclut la présentation d'un environnement propice à la rédaction des contrats qui fournit des solutions sur mesure à partir d'éléments de texte normalisés pour réduire les problèmes et améliorer les communications concernant les problèmes clés. Les objectifs de la démarche ont été établis à partir d'un examen des concepts à la base du nouveau contrat d'ingénierie (New Engineering Contract) et du développement de la base de connaissances du projet 'INCA'. Cet article discute d'une part la logique de la méthode innovatrice proposée et d'autre part la méthodologie nécessaire pour la réalisation d'un projet.

FAISABILITÉ DE L'ANALYSE DES DÉFAUTS ET DE LEURS CONSÉQUENCES DANS L'INDUSTRIE DU REVÊTEMENT

Jeremy P. Layzell et Stephen Ledbetter (page 375)

Dans l'industrie de la construction, le processus de maîtrise d'ouvrage n'est pas aussi bien développé que dans d'autres industries, comme par exemple l'industrie automobile. Le processus de maîtrise d'ouvrage implique de longues chaînes de fournitures qui relèvent des industries manufacturières, et l'entrepreneur est rarement conscient des décisions qui ont été prises concernant le choix des composants et des matériaux. À l'inverse, des décisions peuvent être prises dans des entreprises manufacturières par des gens qui n'ont aucune idée de l'utilisation ultime du produit dans un bâtiment donné. Cet article étudie la faisabilité d'implanter l'analyse des défauts et de leurs conséquences dans l'industrie du revêtement. Cette technique est couramment utilisée dans l'industrie de l'automobile et dans l'industrie de l'aérospatiale. Elle vise à identifier les effets de toutes les décisions aux étapes de sélection, de design et de rédaction de devis; elle oblige le décideur à évaluer l'impact des défauts en termes de coûts, d'interruption de la production etc.

Les auteurs décrivent l'étude d'une chaîne de fourniture d'enveloppes du bâtiment et montrent la structure des communications nécessaires pour informer les décideurs à toutes les phases du processus. L'accès à toutes les informations et à toutes les connaissances disponibles sur le projet est la condition essentielle du succès de l'application de la technique. C'est seulement dans ces conditions que des décisions fermes et bien informées peuvent être prises quant au choix et à la description des composants. Cette approche nécessite non seulement un apport vertical des connaissances mais aussi des communications horizontales concernant la compatibilité des composants. En conclusion les auteurs indiquent qu'une forme simple de la méthode est applicable et qu'elle mènerait à une réduction des coûts dus au réusinage, aux retards et à l'obsolescence prématurée des façades.

L'IMPLICATION DES MAITRES D'OUVRAGE AUSTRALIENS DANS LE PROCESSUS DE LA MAÎTRISE D'OUVRAGE

Dennis Lenard et Anthony Sidwell (page 385)

Le haut niveau d'activité durant le boom de la construction des années '80 a eu une grande influence sur les investissements des maîtres d'ouvrage en Australie. Des études ont montré que la construction était d'environ 20 à 30% plus coûteuse et prenait prenait plus de temps que dans certains autres pays; cette situation incita les maîtres d'ouvrage à investir ailleurs. Au début des années '90, la New South Wales Royal Commission into the Building Industry mit en lumière l'incurie de l'industrie de la construction, et la Construction Industry Development Agency encouragea des réformes. Parmi les résultats tangibles, il faut mentionner le développement de nouvelles procédures de maîtrise d'ouvrage, surtout dans le secteur public dont les responsables ont regroupé leur pouvoir d'achat et développé des approches mieux structurées, et en particulier les exigences de préqualification. Cependant, une enquête récente sur l'attitude des maîtres d'ouvrage faite par le Construction Industry Institute Australia (CIIA) revèle que peu d'entre eux sont intéressés à s'impliquer dans la démarche de la maîtrise d'ouvrage, s'attendant plutôt à ce que l'industrie de la construction s'occupe elle-même de ses propres innovations et de son développement et fasse jouer la concurrence pour choisir le soumissionnaire le plus efficace. Une analyse récente faite par McKinsey & Co a catalogué l'industrie de la construction australienne comme l'une des plus efficaces dans le monde; par contre, les recherches par le CIIA en ce qui concerne l'innovation dans la construction révèlent que la structure de l'industrie réfrène toute innovation réelle et que les gains de productivité récents risquent d'être éphémères.

COMBINAISON D'UN SYSTÈME EXPERT DE RÈGLES ET D'UN RÉSEAU NEURONIQUE ARTIFICIEL POUR ESTIMER LA MAJORATION POSSIBLE LORS D'UNE SOUMISSION

H. Li et P.E.D. Love (page 395)

Cet article présente une nouvelle approche pour évaluer le pourcentage de majoration de l'entrepreneur lors de l'estimation d'un projet de construction. Il s'agit d'un système d'aide à la décision appelé InMES (Integrated Mark-up Estimation System) qui comprend un système expert contrôlant les règles de majoration et un système expert de réseau neuronique artificiel (Artificial Neural Network-based Expert System - ANNES).

Une méthode d'identification des règles a été développée pour générer les règles du réseau ANN. En utilisant les explications insérées dans le système expert renfermant les règles, le system InMES offre aux usagers des clarifications nettes pour justifier les raisons de la majoration estimée. Des données sur les coûts obtenues à partir de soumissions d'un entrepreneur 'gagnant' ont été employées pour 'former' le système ANN et, conjointement avec le système expert de règles, pour déterminer la majoration à laquelle on pourrait s'attendre pour un projet particulier. La combinaison des deux systèmes permet de tirer profit de chacun d'eux. En particulier elle facilite la compréhension du pourquoi et du comment la majoration est estimée; de

plus elle permet de justifier les effets des règles et les contraintes sur l'estimation de la majoration par l'entreprise.

Les auteurs suggèrent que le système InMES proposé pourrait aider les entrepreneurs à préparer un pourcentage de majoration rationnel pour leurs projets. Ce système pourrait aussi les aider à prendre des décisions concernant la soumission, autrement dit à décider s'ils veulent ou non faire une proposition compte tenu de la majoration qu'ils ont estimée avec le système.

FOURNITURE DES SERVICES DE DESIGN POUR DES PROJETS DE CONCEPTION-CONSTRUCTION

Y.Y. Ling (page 405)

Dans le cas des projets de conception-construction, l'entrepreneur a essentiellement deux possibilités pour remplir les tâches de design: soit l'emploi de designers à l'intérieur de sa propre entreprise soit l'emploi de consultants externes. Les inconvénients de la première solution sont les suivants: la 'prolétarisation' des professionnels, le coût élevé des frais généraux, et un certain manque de versatilité, de créativité, d'originalité, de compétence et de flexibilité. Par contre cette approche 'interne' assure une meilleure intégration et de meilleures communications. Par ailleurs les principaux avantages de l'emploi de consultants externes sont: l'attrait de contrats mutuels et l'amélioration de la qualité du design. Néanmoins cette approche comporte des inconvénients, à savoir: des relations de travail plus distantes, des difficultés pour contrôler et motiver les designers, une certaine faiblesse des liens de communication et des problèmes de coordination. Deux études de cas montrent que le manque ou le maintien de professionalisme dépend des qualités de l'entrepreneur en tant que leader, de ses compétences en matière de projets de conception-construction et du nombre de designers à l'intérieur de sa firme, et qu'en fait le problème ne repose pas sur la question de savoir si l'entrepreneur doit employer des designers à l'intérieur de sa firme ou des consultants externes pour réaliser un projet.

LA GESTION DE LA VALEUR: UN MODÈLE POUR L'APPLICATION D'UNE ANALYSE CONJOINTE

Anita M.M. Liu (page 413)

Le souci du maître d'ouvrage est toujours d'optimiser les ressources investies dans le projet ou dans les services que le projet fournira en fin de compte. Cet objectif s'exprime souvent dans les paramètres du projet, à savoir la date de l'achèvement, le prix et la qualité du produit. Ces trois paramètres sont interdépendants et les décisions qu'ils impliquent sont prises à différentes étapes du projet. L'auteur propose un modèle de décision qui inclut le concept de l'analyse de la valeur dans le processus de maîtrise d'ouvrage. L'analyse conjointe - une technique qui se réfère à plusieurs critères de décision convergeant en un point idéal du modèle pour représenter la solution idéale/préférée dans un espace multidimensionnel - est utilisée pour démontrer l'application de l'analyse de la valeur aux différentes phases de la prise de décisions

(préliminaires, partielles et finales) du modèle de décision proposé.

