PROCUREMENT SYSTEMS & TECHNOLOGY TRANSFER

Edited by
Timothy Michael Lewis

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Ed. Dr. T.M. Lewis

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CIBW92 Procurement Systems Symposium

Edited by
Dr Timothy Michael Lewis
Department of Civil Engineering,
The University of the West Indies, St Augustine
Trinidad & Tobago

Proceedings of the International Symposium of the Working Commission

CIB W92 (Procurement Systems)

In association with

CIB W63

(Affordable Housing)

CIB TG36

(Quality Assurance In Construction)

CIB TG23

(Culture In Construction)

JANUARY 14 – 17 2002

TRINIDAD & TOBAGO

Organised by:
The Department of Civil Engineering,
The University of the West Indies,
St. Augustine,
Trinidad and Tobago
West Indies

International Council for
Research and Innovation in
Building and Construction (CIB),
Kruisplein 25g,
3014 DB Rotterdam,
The Netherlands

This edition published by:
The Engineering Institute, The University of the West Indies,
St Augustine, Trinidad & Tobago

Printed and Bound in Trinidad & Tobago by
Express Printing Ltd, Port of Spain, Trinidad & Tobago

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Foreword

About the CIB

CIB is the International Council for Research and Innovation in Building and Construction and is the international association providing a global network for international exchange and co-operation in research and innovation in building and construction. CIB supports improvements in building processes and in the performance of the built environment.

The CIB programme covers technical, economic, environmental, organisational and other aspects of the built environment during all stages of its life cycle. CIB addresses all steps in the process of basic and applied research, documentation and transfer of research results, and in the implementation and actual application of them in practice.

CIB members are organisations and individuals active in the research community, industry, government and education who nominate experts to participate in a network of over fifty Scientific Commissions. Through these, over 5000 experts worldwide from about 500 organisations exchange the latest information, initiate collective R & D projects, organise workshops, seminars, symposia and conferences and publish proceedings, technical analyses, state of the art reports and practice recommendations.

Working Commission W92 of the Council for Research and Innovation in Building and Construction was established in 1989 and the following aims and objectives established for its work:

- To research into the *social, economic and legal* aspects of contractual arrangements that are deployed in the procurement of construction projects.
- To establish the practical aims and objectives of

contractual arrangements within the context of procurement.

- To report on and to evaluate areas of commonality and difference.
- To formulate recommendations for the *selection and effective implementation* of project procurement systems.
- To recommend standard conventions.

Since its inception in 1989 the Commission has organised many Symposia and collaborated with other Working Commissions. Recently such events have been held in Montreal, Canada; Gavle, Sweden; Chiang Mai, Thailand; Cape Town, South Africa; Santiago, Chile and last year at the CIB World Building Congress held in Wellington, New Zealand.

In addition to publishing numerous proceedings the Commission in 1999 produced a state of the art report on construction procurement entitled: Procurement Systems: A Guide to Best Practice in Construction, published by E & FN Spon.

For this symposium, W92 agreed to associate with two other CIB Task Groups and one other Working Commission. W92 has been associated with TG23 on previous occasions. Task Group TG23 was established in 1997 to focus specifically on the issue of culture in construction procurement and as a result the following terms of reference were established for its investigative work:

- To identify and define concepts of culture in the international construction industry and to carry out research into their manifestations and effects;
- To discus and develop appropriate methodologies for the study of culture in construction;
- To examine and, where appropriate, adopt methodologies used in other disciplines, with special reference to the Social Sciences, for researching culture in the construction

industry worldwide.

Working Commission W63 was established in 1993 to focus on research into ways to provide affordable housing world wide. The relationship between affordable housing and procurement issues is obvious.

Task Group TG36 grew out of the Working Commission W88 with the aim of determining and promoting best practice in construction, with a focus specifically on quality assurance issues. Again, the associations between quality and procurement issues are clear.

Symposium Background

This Symposium in Trinidad and Tobago was designed to bring together researchers and practitioners from many parts of the world in order to share their research and knowledge on different aspects of construction procurement.

It was decided in consultation with staff of the Department of Civil Engineering at The University of the West Indies that the theme of the Symposium should be to report, review and speculate on construction procurement as a mechanism to both provide and facilitate technology transfer especially between nations of different economic, political and social status. This theme was to encompass, *inter alia*, topics such as strategic and emergent issues in procurement, organisational learning, cultural issues, developmentally oriented procurement systems, sustainability, partnering and use of e-commerce in construction procurement.

Trinidad and Tobago, being located in the Southern Caribbean and a founder member of CARICOM, the English speaking West Indian economic and trade alliance, was felt to be ideally placed to explore these issues as it trades with North America, Europe, South America and Australasia including Japan and is thus subject to many different approaches to business and commerce. The choice of Trinidad and Tobago for this symposium was further enhanced by the fact that it is within a region in which most of the countries are considered to be less developed or developing, and are thus in need of timely advice on modern procurement practices.

Additionally, due to its tropical climate and being in a region of the world subject to hurricanes and tropical storms, risk and its management are of prime concern for the built environment both physically and psychologically for the population for which it provides the necessary support infrastructure.

With over 50 papers making up the proceedings and more than 60 delegates from around the world participating, the opportunity for knowledge transfer will be high, and the transfer of knowledge may be the precursor for the broader transfer of technology, one of the prime issues being focused on. This symposium should provide the ideal opportunity for the international research community to exchange experiences, and information on progress that has been made and to further develop the research agenda for international construction procurement, as well as to sharpen the focus of attention on cultural issues, affordable housing and quality assurance.

Finally we would like to thank the Department of Civil Engineering at The University of the West Indies, St Augustine, Trinidad & Tobago for making the Symposium possible. We would also like to thank the technical and organizational committees led by Dr T. Michael Lewis for their hard work and dedication in making this event possible.

On behalf of CIB W92, Joint Coordinators, Professors David Jaggar and Steve Rowlinson.

The Coordinators of TG23 are Dr. Richard Fellows and Dr. David Seymour. The Coordinator of TG36 is Prof. William Maloney, and the Coordinator of W63 is Dr. Kenneth Walsh.

Preface

The University of the West Indies was founded in 1948 at the Mona campus in Jamaica. The St Augustine campus, in Trinidad, which was formerly the Imperial College of Tropical Agriculture, became part of the University in 1960. The Cave Hill campus, in Barbados, was established in 1963. The University is an autonomous regional institution supported by and serving 15 different countries in the West Indies.

The Department of Civil Engineering, which is in the Faculty of Engineering, offers a degree programme that is fully accredited by the Institution of Civil Engineers together with postgraduate degrees by taught programmes and research. The Department also provides industry and practice with continuing professional development courses and works closely with other regional bodies on civil engineering related problems especially concerning the built environment, natural disasters and transportation issues.

The Mission of the University of the West Indies is to unlock West Indian potential for economic and cultural growth by high quality teaching and research aimed at meeting critical regional needs, by providing West Indian society with an active intellectual centre and by linking the West Indian community with distinguished centres of research and teaching in the Caribbean and overseas.

The University of the West Indies recognises that as a regional university supported by the West Indian peoples, and as the sole organ equipped to meet local requirements and to relate its own developmental programmes to them, it should give priority to regional needs.

The Department's willingness to take on the organisation of this Symposium was based on a recognition that there should be synergistic benefits to be obtained from the interaction of the representatives of the local industry with the international research community.

This book represents the culmination of more than a year's effort and includes the papers presented at the joint Symposium held in Trinidad & Tobago from 14-17th January, 2002. The symposium brought together researchers and practitioners from around the world to share their experiences, knowledge and research findings on issues involving procurement, culture, quality and affordability.

In order to focus on the theme of the Symposium papers were invited addressing the following aspects:

- Developments in procurement strategies especially those involving partnerships and alliances bringing together multi- national participants.
- Projects involving private finance initiatives, especially in a global context
- Culture and its management within complex projects especially involving diverse organisations.
- Development and application of techniques as an aid to more effective construction procurement including:
    - Bench marking
    - Value management
    - Total quality management
    - Reengineering
    - Buildability
    - Risk management
- The impact of procurement strategies on the environment and sustainability.
- Information and communication issues in construction procurement.

A particular focus set for the Symposium was the use of construction procurement as a catalyst to enhance learning and understanding in terms of how we do things, why we do things and what improvements can be brought about.