VERS UN PROCESSUS INNOVATEUR DE LA MAÎTRISE D'OUVRAGE EN CONSTRUCTION

P.E.D. Love, M. Skitmore et H. Li (page 423)

L'approche fragmentaire avec laquelle on aborde tradionnellement le processus de maîtrise d'ouvrage en construction est un point faible qui fait bien souvent l'objet de reproches. Cet inconvénient affecte l'efficacité des projets étant donné que les pratiques courantes de maîtrise d'ouvrage n'encouragent pas réellement l'intégration, la coordination et la communication entre les participants. De plus, il s'agit d'un groupe de participants changeant et éphémère dont les buts et les objectifs sont souvent divergents. Cette situation ne laisse aucune place à la créativité et à l'innovation au cours du processus de maîtrise d'ouvrage.

Pour surmonter ces difficultés, les praticiens et les chercheurs se sont tournés vers l'industrie manufacturière afin d'y trouver des points de repère et une source potentielle d'innovation. En conséquence, un nouveau concept connu sous le nom de 'Ingénierie concourente' (IC) a servi de point de départ à la recherche. Il s'agit d'une approche holistique applicable au design, au développement et à la production d'un produit. Une équipe multi-disciplinaire est requise, et tous les participants sont regroupés dès la phase de design afin d'identifier les questions qui pourraient surgir en aval suite aux décisions prises lors du design. Cet article suggère que la méthode IC pourrait améliorer la maîtrise d'ouvrage en construction. Un modèle simple illustre comment la méthode IC peut accroître l'efficacité d'un projet de construction.

LA PASSATION COMPÉTITIVE DES MARCHÉS: ÉTUDE ET ANALYSE DE TRAVAUX PUBLICS EN SUÈDE

A.S. Mériaux (page 433)

La concurrence est considérée comme une condition importante pour le bon développement du secteur des travaux publics. Les règles officielles du système s'efforcent d'assurer cette concurrence. Cependant, la législation semble entraver les innovations lors des contrats traditionnels. C'est pourquoi il est nécessaire de développer et de tester de nouvelles formes de contrat. Pour évaluer ces nouvelles formes de contrat, il est nécessaire de clarifier l'état actuel de la concurrence.

Cet article présente une étude basée sur environ 300 projets (sur un total d'environ 1000 cas) réalisés de janvier 1994 à juin 1996. Sur 150 entreprises qui ont déposé des soumissions, 70 ont obtenu des commandes. En Suède, où 85% du marché est contrôlé par cinq entreprises, le nombre moyen de soumissions s'élevait à 7 mais ces soumissions présentaient de grandes variations de prix. Dans la plupart des cas, l'entreprise qui a offert la proposition la moins chère a été retenue, et ce n'est que dans quelques cas que des offres plus coûteuses mais de meilleure qualité ont été retenues.

LES STRATÉGIES DE MAÎTRISE D'OUVRAGE QUI ENCOURAGENT L'INNOVATION: L'ÉLÉMENT FONDAMENTAL DES SYSTÈMES D'INFRASTRUCTURE DURABLES DANS LE SECTEUR PUBLIC

John B. Miller (page 443)

L'efficacité et l'efficience des systèmes et des services d'infrastructure du secteur public déterminent souvent la performance économique et la qualité de vie dans une région. Ces systèmes satisfont des besoins humains essentiels tels que l'eau, le traitement de l'eau, l'énergie et l'habitat; de plus ils facilitent la circulation des personnes, des informations et des biens. Néanmoins, l'investissement public dans les infrastructures ne représente qu'une infime fraction du PIB et ne sera jamais plus qu'un signe stratégique de la part du gouvernement quant à l'orientation, les besoins et les exigences de la Société. Les stratégies de maîtrise d'ouvrage du gouvernement sont critiques lorsque celui-ci définit les modalités dans lesquelles les investissements publics et privés, les ressources, le talent et l'énergie s'appliquent aux services d'infrastructure. Les stratégies de maîtrise d'ouvrage qui encouragent l'innovation dans ce domaine particulier constituent une condition préalable indispensable pour assurer d'une façon durable, la livraison de services en continuel développement, et en retour, éventuellement, un accroissement de la performance économique régionale. Une description de projets choisis aux États-Unis, à Hong-Kong et au Canada est présentée afin de montrer comment les stratégies de maîtrise d'ouvrage peuvent façonner l'innovation pour assurer l'approvisionnement des infrastructures publiques. Des recommandations générales et une structure plus flexible d'encadrement pour la livraison et le financement sont proposées.

LA MÉTHODE CONCEPTION-CONSTRUCTION - UN APERÇU DE CETTE MÉTHODE À HONG KONG

Julie K.W. Mo et Lai-Yin Ng (page 453)

Dans la ville de Hong Kong, l'économie grandissante a eu un impact considérable sur les travaux de construction et d'infrastructure en terme de la demande à la fois de la quantité et de la qualité. Un grand nombre de projets récents ont impliqué des participants du monde entier, aussi bien dans des équipes de design que dans des équipes d'entrepreneurs ou de maîtres d'ouvrage. La complexité croissante des projets de construction et les exigences de plus en plus grandes en ce qui concerne les délais, les coûts et la qualité de la part d'une clientèle aux goûts plus raffinés ont incité à faire appel à des méthodes de maîtrise d'ouvrage plus innovatrices. Bien que la forme traditionnelle de maîtrise d'ouvrage prédomine encore, d'autres méthodes telles que l'approche conception-construction et la gérance de construction, sont devenues de plus en plus fréquentes durant la dernière décennie.

Les opinions des professionnels divergent sur l'à-propos de la méthode conception-construction malgré l'avantage indéniable de l'intégration du design et de la construction que cette méthode peut offrir. Pourtant, avec les changements de la demande et des tendances de

l'industrie, on se demande si les professionnels locaux veulent vraiment donner une nouvelle image à cette méthode. Cet article cherche à présenter une analyse comparative des opinions des architectes et des entrepreneurs de Hong Kong sur l'emploi de la méthode conception-construction. Par le biais de cette étude, l'auteur espère qu'on pourra mieux apprécier la pertinence de cette méthode pour l'acquisition des projets de construction à Hong Kong.

LES MOTIVATIONS DU MAITRE D'OUVRAGE ET LA STRUCTURE DU PROCESSUS DE MAÎTRISE D'OUVRAGE DANS LE DOMAINE DE LA CONSTRUCTION

R.A. Mohsini et C.H. Davidson (page 463)

Une étude de la littérature sur la maîtrise d'ouvrage fait ressortir la relation causale qui existe entre le maître d'ouvrage, source de toutes les décisions stratégiques (autrement dit, le côté de l'acheteur) et l'industrie de la construction avec sa structure et son fonctionnement (autrement dit le côté de la livraison de la marchandise). De plus, la réponse de cette industrie en termes de performance, d'efficacité, de technologie et de tous les autres attributs du produit est considérée comme étant directement dépendante de la façon dont le maître d'ouvrage organise les paramètres stratégiques. La responsabilité du succès ou le fardeau de l'échec d'un projet et de plus l'efficacité et la productivité de l'industrie de la construction toute entière semblent reposer sur les décisions du maître d'ouvrage. Quant au côté responsable de la livraison du produit, il est dépeint comme un groupe réactionnaire, prenant exemple sur le groupe responsable de la maîtrise d'ouvrage car il insiste sur le fait que les maîtres d'ouvrage restent toujours des décideurs stratégiques dans le processus de construction.

Cependant les motivations des maîtres d'ouvrage ont évolué d'une façon significative depuis les années '70. La croissance rapide de la technologie, associée en contrepartie à des effets d'obsolescence et les conséquences de ces effets sur les intentions des maîtres d'ouvrage, ont poussé ces derniers à évaluer leurs décisions par rapport à la contribution de ces facteurs pour leurs propres affaires. Dans ce nouvel environnement, où les bâtiments sont considérés comme un moyen et rarement comme une fin en soi, les maîtres d'ouvrage sont de plus en plus réticents à devenir des partenaires influents dans le processus de construction. La relation causale traditionnelle entre la maîtrise d'ouvrage et le côté responsable de la livraison, surtout en ce qui concerne l'innovation, l'efficacité et la productivité, disparaît rapidement. La charge de faire progresser rapidement et continuellement l'innovation, d'identifier une demande sans cesse changeante et de délivrer des produits appropriés est rapidement déplacée vers le côté de l'industrie responsable de la livraison du produit fini.

AMÉLIORATION DE LA MAÎTRISE D'OUVRAGE ET INNOVATION: LE CAS DES SERVICES DE SANTÉ PUBLIQUE

Krisen Moodley, Christopher Preece et Roy Woodhead (page 473)

Depuis 1979, le Royaume-uni a été gouverné par le parti conservateur, et la lutte pour

l'efficience, l'utilisation du marché comme régulateur du monde des affaires et la réduction des dépenses publiques sont devenues le fondement de l'idéologie politique du gouvernement. Les services de santé publique, anges gardiens de la médecine universelle, n'ont pas échappé à cet idéal, et ils ont été affectés par des restructurations majeures qui ont eu une sérieuse influence sur le programme de développement d'un des plus grands clients en matière de construction publique.

Cet article donne un aperçu de certaines expériences et de certaines questions qui sont survenues au cours de cette période de restructuration des services de santé publique. Les auteurs soulignent particulièrement les facteurs qui ont influencé l'avenir des projets et les leçons qui ont pu être utilisées par les maîtres d'ouvrage au cours du processus. Ils examinent également les changements apportés au processus de maîtrise d'ouvrage pour répondre à la nouvelle structure de l'organisation et à l'introduction de principes commerciaux dans les services du secteur public. En conclusion les auteurs indiquent comment un maître d'ouvrage important a adapté sa structure organisationnelle aux changements, aux pressions politiques extérieures et à une demande plus commerciale.

LA MAÎTRISE D'OUVRAGE ET L'INITIATIVE DE FINANCEMENT PRIVÉ

Hugh Mulcahy et Robert Scott (page 483)

En matière de maîtrise d'ouvrage, l'initiative de financement privé ('Private Finance Initiative - PFI') prônée par le gouvernement britannique, n'est pas indépendante de toute stratégie de maîtrise d'ouvrage. Les concepts qui sous-tendent cette approche, en effet, ont entraîné une dissociation entre celui qui possède le bâtiment (le propriétaire) et celui qui se procure les commodités du bâtiment (le gouvernement-locataire).

Traditionnellement, lorsqu'un ministère du gouvernement voulait acquérir des bâtiments pour son propre usage soit il passait un contrat de location avec un promoteur immobilier, soit il achetait un site et employait une équipe professionnelle et un entrpreneur pour construire le bâtiment, mais l'insuffisance des capitaux étouffait l'innovation.

Avec l'initiative de financement privé, le gouvernement n'a plus vraiment d'intérêt dans l'immobilier. En effet, il se procure un ensemble de facilités en échange d'un certain paiement au cours de la durée du contrat. Toutes les responsabilités et tous les risques associés à la possession d'un bâtiment reposent sur celui qui fournit les facilités en question. L'emphase mise sur la fourniture de tous les services et l'optimisation des ressources pendant la période du contrat encourage le fournisseur à considérer la solution la plus efficace en matière de coût pendant toute la durée des liens contractuels. Par exemple, une approche innovatrice à l'égard de l'utilisation de l'énergie pourra nécessiter un plus grand déboursement de capital initial mais permettra de faire des économies à long terme grâce à une plus grande efficacité. Ainsi cette approche innovatrice sera le résultat de la stratégie de maîtrise d'ouvrage caractérisée par l'initiative de financement privé.

PERSPECTIVE DE COOPÉRATION DES MAÎTRES D'OUVRAGE AVEC DES ENTREPRENEURS/CONCEPTEURS À L'ÉCHELLE INTERNATIONALE

Donald E. Mulligan et Moawia E. Abdelkarim (page 493)

On a coutume de croire que les stratégies adoptées par les grands maîtres d'ouvrage œuvrant à l'échelle mondiale affectent directement l'innovation recherchée par les divers participants du processus de construction. Cet article découle d'une recherche indépendante entreprise pour décrire une ou plusieurs études de cas afin de clarifier une stratégie de maîtrise d'ouvrage qui encouragerait l'innovation au cours du processus de construction.

Les auteurs examinent les stratégies de trois grands maîtres d'ouvrage américains. Ceux-ci ont été impliqués intensivement dans des projets de construction mondiaux pendant plusieurs années durant lesquelles chacun d'entre eux a réussi à bâtir une myriade de relations (ententes, co-entreprises, partenariats, etc.) avec plusieurs firmes étrangères. De plus, ces entreprises américaines ont eu l'occasion d'explorer de nombreuses stratégies de maîtrise d'ouvrage dont certaines fonctionnent bien dans certaines régions du monde mais absolument pas dans d'autres.

Il y a des maîtres d'ouvrage qui choisissent de garder la responsabilité du design dans leur propre entreprise. D'autres ont l'impression qu'il est préférable d'engager un organisme qui n'a pas de connection avec le maître d'ouvrage pour pouvoir faire du projet un objet de créativité. Les auteurs considèrent que les facteurs les plus important lors du choix décisif d'une stratégie de maîtrise d'ouvrage dépendent de la culture de l'entreprise et du pays dans lequel le projet sera construit. Les maîtres d'ouvrage qui s'impliquent réellement dans leurs projets et qui sont conscients de la façon de faire des affaires dans un pays étranger doivent transmettre ce savoir-faire aux entrepreneurs, aux designers et aux fournisseurs.

UN EXAMEN DES DÉCISIONS DE L'INDUSTRIE MANUFACTURIÈRE CONCERNANT L'INVESTISSEMENT DANS DE NOUVEAUX BÂTIMENTS

Ian J. Murdoch (page 501)

Cet article cherche à identifier les différents modes de comportement à l'égard de l'investissement dans les bâtiments par l'industrie manufacturière en faisant une classification selon les catégories industrielles, les établissements et/ou les entreprises. Il cherche d'une part à différencier les différents secteurs manufacturiers en fonction de leur tendance à investir dans de nouveaux bâtiments et dd'autre part à déterminer si les entreprises investissent dans l'espoir de profits (selon le modèle néo-classique) ou à investir à partir de réserves provenant de profits antérieurs (selon le modèle réaliste) ou si les dépenses d'investissement sont une fonction de la profitabilité ou du taux de changement de profitabilité. Cet article explore également si la menace de la concurrence est une motivation pour envisager l'investissement et s'il y a eu des changements d'orientation des dépenses de capital pour l'équipement de production plutôt que pour l'investissement dans les bâtiments. Cette étude voudrait d'une part développer des modèles plus perfectionnés sur les comportements favorables à l'investissement plutôt que de simples modèles de la demande, et d'autre part examiner les vrais motifs sous-jacents qui inci-

tent à investir dans la construction (en utilisant les données empiriques récentes) et par conséquent donner une meilleure connaissance des conditions du marché aux professionnels de la construction.

CRÉATION D'UN ENVIRONNEMENT D'APPRENTISSAGE SUR CHANTIER - UNE APPROCHE BASÉE SUR LA FORMATION CONTINUE

Peter Murray et Ross Chapman (page 511)

L'apprentissage devient de plus en plus un facteur clé dans les entreprises qui s'efforcent de tirer profit du meilleur de la pratique professionnelle et des avantages de la concurrence. Dans l'industrie de la construction des Nouvelles Galles du Sud, cependant, les efforts dans ce sens ne sont pas intégrés dans la pratique courante, et de nombreuses firmes placent les exigences à court terme du projet avant toute tentative pour accroître la productivité par le biais de l'apprentissage. Et pourtant, les avantages que tirent les entreprises qui créent un environnement favorable à l'apprentissage sont évidents, surtout si cette approche est basée sur le développement continuel du progrès culturel.

Cet article examine la façon dont une entreprise a relevé le défi en créant un système d'apprentissage sur chantier. Utilisant la méthode des études de cas, les auteurs étudient comment les gestionnaires ont été incités à considérer la formation continue comme une condition essentielle pour accroître la productivité, et à perfectionner le niveau de compétence de l'ouvrier sur le site même du chantier. Selon les auteurs, les gestionnaires qui reconnaissent les caractéristiques clés de l'apprentissage sont mieux placés pour les harmoniser avec les capacités intrinsèques de la firme et le comportement organisationnel qui sont indispensables pour améliorer continuellement le milieu du travail.