All papers have been refereed to high acceptance standards by an international panel. They have been grouped by their main focus into twelve technical sessions

- Public-private partnerships
- Contract procurement systems
- Contract performance issues
- Innovative approaches
- Cultural issues
- E-commerce in construction
- Design Issues
- Claims, safety and issues
- Dealing with risk
- Ethics and trust
- Information and evaluation
- Economics and sustainability

Acknowledgements

I would like to express my sincere gratitude to the members of the organizing committee for their help and guidance in making this symposium into a reality. These thanks go especially to the staff of the Department of Civil Engineering and the Engineering Institute for accepting the challenge and contributing to the effort to make this symposium a success.

Michael Lewis
St Augustine, Trinidad & Tobago, 2001

Target pricing in Partnering Projects

Examining the Effect of Integrated Project Teams and Target Pricing in Three Pilot Projects

Ola Lædre[1] & Tore I. Haugen[1]

Abstract

In Norway there is a trend in organizing the building process with focus on better integration of the different parties and use of new procurement methods. Our experiences started with the research project *"The Integrated Building Process 1996 - 1999"* where we developed and tested different partnering models in several small scale building projects. These experiences have led us into a number of other development projects using different elements of partnering models with procurement based on negotiations, target pricing and incentives.

In our recent studies we have evaluated three pilot construction projects, two small road projects and one railway crossing point, all involving a tunnel and a roadbed. One of the projects was classified as a research project and based on a negotiated contract, one contract was based on competitive bidding among pre-qualified contractors and one contract was made between two separate divisions within the same public agency. The goals in these projects have been to create better integration and co-operation between the clients, the external consultants and the contractor. This integration should be leading to a better result with respect to total costs and quality. The contracts between the public clients and contractors have been based on an agreed target price with incentives linked to the final costs. We were involved in order to evaluate the co-operation between the parties.

The evaluation is based on reports from interviews and discussions with the project participants. The results from the evaluation are presented in internal reports, only intended for the participants in the projects. Our main impression is that the project participants had a

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share of positive experiences that was predominant to the share of negative experiences. The participants chose better and more cost effective technical solutions during both the programming and production period, and they considered the partnering models as inspiring. At the same time there was a potential for an optimization of the procurement methods and project organizations used.

Our studies confirm the general international understanding of the success-factors for partnering in construction projects:

- Teambuilding - creating an integrated team based on trust and with a common workplace
- Risk analysis and better planning in the early stages
- Efficient project management with clear definitions of roles and responsibilities combined with good leadership
- A change from comprehensive formal communication and documentation between the project partners to well structured, but more open and informal communication

Keywords: Partnering, Integrated Project Teams, Incentive Contracts, Mutual Trust.

Introduction

Since the late 1980s we have seen the development and use of different partnering models in the construction industry. This has been a primary management strategy for improving organizational relations and project performance (Li et al. 2000). The driving forces for this strategy have been studies based on the concepts of total quality management (TQM) and business process re-engineering (BPR). These studies of the construction industry have documented an industry with low productivity and efficiency at a project portfolio level.

To increase productivity and efficiency in the construction industry, a strong focus has been set on better integration of the client, architects, engineers, general contractors, subcontractors and suppliers in one integrated project organization. The different parties are normally independent firms and organizations, with separate goals and objectives and different operation procedures. Typically problems that occur are lack of communications and co-ordination leading to changes and alterations during the process. This again causes disputes, rising costs, reduced performance and reduced quality.

Li et al. (2000) gives a thorough international overview of the background for partnering in construction since the late 1980s, different partnering definitions, status and future regarding research in this area. Future studies are recommended to emphasize on the identification of performance measures and critical success factors, development and test of partnering models and processes, and the formation and selection of partnering strategy.

Compared to the international arena, the development of partnering models in Norway started in the early 1990s. Our experiences started with the research project *"The Integrated Building Process 1996 - 1999"* (Haugen 1999), where we developed and tested partnering models in different small scale building projects. Our basic findings (Bølviken 2000) regarding the establishment of a successful integrated organization are:

- Focus on the process
- Common goals and objectives
- Mutual trust - openness
- Knowledge transfer between the parties
- Teambuilding
- Project management – routines
- Commitment from top management
- Rules for conflicts and sanctions

These findings correspond well to the different views on trust in the partnering literature. This is discussed by Thomassen (1999) who especially refers to Barlow (1997) giving six elements of successful partnering (in order mentioned); a) the need for trust; b) the "right personalities"; c) openness in communication d) organizational culture and organizational learning e) teambuilding and f) the role of management.

Our first experiences related to partnering and integrated project organizations has led us into a number of other development projects using different elements of partnering models with procurement based on negotiations, target pricing and incentives. The first development of partnering models was done in the private sector. Today in Norway we see a growing interest for partnering models used in the public sector, both for infrastructure projects, in health care and education. There are initiatives for using Public-Private-Co-operation (PPC) in a few infrastructure projects, and several public projects are involving various kinds of BOOT-contracts (Build-Own-Operate-Transfer). This is not only a trend in Norway, we also see this trend in different Scandinavian countries (By & Boligministeriet 2000), (Barok 2000).

In the first pilot projects we tried out some very simplified and idealistic contract models, focusing on the elements and process in creating an integrated project organization. These simplified contract models and procurement methods can only be used in research projects where there is a strong focus on success and commitment from all the participants.
We are therefore in the process of developing new procurement and contract models for project partnering in construction, taking into account legal issues, risk, conflict resolution etc.

For the three pilot projects discussed in the following, three new contract models based on agreed target prices and incentives has been developed.

Case Studies of the Three Pilot Projects

In our recent studies we evaluated two small road projects and one railway crossing point project, all involving a tunnel and a roadbed. The projects have some comparable aspects:

- Key personnel from the clients and the contractors share site offices with canteen, telephonist, computer servers, printers and so on.
- The length of new roadbeds are ranging from 1000 to 2000 meters.
- The tunnels have lengths ranging from 100 to 300 meters.
- Contract sums between 30 and 50 mill. NOK.
- The contractors participated in the programming teams
- The clients participated in the designing of the contractors` working plans.

Goals and Objectives for the Pilot Projects

The goals for the three projects were almost identical. After translation from Norwegian the wording would be like:
The two parties, the public client and the general contractor, have a common interest in creating an integrated project organization and a goal of achieving a better total project performance. The basis for the work will be a contract with an agreed target price and incentives for both parties.

Objectives for a better total project performance:

- Produce better technical results/solutions
- Improve the project economy for both parts
- Optimize the use of resources in the project

Objectives for an integrated project organization:

- Mutual confidence in the relationship between the client and the contractor
- An inspiring and pleasant working atmosphere
- Mutual transfer of experiences between all parts in the project

The goals for the three projects focus on co-operation and use of resources. We were mainly involved in the projects to evaluate the co-operation, but it was not possible to do so without regarding the use of resources.

The Contract Model

The characteristic of the target price contract used in the three projects is the formula:

$$K = F + S + (M-S)/2$$

Where: K = contract sum
F = the contractors preset profit
S = actual laid-down costs of the contractor (and eventually of the client)
M = target price, i.e. pre-assumed laid-down cost

The proportions of F and M are set after tender competitions and/or negotiations. The target price formula offers economical incentives to both the client and the general contractor, and basically both parties will benefit from making the S as low as possible. If S also includes the laid-down costs of the client, both parties are rewarded when the extent of tasks for the client in the project is reduced.

One of the projects was classified as a research project and based on a negotiated contract based on existing standards (NS3430). In the second project a specially designed contract was signed after competitive bidding among pre-qualified contractors. In the third project two separate units within the same public agency had the role as client and contractor. They signed an agreement based on an incomplete and brief project description.

Research Methodology

We interviewed participants from both the programming and production period of the three projects. All the interviews were based on an interview guide, with some slight revisions from project to project. The questions were qualitative focusing on the following topics:

- Individual background and competence
- Teambuilding – agreement on common goals and objectives
- Contractual allocation of responsibility and power
- Communication and involvement

- Documentation and written communication
- Partnering structure and management
- Feedback and openness
- Trust and co-operation
- Learning and knowledge transfer
- Shared risk
- Overall results regarding technical and economical performance

Written reports from the interviews have been sent to each of the respondents for verification. This has been the basis for a neutral intermediate reporting back in separate workshops, with following discussions that led to clarifications of various disagreements. The respondents were very positive to this feedback and the discussions.

The feedback was given on a very practical level in order to get a more thorough discussion and involvement from the parties. We saw that our findings were used in the ongoing project development processes. In this way our work represents action research. The results from the studies were finally reported in internal reports the summer of 2001.

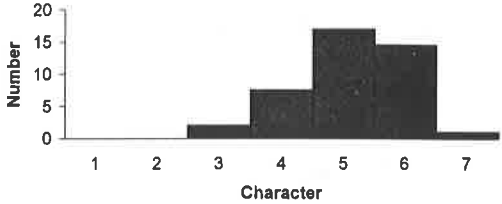
The respondents were allowed to speak free and easy, so the interviews were affected by their personal interests. Furthermore, it is not necessarily the procurement methods or integrated project organizations that caused the experiences of the respondents.