LES VOIES DE LA MAÎTRISE D'OUVRAGE - UNE PERSPECTIVE POLITICO-CULTURELLE

Robert Newcombe (page 523)

Cet article porte sur l'usage et l'abus de pouvoir dans certains cheminements de maîtrise d'ouvrage. L'auteur élargit la perspective théorique et présente une vue plus holistique des projets en se plaçant sur le plan culturel et politique. Selon l'argument principal proposé, la culture agit comme une force centripète sur les projets tandis que la politique peut être considérée comme une force centrifuge. Culture et politique ont des effets positifs et négatifs, et le rôle du gestionnaire de projets est d'arriver à un juste équilibre des forces conflictuelles en établissant et en maintenant un système 'd'équilibre dynamique'. L'établissement d'un tel système est probablement plus facile si l'on utilise la voie de la gestion de la construction que lorsque l'on emploie la méthode traditionnelle de design-appel d'offres-construction. L'inno-vation peut être réprimée ou encouragée si le projet a une culture solide; quant à la politique, elle est généralement une force en faveur de l'innovation.

CO-ENTREPRISES DE CONSTRUCTION À HONG KONG

Lai Yin Ng (page 535)

La construction massive du métro dans les années '70 a été le point de départ des co-entreprises dans le domaine de la construction à Hong Kong, mais après son achèvement, le nombre de co-entreprises a baissé d'une façon significative. Néanmoins dans les années '90, la tendance a repris à cause de la construction du nouvel aéroport de Hong Kong. Une étude récente indique que la co-entreprise est rare pour les projets de bâtiments publics et privés, mais qu'elle est beaucoup plus répandue pour les travaux de génie civil, et en particulier pour les travaux associés à l'aéroport proprement dit, connu sous le nom de Airport Core Program (ACP). La majorité des contrats ACP ont été adjugés à des co-entreprises du fait des risques financiers élevés dus à la grandeur des contrats et aux avantages concurrentiels résultant de l'amalgame des ressources. Étant donné que Hong Kong est en pleine période de développement de ses infrastructures, il est tout à fait à propos d'étudier l'application actuelle de la co-entreprise dans le domaine de la construction à Hong Kong et d'examiner son potentiel de développement dans l'immédiat. Une étude de cas reposant sur un des projets ACP a été choisie pour illustrer les causes et les avantages de la co-entreprise. Les problèmes inhérents à ce type de projet de même que les facteurs de succès sont également discutés dans cette étude de cas.

LA MÉTHODE CONCEPTION-CONSTRUCTION POUR UN HÔPITAL: UNE ÉTUDE DE CAS À HONG KONG

Lai Yin Ng et Julie K.W. Mo (page 545)

Les projets d'hôpitaux ont longtemps été construits à Hong Kong selon la méthode traditionnelle de maîtrise d'ouvrage. Récemment, cependant, les responsables des établissements hospitaliers de Hong Kong ont commencé à se démarquer de la norme pour la construction d'un hôpital au nord de la ville (North District Hospital) en utilisant la méthode de maîtrise d'ouvrage conception-construction. Cette méthode employée aux États-unis et dans le Royaume-uni pour des bâtiments hospitaliers est considérée comme un choix 'dans le vent'. Cet enthousiasme est peut-être dû à la nature des projets hospitaliers qui sont toujours considérables en termes de temps et de coûts. Techniquement les hôpitaux sont généralement très complexes et de ce fait la méthode conception-construction permet la flexibilité et la diversité dans le processus de design et de construction. Le premier hôpital construit à Hong Kong en utilisant la méthode conception-construction a soulevé un très grand intérêt mais beaucoup de questions. Cet article cherche à répondre à ces questions et à attirer l'attention sur l'application de la méthode conception-construction pour les établissements hospitaliers de Hong Kong.

L'INFLUENCE DE LA CULTURE SUR LA MAÎTRISE D'OUVRAGE DANS LA CONSTRUCTION

A.B.Ngowi (page 555)

L'application de la technologie de l'information trouve constamment sa place dans l'industrie de la construction et entraîne une utilisation de nouveaux systèmes de maîtrise d'ouvrage fondés sur l'hypothèse que le système de maîtrise d'ouvrage traditionnel est désuet et incapable de faire face à la complexité des nouvelles demandes. Cependant, les nouveaux systèmes sont souvent caducs parce que dans la plupart des cas, ils ne tiennent pas compte du contexte culturel des intéressés (clients, designers, membres de l'équipe de construction et le public en général).

Une enquête menée dans l'états membres de la Communauté de développement de l'Afrique du Sud a montré que les résultats d'un système de maîtrise d'ouvrage employé pour des projets dans lesquels les intéressés avaient des milieux culturels similaires, étaient différents des résultats obtenus dans les cas où les intéressés provenaient de milieux culturels différents. L'auteur considère que les aspects techniques des systèmes de maîtrise d'ouvrage dans le domaine de la construction ne peuvent pas assurer le succès du processus et il conclut en soulignant que l'innovation dans ces systèmes devrait également prendre en considération la culture des intéressés.

AMÉLIORATION DE LA PRODUCTIVITÉ DANS LE DOMAINE DE LA CONSTRUCTION À SINGAPOUR: LES CLAUSES CONTRACTUELLES ET LA MAÎTRISE D'OUVRAGE

George Ofori et Philip Chan (page 565)

Singapour, qui fait face à un manque crucial d'ouvriers, apporte beaucoup d'attention à la formulation et à l'application de programmes qui visent à accroître la productivité de la construction, et par conséquent à réduire le nombre d'ouvriers pour réaliser les projets nécessaires au développement du pays.Ce besoin d'accroître le niveau de productivité de la construction à Singapour s'est focalisé sur la création de mesures d'incitations, d'informations et de conseils aux entrepreneurs pour qu'ils adoptent des techniques et des équipements appropriés pour leurs projets. Des efforts ont également été faits pour promouvoir l'utilisation de designs standard et de composants préfabriqués. Ainsi, cette emphase sur l'accroissement de la productivité de la construction s'est concentrée sur l'aspect économique et technologique de la productivité et sur les mesures que les entrepreneurs devraient prendre.

Les auteurs étudient le rôle que les clients du secteur public et du secteur privé peuvent jouer pour augmenter la productivité à Singapour. Ils discutent aussi comment les clients peuvent contribuer à cet effort national lorsqu'ils choisissent un mode de maîtrise d'ouvrage dans la pratique courante. De plus, ils insistent sur les implications des clauses incluses dans les formulaires standard du contrat de construction en usage à Singapour, toujours dans le but d'accroître la productivité dans la construction. Ils soutiennent cependant, que, même si la ré-

daction appropriée de certaines clauses spécifiquement pertinentes dans les documents de contrat pourrait mener au succès des incitations à la productivité, il est fort probable que cette mesure modifierait la répartition des risques dans le contrat de construction. Il serait donc nécessaire de prévoir de nouveaux arrangements contractuels pour une meilleure adaptation à ce changement.

UNE RÉPONSE AUX CHANGEMENTS DU MARCHÉ: MAÎTRISE D'OUVRAGE ET GESTION DE PROJETS RÉSIDENTIELS DANS LE SECTEUR PRIVÉ À SINGAPOUR

George Ofori, Christopher Leong et Teo Pin (page 575)

Depuis la fin des années '80, les prix de l'immobilier ont augmenté d'une façon significative à Singapour - surtout dans le cas des unités résidentielles du secteur privé. Les acheteurs/ consommateurs sont mieux informés et plus clairvoyants. Parmi les objectifs des clients, ce sont les délais et la qualité de la construction plutôt que les coûts qui retiennent l'attention des promoteurs privés. Cette attitude a radicalement modifié les préoccupations antérieures qui portaient généralement sur la minimisation des coûts et en particulier sur le coût initial de construction. Avec les changements des divers aspects du marché de l'immobilier, on apporte plus de soin non seulement à la surveillance et à la supervision de la construction sur chantier pour assurer un plus haut niveau de qualité de l'ouvrage, mais aussi à la préparation préliminaire du design et aux différentes méthodes de maîtrise d'ouvrage.

Cet article étudie la situation courante de la maîtrise d'ouvrage et de la gestion des projets de construction pour des clients de Singapour en illustrant particulièrement le développement résidentiel privé. Il décrit la nature de la maîtrise d'ouvrage et les stratégies/procédures de la gestion, de même que l'évolution de ces processus et des facteurs critiques qui les ont influencés. Enfin cet article présente les perspectives d'avenir de ces processus et propose des meilleures façons et des meilleurs moyens pour que les firmes puissent s'adapter rapidement aux changements de l'environnement.