Quantitative Results

For a number of the topics the respondents were asked for a quantitative value from 1 – 7, (neutral is 4) compared to a traditional construction project. We obtained the following histograms:

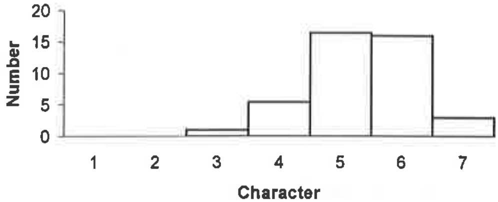
Are your expectations regarding the project integration satisfied ?
(*Scale 1-7 where 1 is worst, 7 is best and 4 is neutral)*

$n = 42$
$\overline{x} = 5{,}12$
$\sigma = 0{,}81$



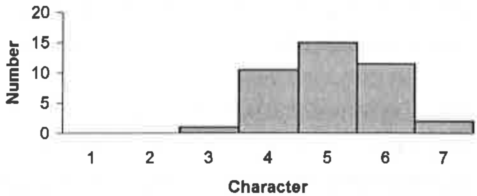
Your engagement in this project compared with other projects?

$n = 42$
$\overline{x} = 5{,}35$
$\sigma = 0{,}79$



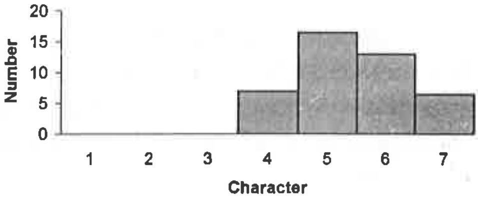
Co-operation and results in this project compared with earlier projects?

$n = 40$
$\overline{x} = 5{,}08$
$\sigma = 0{,}87$



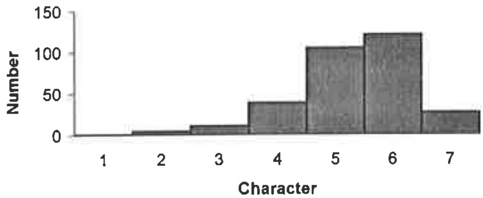
In what degree are your point of view and professional utterances regarded in this project compared with other projects?

$n = 43$
$\overline{x} = 5{,}44$
$\sigma = 0{,}90$



How good has the communication and co-operation with the other project participants been? *(n is big because the participants was asked to give a character to each of the other participants)*

n = 309
$\bar{x}$ = 5,31
σ = 1,12



In order to find standard deviation and mean value we used the following formulas:

$$\sigma^2 = \frac{n \sum x^2 - (\sum x)^2}{n\,(n-1)} \qquad \bar{x} = \frac{\sum x}{n}$$

Our histograms shows that the characters are mainly normally distributed, with an average bigger than 5. The trends indicate that the respondents have experienced a high degree of satisfaction compared with other projects as far as expectations, engagement, communication and co-operation is concerned.

Qualitative Results

The Effect of the Partnering Models:

- The effect from the use of partnering models varied in the three projects. In the first project the management personnel did not notice any dominating effects, but the foremen and their workers at the site really did. In the second project the management personnel did notice big effects, while the foremen and their workers did not. In the third the client had decided to have a peripheral role, so both parties experienced the effect.

Positive Experiences:

- Theoretically, all formal project routines were described in the various contracts. Practically, the participants had to adjust the project management routines as time went by.

- Both parties tried to find technical solutions that were more cost-effective and better for the total project organization, not only for one single party in the project. The target price contract was the basis for creating the win-win situation. Focus was moved from the project economy of the single parties to the total project economy.
- The projects benefited from the participation of the contractors in the programming work.
- The contractors contributed with improved technical solutions, plans adapted to the production and communication of the plans throughout the project organization. The target price was considerably reduced in the three projects, as the contractors proposed technical solutions differing from the ones in the original plans.
- The participants found the partnering model inspiring, as they used their experience and competence regarding technical solutions during the programming and production period.
- The continuity in the project organizations was high since key personnel from the clients and the contractors participated in both the programming and production period.

Sharing site office facilities makes it easier for the project participants to communicate and to have less formal information and documentation in the project.

Possible Traps and Moments to Remember:

The consultants must be involved in the project organization. They have no natural incentives in the target price formula, but their participation is necessary when the contractors suggest changes of the technical solutions and original programming plans.

- Good was defined as sufficient quality. Potential expenditure cuts are cashed out, and the financial savings were not directly used to improve the product quality. The future owner must have the opportunity to participate in the integrated project organization.

- Both parties have to review the program and specifications thoroughly to find any disagreements from the initial technical and functional specifications. In all cases they reported that more time should have been spent on planning in order to examine risks and possible changes during the production period.
- Even though the right arrangement for a partnering process are made, the co-operation will be dependent on the personal skills and former experiences of the project participants. The co-operation will benefit from a continued focus on creation and maintenance of partnering processes.

Summing Up

Relating the results and findings in the three pilot studies to our previous work on partnering issues, we sum up the following success factors (Bølviken, 2000):

<u>Focus on the process</u>
There is a need for continuous focus on the goals and objectives for the partnering processes. Evaluation with interviews and workshops has positive effects, it will always be beneficial to make the participants aware of actual improvements.

<u>Common Goals and Objectives</u>
The economical incentives in the target price formula led to common goals for the parties, which encouraged co-operation leading to optimization of technical solutions and expenditure cuts. The discussions were more focused on technical issues than on economical issues. At the same time the parties spent less time on arguing about mistakes that had occurred, and

more on spotting future problems.

Mutual Trust and Openness

The traditional roles of the client and the contractor are not forgotten even though the parties are co-operative. Mutual trust and openness makes it easier to discuss both positive and negative incidents at the project. The positive potential of the target price contract is dependent on the participants' personal will to show mutual trust and openness.

Knowledge Transfer Between the Parties

On a long term basis all parties will benefit from knowledge transfer, and get an understanding of each other's aspects. The possibilities of mutual transfer of experiences will be best exploited if the necessary arrangements are made. Knowledge of processes connected to programming, production and maintenance will effect the participants` performance.

Teambuilding

There are several ways to establish an integrated project organization. Sharing of site offices and social gatherings were arrangements that contributed to teambuilding in the projects. The feeling of being part of an integrated project organization helped the participants to focus on the common goals and objectives.

Project Management Routines

The client and contractor must not become allies with a front against the future project owner, the interests of the future owner must be taken care of. Simultaneously, it must be possible to make decisions *in situ*. Documentation concerning changes and economical development must be continuously updated. Successful partnering demands clear definitions of roles and responsibilities combined with good leadership.

Commitment from Top Management

The top management of both the client and the contractor have to show commitment to the principles of partnering. At the same time the top management must give the sufficient decision-making authority to the participants from the integrated project organization.

Rules for Conflicts and Sanctions

A target price contract should have clear specifications of technical and functional quality. Clear contract specifications will prevent later unpleasant surprises and discussions between the involved parties. Precise specifications of sanction possibilities and rules for managing conflicts contribute to clarification of the roles of the project parties.

With regards to the wording of the agreements, payment routines, risk sharing and organization, the three projects we have evaluated are different. At the same time they have similarities that have led to co-operation between the parties, and presumably an increase of both efficiency and productivity.

Acknowledgements

We would like to thank Veidekke asa, Vegdirektoratet and Jernbaneverket Utbygging for their initiative and the support of the research work.

Information on the Web

More information about the projects can be found on the following web addresses:

www.trekantsambandet.no
www.vegvesen.no/vestfold/prosjekter/start.stm
www.jernbaneverket.no/prosjekter/vestfoldbanen/nykirke
www.veidekke.no =>prosjekter=>referanseprosjekter=>samferdsel=>nykirke

References

BAROK 2000, "*Samspill – Satt i system*", www.ebanett.no/BAROK, Oslo, December 2000.

Bølviken, T. "*Erfaringer med samspill og konkurranse i* *byggeprosjekter*", *In* Proceedings, NIF-kurs, "Samspill og nye kontrakstformer", Trondheim 2001.

Erhvervsfremme Styrelsen, *"Partnering - et studie af nye samarbejdsformer i byggeriet*", www. Efs.dk/publikationer/rapporter/bygge_partneringrapport/index.html, Copenhagen, May 2000.

Haugen, T. 1999. "The Building Process: challenges in a changing environment.", *In* Proceedings, Chalmers 1999 "*Construction Economics and Organization*", Department of Management of Construction and Facilities, Chalmers University of Technology, Göteborg, Sweden.