LES PIÈGES DE LA MÉTHODE DE MAÎTRISE D'OUVRAGE CONSTRUCTION-FONCTIONNEMENT-TRANSFERT: QUELQUES EXEMPLES DANS LE DOMAINE DES TRANSPORTS THAILANDAIS

Stephen Ogunlana (page 585)

Beaucoup de pays en voie de développement considèrent que le financement privé est la solution pour leurs projets d'infrastructure. C'est pour cette raison qu'ils utilisent de plus en plus différentes formes de l'approche construction-fontionnement-transfert (en anglais: BOT) dans plusieurs pays. Les promoteurs de ces projets ont tendance à concentrer presque exclusivement sur les aspects techniques et commerciaux. Cependant l'expérience de projets dans le domaine des transports en Thailande montre que les prévisions économiques devraient être traitées pour ce qu'elles sont, autrement dit juste des 'prévisions'. La réalité peut être tout à fait différente si

les aspects contractuels des projets sont négligés. Considérer le gouvernement du pays-hôte comme un partenaire est une grande erreur. Si le gouvernement tergiverse ou se montre incapable de livrer ce qu'il a promis à l'une ou l'autre des trois étapes du processus, les concessionnaires se retrouvent avec un projet qui, économiquement, ne peut pas remplir ses promesses. Pire encore, les concessionnaire sont souvent incapables de redresser la situation par un recours juridique.

Dans le cas de la deuxième phase du système routier, la compagnie concessionnaire a réalisé une percée technique d'importance mais un conflit avec les autorités locales a complètement ruiné toutes relations. En ce qui concerne le projet de l'autoroute à péage, le gouvernement a été incapable de remplir ses obligations de contrat rapidement, et de ce fait les concessionnaires ont connu de grandes difficultés. Pour réussir, il faut que les projets 'BOT' dans les pays en voie de développement soient focalisés sur les responsabilités du gouvernement hôte et sur la façon de traiter les carences ou le manque de coopération des gouvernements pour remplir leurs obligations contractuelles.

RELATION ENTRE LES PARTIES INTÉRESSÉES ET LES TECHNIQUES SOPHISTIQUÉES DE MAÎTRISE D'OUVRAGE

Angela Palmer et Denny McGeorge (page 595)

Les techniques modernes de la gestion de la construction prônent une approche holistique pour résoudre les problèmes dus à l'implication des différentes parties intéressées dans un projet donné. Cependant, bien qu'on reconnaisse l'importance de l'application de ces techniques, on ne s'est pas encore penché sur la façon concrète de les mettre en œuvre. En ce qui concerne le partenariat par exemple, on reconnaît le besoin d'inclure tous les participants qui ont un intérêt dans le projet, mais il n'y a aucun moyen pour faire face au fait que les procédures de maîtrise d'ouvrage existantes ne permettent l'engagement et par conséquent la participation des sous-entreprenours que vers la fin du projet. À cette étape, tout avantage qui pourrait éventuellement résulter de ce partenariat est complètement perdu.

Cet article examine le rôle du sous-entrepreneur en tant que partie prenante dans le projet de construction. Il souligne comment les différences de pouvoir qui existent actuellement sont un obstacle au concept de participation des intéressés; des recommandations sont proposées pour que cette barrière puisse éventuellement tomber.

LES IMPLICATIONS DES QUESTIONS ENVIRONNEMENTALES SUR LA MAÎTRISE D'OUVRAGE

Christine L. Pasquire (page 603)

Cet article aborde un certain nombre de notions relatives à l'environnement et à la législation dans ce domaine qui affectent l'industrie de la construction. Ces questions sont regroupées

selon une structure qui les met en relation avec le processus de construction et qui permet de les représenter graphiquement par un modèle de maîtrise d'ouvrage. En conclusion, une solution alternative est proposée; elle met en évidence le besoin de nouvelles recherches.

LES MÉTHODES CONCEPTION-CONSTRUCTION EN FINLANDE

Pirjo Pernu (page 615)

Afin d'employer avec plus d'efficacité non seulement l'expertise technique et financière mais aussi les capacités d'invention de l'industrie de la construction, de grands efforts ont été faits en Finlande pour développer des outils à l'intention des maîtres d'ouvrage pour la réalisation de bâtiments ou autres aménagements. Ces efforts ont été concentrés sur le développement de l'appel d'offres et sur les méthodes de maîtrise d'ouvrage dans le but d'améliorer la productivité à la fois du marché domestique et du marché de l'exportation.

Cette étude vise à aider les maîtres d'ouvrage à utiliser la méthode conception-construction de la façon la plus adéquate pour satisfaire leurs objectis spécifiques. Il y a trois types de méthodes de conception-construction qui diffèrent selon les objectifs ultimes du maître d'ouvrage: (i) le maître d'ouvrage fait jouer la concurrence pour avoir le prix le plus bas, (ii) il met l'emphase sur l'optimisation des ressources financières ou (iii) il vise à atteindre le plus haut niveau de qualité.

Lorsqu'il y a compétition pour le prix, c'est la soumission la plus basse satisfaisant les exigences de qualité, qui sera choisie. Lorsque la soumission correspond à l'optimisation des ressources, la méthode conception-construction est plus difficile parce que le choix doit être basé à la fois sur le prix et sur la qualité de la solution de design selon les principes de l'analyse de la valeur. La troisième méthode qui se réfère à la qualité est considérée comme la meilleure en Finlande. En effet, le prix cible est déjà fixé dans l'appel d'offres et l'évaluation est uniquement basée sur la qualité de la solution de design proposée par le soumissionnaire.

Le grand problème est de développer des documents d'appel d'offres qui soient appropriés et faciles à utiliser pour différents projets de construction et pour différents maîtres d'ouvrage. Une solution consiste à élaborer un modèle de documents qui comprend trois parties. Le programme d'appel d'offres variera en fonction de l'objectif spécifique de l'approche conception-construction adoptée et des conditions de contrat imposées par chaque maître d'ouvrage. Quant aux instructions de design, elles seront préparées séparément pour chaque projet. Cependant la structure et le contenu logique de chaque document seront toujours les mêmes.

GESTION ET DIFFÉRENCES CULTURELLES; L'ÉTUDE DE CAS D'UNE ENTENTE TRANS-ATLANTIQUE DANS LE DOMAINE DE LA CONSTRUCTION

Roberto Pietroforte (page 625)

Des ententes de longue durée sont un outil viable pour les entrepreneurs généraux; elles leur permettent de trouver leur place sur les marchés internationaux et d'accroître l'ampleur de leurs services à la clientèle. Contrairement à ce qu'on a coutume de croire, cette opportunité n'est pas réservée aux grandes firmes comme le montre la stabilité de l'entente qui s'est développée entre une entreprise italienne et une entreprise américaine, toutes deux de taille moyenne.

Cet article illustre les défis que représentent d'une part le développement et la solidité de cette forme de collaboration et d'autre part le type d'efforts de gestion et de ressources qui sont nécessaires dans une telle aventure bi-culturelle. La compréhension du milieu corporatif et du milieu national, la continuité d'un engagement et d'un mode de communication de haut niveau par les gestionnaires, enfin une mentalité de gagnants et une confiance réciproque sont les facteurs d'un véritable succès.

STRATÉGIES DE PRÉQUALIFICATION ET PRÉSENTATIONS EN ÉQUIPE PLUS EFFICACES DANS LES RELATIONS CONTRACTUELLES

Christopher Preece, Krisen Moodley et Tony Putsman (page 633)

Les procédures de pré-qualification sont généralement utilisées pour évaluer les services contractuels qui permettent une concurrence basée en premier lieu sur la réputation de la qualité des services et en second lieu sur le prix. Pour assurer sa réussite, une firme a besoin de communiquer un message clair et persuasif au client et à ses conseillers. Les présentations de pré-qualification permettent aux clients de faire un choix plus éclairé et par conséquent d'ajouter une plus-value au processus de maîtrise d'ouvrage. Des présentations personnelles complétées par des brochures et par une bonne publicité devraient être planifiées et coordonnées pour communiquer un message cohérent. L'objectif est de bien comprendre les exigences du client en matière d'information et de clarifier ses attentes et ses besoins spécifiques.

La promotion des services exige un mode de communication de bonne qualité fondé sur la valeur des services et sur la réputation de succès de la firme. Il est probable que les bonnes occasions ne se concrétisent que par le partage de l'information qui importe aux clients pour leurs projets. L'organisation des équipes de présentation a besoin d'être renforcée par une coopération multi-fonctionnelle pour pouvoir bénéficier des avantages de la concurrence. De plus en plus, les clients cherchent à établir des liens à long terme en s'appuyant sur un partenariat de groupes organisationnels compatibles. Ce besoin nécessite d'apporter plus d'attention aux communications personnelles, aux négociations et aux services aux usagers pour donner toute satisfaction à la clientèle.