Thomassen, A 1999. "Assessing partnering: why trust is important", *In* Proceedings, Chalmers 1999 "*Construction Economics and Organization*", Department of Management of Construction and Facilities, Chalmers University of Technology, Göteborg, Sweden.

"*Byggeriets Fremtid – Fra Tradisjon til Innovasjon*", By & Boligministeriet 2000, København, ISBN 87.90704-32-0.

Li, H., Cheng, E. and Love, P. "Partnering research in construction", *Engineering, Construction and Architectural Management*, 7, 76-92.

Public-Private Partnerships in project procurement

Can the UK initiative offer developing countries some useful lessons?

Marcus Ahadzi[1] & Graeme Bowles[1]

Abstract

The UK government launched its Private Finance Initiative (PFI) in 1992 as part of a strategic rethink for the procurement of not only major infrastructure projects such as roads and bridges but also for such services as IT, accommodation and libraries for schools etc through private sector participation in the form of Public-Private Partnerships (PPPs). This paper briefly outlines the basic principles underlying the UK initiative and examines through a survey, the significance of institutional structures and policy frameworks in pushing forward such an initiative. At the same time a survey was conducted on Ghana, a developing economy, using the Ministry of Roads and Highways which is in the process of experimenting this procurement strategy. The essence was to establish whether the enabling environment existed to successfully promote such a strategy. The conclusion was that though the manpower resources exist within this public sector organisation, there is the need to develop comprehensive institutional structures and policy frameworks for such a strategy to succeed.

Keywords: developing countries, private finance initiative, procurement, public-private partnership, UK, Ghana

Introduction

Infrastructure financing can be grouped into two broad categories - services such as water, sanitation, etc the direct beneficiaries of which are readily identifiable and can therefore be readily financed through user-charges; and the

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provision of such services as drainage, schools, roads, whose charges may be difficult to pass directly on to the beneficiaries (Kim 1997). The problem however is that national budgets derived from revenue and taxes alone cannot meet the rather huge investments required to either build most of these public infrastructures or renew the decaying ones without critically sacrificing those other vital areas as welfare, health and education. Estimates by the World Bank indicate that within Asia alone, demand for infrastructure investment for the period 1995-2004 will amount to US$1,262 billion (Ong and Lenard, 2001). These huge demands for infrastructure development is attributable to the fast population growth especially within the urban settings of the developing countries. Cities such as Lagos are expected to grow in population from a mere 1.0 million in 1950 to 24.4 million people by 2015 (Financial Times, 2001a). Iain White (2001), writing about Delhi, painted a vivid picture of the typical chaotic conditions on the roads in most of these fast growing cities – *'a two-lane highway reconfiguring itself into five-lanes of chaos with every one giving way to the might of lorries and buses and nobody taking notice of pedestrians'*. Similar pressures are being put on such other public sector facilities as education and health.

In the UK for example, total civil procurement for 1997-1998 was £12.9 billion (HM Treasury, 2001). However, following the success of the privatisation policies embarked upon in the 1980s, it became apparent that involving the private sector would inject the needed capital into public infrastructure and help exploit the full range of private sector commercial and creative skills. This opened the door for the new strategic rethink in public procurement – the Public Private Partnerships (PPPs) through the Private Finance Initiative (PFI). Within the developing countries also, the high demand for infrastructure development coupled with the pressures on national budgets is making governments move towards encouraging the private sector to invest in infrastructure projects in the forms of Build Operate and Transfer (BOT), or its other variants. A number of these projects have reportedly run into problems along the line

(Wells, 1999; Tam, 1999). In Ghana, discussions started since 1995 on a number of build and transfer road projects. To date, none of them has yet taken off effectively.

As part of a study of the PPP procurement strategy with emphasis on the management of host country risks, this preliminary review examines how the institutional structures and policy frameworks of the UK initiative are effectively enhancing the process. Drawing lessons from the UK study, a study was conducted on Ghana using the Ministry of Roads and Highways and its agencies - an organisation in the process of embracing such a procurement strategy. The essence was to establish whether the appropriate frameworks and structures exist to promote this sort of strategy.