Cet article souligne que le processus qui allie intelligence et information est une bonne façon

d'aider les équipes à centrer leurs discours sur les exigences des clients. Il met en évidence le rôle du marketing dans le processus de préqualification, et il identifie les compétences de gestion et les exigences de formation. Il examine la manière d'améliorer l'efficacité de cette étape vitale du marketing des services contractuels. Enfin, une étude de cas décrit brièvement comment un grand entrepreneur en construction du Royaume-uni a essayé d'appliquer une approche plus efficace et mieux ciblée du marketing au cours du processus de pré-qualification.

LES SYSTÈMES DE MAÎTRISE D'OUVRAGE ET LES MESURES ÉCONOMIQUES DE PROTECTION CONTRE L'INCENDIE PENDANT LA CONSTRUCTION

M.C.Puybaraud et R. Barham (page 643)

Les risques d'incendies sont plus grands pendant la construction ou la rénovation des bâtiments parce qu'il y a une grande quantité de produits combustibles en contact avec un grand nombre de sources potentielles d'ignition. Sur un total de 618 incendies au cours de la construction de bâtiments en 1993 dans le Royaume-uni, 50% étaient prémédités ou probablement prémédités. Malgré les assurances, les pertes financières sont considérables et finalement tous ces coûts doivent être supportés par la Société. Bon nombre de ces incendies pourraient être évités, ou tout au moins limités quant aux dégâts si l'on développait et si l'on appliquait des plans de protection préventive et des mesures de gestion de sécurité qui sont en fait strictement imposés dès le début du processus de maîtrise d'ouvrage.

Cet article souligne le besoin d'élaborer des systèmes de gestion de la prévention des incendies pour les grands projets de construction (et même pour tous les projets) afin de réduire les risques de feu et de limiter à un minimum les conséquences qu'il peut entraîner.

CONSÉQUENCES D'UNE MAÎTRISE D'OUVRAGE MAL STRUCTURÉE

Stephen G. Revay (page 655)

L'industrie de la construction est extrêmement fragmentée à la fois sur le plan géographique et au niveau de ses produits. Les participants de l'industrie sont différents les uns des autres par leurs activités, leurs intérêts et leur organisation.

Par conséquent, lorsqu'on essaie de définir ce que représente une maîtrise d'ouvrage mal structurée et ses conséquences les plus probables, aucune réponse simple n'est possible. Néanmoins il faut trouver une solution non seulement pour ceux qui sont directement impliqués dans le processus de construction mais aussi pour sauvegarder les intérêts de ceux qui sont indirectement impliqués qui pourraient également en supporter les conséquences si le projet tournait mal.

Cet article examine les aléas des systèmes de maîtrise d'ouvrage les plus souvent employés en

soulignant les conséquences de leurs défauts potentiels.

LES SYSTÈMES DE MAÎTRISE D'OUVRAGE: UNE VUE DE HONG KONG

Steve Rowlinson (page 665)

L'industrie de la construction de Hong Kong connaît un succès extraordinaire. Un de ses symboles, la Banque de Hong Kong, a montré la voie en construisant des bâtiments qui reflètent l'innovation et la modernité, comme en témoignent à la fois son siège social le plus récent et même le précédent construit en 1935. Hong Kong a également connu un grand succès avec des projets ayant recours à l'approche de maîtrise d'ouvrage 'BOT' (construction-fonctionnement-transfert) et son nouveau projet d'aéroport présente de nouveaux défis qui ont été abordés avec vigueur et détermination.

Derrière ces nouvelles approches se cache une certaine inertie due à l'influence de la tradition dans le domaine de la construction. Pour bien comprendre l'industrie de la construction de Hong Kong, il faut tenir compte du fait que le coût du terrain par rapport à celui de la construction est de 80:20. Ce coût très élevé du terrain donne plus d'importance à la rapidité de la construction qu'à l'innovation, et dans cette situation il faut des moyens testés et même éprouvés pour atteindre un tel objectif. Il ne faudrait pas oublier, cependant, que Hong Kong est le reflet d'un mélange extrêmement intéressant des coutumes de l'Est et de l'Ouest et l'impact de la culture unique de cette ville apparaît clairement dans les projets de construction. L'auteur prend l'exemple du Centre des conventions et des expositions pour illustrer cette influence de la culture sur la construction et sur la performance des projets. En conclusion il propose une discussion concernant l'emprise de la culture sur la gestion des projets.

L'INFLUENCE DES SYSTÈMES DE LIVRAISON ET DES MÉTHODES DE RÉMUNÉRATION SUR LA CONSTRUCTION DES ÉTABLISSEMENTS SCOLAIRES

James R. Sears, Guillermo F. Salazar et Roberto Pietroforte (page 673)

Aux États-unis, les institutions de l'enseignement font face à un arriéré considérable de travaux d'entretien différés et aux défis d'optimiser les rares ressources disponibles. Pour trouver plus facilement des solutions à ces problèmes, cet article présente en premier lieu l'importance relative de 19 objectifs différents de projets de construction. Ensuite, les auteurs explorent l'impact spécifique de divers systèmes de construction et de plusieurs méthodes de rémunération sur les coûts, l'échéancier de la construction, et la performance concernant la qualité de 33 projets de construction scolaire. Des recommandations sont proposées à propos du calendrier des opérations et de l'enchaînement des décisions initiales associées à la distribution des rôles, des responsabilités et des risques supportés par les parties contractantes. Finalement un arbre de décision permettant de sélectionner un système de livraison et une méthode de rémunération est proposé.

APPLICATION DES SYSTÈMES DE QUALITÉ DANS LES PROJETS DE CONSTRUCTION

Alfredo Serpell et Alfredo Sarmiento (page 681)

Les auteurs présentent un résumé des principales caractéristiques, des problèmes, des limites et des avantages du processus d'application des systèmes de qualité basés sur ISO 9000 dans des projets de construction au Chili. À la demande d'un maître d'ouvrage, ce processus d'application fut utilisé par différentes entreprises de construction qui n'avaient aucune expérience antérieure avec les systèmes de qualité ou ISO 9000. Les différentes phases du processus sont décrites. Les caractéristiques particulières et plus générales du processus et les leçons que l'on peut en tirer sont analysées selon l'appréciation de divers participants. Un intérêt particulier est apporté à l'impact que les systèmes de qualité peuvent avoir sur les relations qui se développent entre le maître d'ouvrage et les entrepreneurs. Enfin des recommandations sont proposées pour améliorer le processus d'application des sytèmes de qualité dans les projets de construction et pour leur application éventuelle dans des pays qui ont peu d'expérience de ce domaine.

LE MANQUE DE SENSIBILITÉ AUX PROBLÈMES DES MAÎTRES D'OUVRAGE OCCASIONNELS DANS L'INDUSTRIE DE LA CONSTRUCTION DU ROYAUME-UNI

Asif Sharif et Roy Morledge (page 693)

La plupart des maîtres d'ouvrage de l'industrie de la construction dans le Royaume-uni constituent de petits groupes occasionnels. Même lorsque les maîtres d'ouvrage appartiennent à de grandes corporations, ils sont divisés, régionalisés ou subdivisés de telle sorte qu'ils appartiennent également à ce type de clientèle. Un grand nombre de cadres sont déplacés à l'intérieur de leurs entreprises ou entre plusieurs organisations, et il est peu probable qu'ils aient la possibilité d'acquérir de l'expérience sur les processus associés à la maîtrise d'ouvrage dans le bâtiment.

Les auteurs examinent les problèmes rencontrés par un échantillonage de ce type de clientèle et recherchent s'il existe des mécanismes dans ce secteur pour les résoudre ou tout au moins pour trouver des améliorations stratégiques à long terme. La fréquence des différents types de problèmes et leurs causes sont étudiées; l'implication des maîtres d'ouvrage dans le choix des stratégies et des participants à la phase qui précède la construction ainsi que leur niveau de compréhension du processus de maîtrise d'ouvrage sont analysés. Tout changement dans les relations entre les participants durant le processus de maîtrise d'ouvrage est également pris en considération. En conclusion, les auteurs présentent le type et l'importance des problèmes identifiés par les maîtres d'ouvrage occasionnels et résument les étapes adoptées par ces clients pour trouver des solutions à long terme.

LES STRATÉGIES DE MAÎTRISE D'OUVRAGE - L'INNOVATION ET L'ÉVALUATION DU SUCCÈS D'UN PROJET DE CONSTRUCTION

Adrian J. Smith et Brian Wilkins (page 703)

Jusqu'à quel point le choix de la stratégie de maîtrise d'ouvrage adoptée par le client limite ou encourage l'innovation de la part des autres participants chargés de la livraison d'un projet de construction? De nombreuses causes affectent cette situation. Celles-ci incluent évidemment le type de projet, la localisation, la disponibilité des ressources et les contraintes de temps et de coût, mais le facteur peut-être le plus important est de savoir à quel point le maître d'ouvrage comprend et est capable de communiquer ce qu'il veut réellement, autrement dit à quel point il peut faire une description adéquate de ses intentions. Tous ces facteurs pourraient être exprimés en fonction des risques que toute nouvelle approche fait courir aux différentes parties impliquées et en fonction des pénalités qui surviendront vraisemblablement si les choses ne s'arrangent pas selon les plans. Les auteurs se posent la question de savoir si les méthodes innovatrices sont désirables et si elles doivent être encouragées surtout en ce qui concerne le design, les stratégies de maîtrise d'ouvrage et les méthodes de construction. Toutes ces questions devraient être pondérées par le client à la phase initiale de la préparation du mandat.

Les auteurs essaient d'aborder ces questions en se référant à l'étude de projets réalisés à Hong Kong. Ils examinent la stratégie de maîtrise d'ouvrage employée et le degré d'incorporation des innovations, afin de mettre ces facteurs en parallèle avec le succès du projet. Enfin ils indiquent les facteurs qui semblent critiques lorsque l'innovation est un succès du point de vue du client.

L'ÉQUIPE DE CONSTRUCTION - UNE CLÉ POSSIBLE DE LA MAÎTRISE D'OUVRAGE: ÉVALUATION D'UN 'INVENTAIRE' DE DIVERSES PERCEPTIONS DU MOI DANS LE RÔLE DE L'ÉQUIPE SELON LA MÉTHODE DE BELBIN

James Sommerville et Shirley Dalziel (page 711)

Pour garantir l'introduction de nouvelles formes d'innovation dans la maîtrise d'ouvrage, il est nécessaire de passer en revue les différents processus de sélection conçus pour constituer une équipe multi-disciplinaire. D'autres industries ont entrepris depuis bien longtemps des tests psychométriques pour évaluer les membres éventuels d'une équipe afin de déterminer et d'exploiter le potentiel spécifique de chaque individu.

L'utilisation de l'inventaire des diverses perceptions du moi dans le rôle de l'équipe ('Belbin's Team-Role Self-Perception Inventory') permet d'identifier non seulement le rôle particulier de chaque équipier mais aussi les prédispositions de chaque individu pour le rôle qu'il devra jouer dans l'équipe. Une analyse des réponses obtenues auprès de plusieurs cohortes d'étudiants appartenant à diverses branches industrielles illustre des différences significatives à l'intérieur des groupes. Selon les auteurs, les résultats soulèvent des questions fondamentales au sujet de l'innovation de la maîtrise d'ouvrage dans le domaine de la construction en ce qui concerne le développement et la composition des équipes.

CRISE DE LÉGITIMATION ET INNOVATION DANS LE DOMAINE DE LA GESTION DE LA CONSTRUCTION

F.R.Stansfield (page 723)

Les concepts à la base de la théorie sociale d'Habermas offrent un cadre de référence permettant de faire une analyse critique de la gestion dans le domaine de la construction et plus spécifiquement dans le domaine du développement des bâtiments de santé publique dans le Royaume-uni. Tandis que les post-modernistes considèrent que la société a déjà changé, Habermas voit la société moderne comme un projet en continuel devenir. La société peut connaître des crises à différents niveaux: économique, politique et socio-culturel, ces crises agissant les unes sur les autres pour des raisons qui découlent de problèmes courants, en particulier dans le domaine de la gestion de la construction du Royaume-uni. Ces difficultés incluent une crise de légitimation puisque des changements économiques et administratifs ont sapé les dispositions courament acceptées et la culture qui sous-tend la construction, par exemple, dans les services nationaux de la santé. L'importance du partage de ces notions est renforcée par les travaux récents d'Habermas qui fait une distinction entre la communication dirigée vers un objectif et la communication qui renforce une meilleure compréhension mutuelle. Alors que les méthodes de gestion de projets se sont développées au Royaume-uni dans le but d'amplifier au maximum la communication dirigée vers un seul objectif, des problèmes ont surgi parce que ces méthodes ont ignoré les multiples niveaux de communication qu'il est indispensable à considérer pour atteindre le succès. Les accords réalisés grâce au partenariat constituent une façon de résoudre le problème, et la compréhension des besoins de socialisation devrait améliorer ce type de procédure. La théorie d'Habermas met à notre disposition un outil analytique qui complète l'investigation empirique. Cette théorie offre non seulement une capacité d'interprétation pour expliquer les nouvelles innovations dans le domaine de la gestion de la construction mais aussi une capacité de prospective pour suggérer des améliorations.

CHANGEMENTS DANS LES RELATIONS ENTRE LES CLIENTS ET LES AMÉNAGISTES: L'UTILISATION DES NOUVELLES NORMES FONCTIONNELLES ASTM/ANSI POUR LA MAÎTRISE D'OUVRAGE DES IMMEUBLES À BUREAUX

Françoise Szigeti, Donald N. Henning et Gerald Davis (page 733)

Cet article place le processus de maîtrise d'ouvrage dans le contexte changeant des relations entre les intéressés; il étudie les tensions qui, de nos jours, ont une influence sur ces relations. Au cœur du processus de maîtrise d'ouvrage se trouve la tâche esentielle qui consiste à définir ce qu'il faut bâtir, dans quel but et quel doit être le niveau fonctionnel à atteindre. L'amélioration des décisions stratégiques prises par le maître d'ouvrage potentiel ou l'occupant durant la phase préliminaire de planification (qu'on appelle la phase d'initiation du projet) est d'une importance majeure si l'on veut apporter des réponses valables dans un climat de tensions; en effet, la stratégie d'attraction sur un produit ou un service est généralement plus efficace que la stratégie oblique qui nécessite de pousser un produit ou un concept. Un ensemble de nouvelles normes ASTM/ANSI et des Outils et Méthodes Fonctionels (Serviceability Tools

and Methods - ST&M) peuvent fournir aux maîtres d'ouvrage et aux occupants de bâtiments une façon systématique, détaillée, complète et facile pour améliorer la qualité de l'information dont ils dépendent pour élaborer leurs décisions stratégiques concernant les exigences fonctionnelles d'un projet de construction.

EMPLOI DE LA MÉTHODE CONCEPTION-CONSTRUCTION POUR UN PROJET DE RÉNOVATION COMPLEXE À HONG KONG: LE CHAMP DE COURSES DE HAPPY VALLEY

C.M. Tam (page 743)

La méthode de maîtrise d'ouvrage conception-construction a été progressivement acceptée à Hong Kong par l'industrie de la construction au cours de ces dernières années. Il s'agit d'une nouvelle approche à Hong Kong, même si son nom était déjà familier depuis plusieurs décades. Cette méthode s'est avérée satisfaisante pour des projets standard à petite échelle, dont la qualité du design et de la construction n'étaient pas d'un intérêt primordial. Cependant son application n'avait pas encore été testée à Hong Kong pour de grands projets de 1.2 milliards de $HK (c'est-à-dire 153 millions de $ américains).

L'objectif de cette étude est d'examiner les avantages et les difficultés que le maître d'ouvrage peut rencontrer lorsqu'il veut appliquer la méthode conception-construction à Hong Kong pour un projet complexe de grande envergure. Une étude de cas sur le projet de rénovation du champ de courses de Happy Valley illustre l'application, la performance, les avantages et les inconvénients de l'approche conception-construction.

QUAND LES ENTREPRENEURS OFFRENT UN CONTRAT GLOBAL AUX MAÎTRES D'OUVRAGE, IL Y A UN CHANGEMENT DANS LA CULTURE DES RELATIONS CONTRACTUELLES

Wilco Tijhuis et Ger Maas (page 751)

Dans le cadre d'un projet de recherche de plus grande envergure, cet article fait spécifiquement le point sur l'expérience des entrepreneurs qui offrent une plus-value explicite à leurs projets de construction. La procédure consiste non seulement à livrer le bâtiment au client mais aussi à offrir une certaine période de maintenance (outre les garanties normales) par exemple en cas de changement d'usage. Cette procédure correspond en fait à l'approche 'CTM' qui inclut construction-transfert-maintenance (en anglais: BTM - Build-Transfer-Maintenance). L'entrepreneur accroît l'envergure de sa tâche qui ne consiste plus à fournir uniquement un bâtiment au client mais à devenir un fournisseur de tous les services pendant le cycle de vie de la construction. Quand on élargit les objectifs de la phase de design et de la construction pour inclure une phase de maintenance totale, il est possible de faire plus de profits et d'assurer plus de continuité à long terme mais il faut qu'il y ait de fortes probabilités de réduire les risques grâce à l'organisation du projet. Si l'on suppose que les coûts d'un projet de construction sont plus élevés

durant la période d'exploitation que pendant la période de construction proprement dite, cette approche est plus intéressante pour les clients et pour les entrepreneurs, aussi bien dans l'immédiat que dans un proche avenir. Une étude de cas récente est brièvement décrite. Les résultats sont principalement centrés sur la façon dont les entrepreneurs devraient développer leur stratégie. Ces résultats sont complétés par des recommandations et par une description des avantages et des inconvénients pour les entrepreneurs et les maîtres d'ouvrage qui voudraient envisager cette approche.

QUASI-FIRMES POUR DE VRAIES INNOVATIONS

H. van Tongeren et A.G. Dorée (page 761)

L'industrie de la construction est bien connue pour l'insuffisance de ses innovations. De nombreux rapports et articles ont été écrits à ce sujet depuis plus de trois décades. Les explications possibles de cette situation se trouvent résumées dans les termes suivants, tels que fragmentation, segmentation, ségrégation quand les textes se réfèrent à la structure de l'industrie et par des qualificatifs, tels que opportuniste, hostile, antagoniste et contradictoire, quand on se réfère à la culture de l'industrie. Dans cet article, les auteurs soutiennent que la principale cause du status quo est due au fait que l'industrie de la construction, par rapport aux autres industries, manque de vrais fabricants capables de développer des produits et de faire face à la concurrence pour ces produits. En effet, c'est ce type de concurrence qui peut être considérée comme une source de stimulation de l'innovation. Dans la construction, la valeur de la production est testée sur le marché mais la valeur du produit ne l'est pas. En conséquence, les décisions de design ne sont pas mises à l'épreuve sur le marché. C'est précisément ce point faible que les auteurs ont étudié ainsi que les améliorations possibles pour y remédier. Des ententes stratégiques durables comme s'il s'agissait quasiment de firmes à l'image de celles des fabricants sont proposées et, dans ce cas le design devient une clé essentielle. Une innovation organisa-tionnelle de ce type pourrait changer la façon de faire des affaires dans l'industrie de la construction; elle en modifierait sa structure et sa culture.

LA MAÎTRISE D'OUVRAGE ÉLECTRONIQUE: UN PAS VERS L'INTÉGRATION D'UN SYSTÈME D'INFORMATION DE LA CONSTRUCTION

Elvire Q. Wang et Claude Parisel (page 771)

Pour assurer l'acquisition d'un bâtiment à l'ère électronique, les auteurs proposent un système d'information appelé 'intranet' au service de l'organisation temporaire chargée de réaliser le projet. Le cœur de ce système intranet est un modèle de design du bâtiment à l'étude. Une nouvelle approche, basée sur une technologie avancée de modélisation, permet de perfectionner le modèle du bâtiment grâce à des moyens astucieux de modélisation spatiale.

Ce modèle de design a deux objectifs dans le processus de maîtrise d'ouvrage: (i) il aide le

maître d'ouvrage à la phase initiale du projet, (ii) il permet à chaque spécialiste de retrouver les informations qui l'intéressent - point important pour tous les participants impliqués dans le design et la construction du projet. L'utilisation du système intranet devrait faciliter la maîtrise d'ouvrage des projets de construction à l'avenir.

LES INNOVATIONS ET LA MAÎTRISE D'OUVRAGE - POURQUOI ET JUSQU'OÙ? BONNE QUESTION POUR LA RECHERCHE

Stephen Wearne (page 781)

Dans les vingt-cinq dernières années, de nombreuses innovations ont été apportées au processus de maîtrise d'ouvrage en Amérique du nord et dans le Royaume-uni. L'auteur pose la question de savoir si l'on comprend comment les maîtres d'ouvrage en tant que clients font leur choix parmi les différentes stratégies de maîtrise d'ouvrage, quels problèmes ils cherchent à resoudre, s'ils y arrivent réellement ou si leurs résultats sont dus à l'effet Hawthorne.

MAÎTRISE D'OUVRAGE ET PROGRÈS TECHNOLOGIQUE - UN NOUVEL OUTIL POUR DES SOLUTIONS PLUS EFFICACE DANS LE BÂTIMENT

Hans Westling (page 791)

Le secteur de la construction est caractérisé par une fragmentation importante et bien souvent par une planification à très court terme pour des projets d'une très longue vie. Le travail en équipe instauré par des acheteurs et des usagers orientés vers l'avenir (propriétaires de biens immobiliers, maîtres d'ouvrage d'organisations publiques et privées) peuvent lancer des défis si des objectifs bien concrets et des exigences de performance sont formulés d'une façon adéquate.

La coopération et la maîtrise d'ouvrage de la technologie sont des outils très puissants qui font naître l'innovation. Au cours de projets impliquant énergie ou rénovation, des résultats importants ont été obtenus, en particulier la réduction de moitié de la consommation d'énergie ou des coûts et une accélération notable de l'application de l'innovation technologique à la construction. La création de nouveaux réseaux dans les cas de séparation des participants des équipes de conception et de construction, combinée à des efforts pour soutenir ces réseaux accélera le processus d'innovation. De nouveaux contrats de coopération acceptés à l'échelle internationale et diverses autres mesures pour mieux définir les responsabilités sont absolument nécessaires. Des travaux internationaux sur les critères de performance représentent un effort important même s'ils prennent beaucoup de temps, car ils offriront d'autres possibilités pour développer des solutions plus efficaces dans le secteur de la construction.

MAÎTRISE D'OUVRAGE ET MAINTENANCE DES BÂTIMENTS: LA MAINTENANCE JUSTE-À-TEMPS

Brian Wood (page 801)

Traditionnellement, l'intérêt des entrepreneurs dans les projets de construction se limitait à la période qui s'étend entre l'appel d'offres et l'achèvement des travaux. Il est rare que les entrepreneurs en construction développent des relations de longue durée avec les clients. Cependant les clients sont de plus en plus conscients des coûts d'entretien et de la possibilité de réduire ces coûts par un design et un mode de construction appropriés. Un design soigné peut réduire le fardeau de la maintenance et la rendre plus facile. Les entrepreneurs sont bien placés pour offrir des services pendant tout le cycle de vie des bâtiments mais en fait actuellement ils ne misent pas du tout sur ce potentiel et ils abandonnent les marchés existants au personnel de diverses autres firmes. Le développement de la maîtrise d'ouvrage conception-construction ou autres méthodes similaires a plutôt incité les entrepreneurs à s'impliquer davantage au début du processus à la phase de design.

La maintenance des bâtiments est généralement faite par des hommes-à-tout-faire, par le personnel des clients du secteur public ou par celui des petits entrepreneurs, surtout lorsqu'il s'agit de rénovations à petite échelle accompagnées de travaux de réparation réalisés d'une façon ad-hoc, le plus souvent sur une base contractuelle relativement floue. La maintenance demeure donc la Cendrillon de l'industrie de la construction.

Les entreprises qui assurent la sécurité et le nettoyage fournissent des services de maintenance 'juste à temps' en ayant recours à des ressources extérieures, autrement dit à des sous-traitants, qui sont généralement de petits entrepreneurs locaux. L'Initiative de Financement Privé a stimulé la passation de contrats de 'construction plus maintenance' ou de contrats 'conception-construction-maintenance' grâce auxquels les entrepreneurs et/ou leurs financiers gagneront ou perdront projets et profits selon leur capacité de prévoir et de contrôler les coûts de maintenance. Cette approche donnera naissance à une planification et à des procédures de maintenance de plus en plus recherchées. Actuellement les clients reconnaissent la nécessité d'engager des professionnels et des entrepreneurs pour assurer la maintenance.

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