The UK Initiative

The principles, policy framework and institutional structures

The basic principle behind the UK's PPP initiative is to transform government departments from being owners and operators of assets into the purchasers of services from the private sector over concession periods that may last 10 – 30

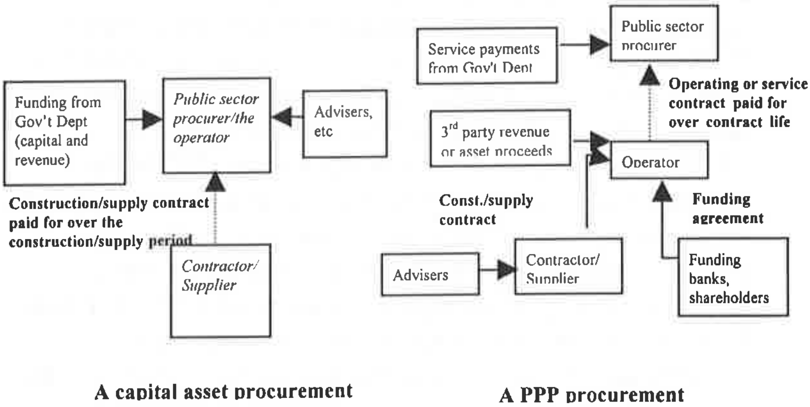

Figure 1. Capital Asset Procurement vs. PPP Procurement
Source: PFP (1996) *Risk and Reward in PFI Contracts*

years. In this respect, the emphasis is on 'what' and not 'how' the services are to be provided through the use of output specifications (PFP, 1996). Figure 1 provides an illustrative distinction between the PPP form of procurement and Capital Asset procurement.

During the early stages of the initiative, the Treasury as a policy would not approve any capital projects unless private finance options had been explored. This was meant to maximise the scope for and use of private finance unless for whatever reason private finance was not possible. It is not surprising therefore that a whole range of projects have been procured across a spectrum of sectors including health, education and transport (DETR, 2000; Ahadzi & Bowles, 2001a). To date, contracts for over 400 projects in estimated capital value of £17b have been concluded (Financial Times, 2001b)

The process however has not been without difficulties. Ahadzi and Bowles (2001b), identified the tendering and the negotiation stages as the key areas where delay are mostly experienced resulting in huge costs to both bidders and the public sector organisations. To avert these problems, a number of structures were set up along the line to provide relevant guidance. The first of these was the Private Finance Panel (PFP) composed essentially of part-time members drawn from both the public and private sectors supported by seconded full-time executives – the Private Finance Panel Executives (PFPE). These bodies were later replaced in 1997 by the Treasury Taskforce (TTF) with a two-year mandate to provide strong inputs in developing highly skilled departmental procurers capable of procuring their PPP projects without much central support through the departmental Private Finance Units (PFUs). The TTF has currently been replaced by Partnerships UK (PUK) - a public private body set up to build up £1 billion in equity and debt to promote PPP projects in addition to continuing the roles played by the TTF (Building, 1999).

At the local authority level, The Public Private Partnership Programme (4Ps) was established in 1996 with specific emphasis on aiding local authorities procure projects successfully. In addition to the above structures, the National Audit Office (NAO) and the Treasury Parliamentary Subcommittee regularly review the concluded PPP deals to confirm how well the departments managed the procurement process.

Research methodology and outcome

This preliminary study was conducted through questionnaire survey followed by structured interviews. Questionnaires were sent out to 64 participants within the contracting, consulting, financing and client organisations in the UK the list was drawn from the 1997/8 PFI Report Yearbook containing organisations and key individuals involved in the PPP procurement process. The response rate was 45%. A sample of questionnaires was also sent to 20 participants in Ghana's Ministry of Roads and Highways and its agencies and the response rate of 42%

As shown in figures 2 and 3 the results of the UK survey strongly brought to the fore the significance of establishing the appropriate structures responsible for providing the necessary guidance and training to enable the PPP procurement process move smoothly.

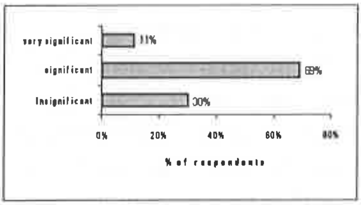

Figure 2. Significance of guidance from the treasury taskforce

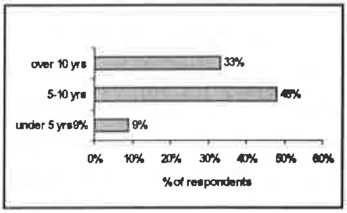

Figure 3. Experience level required of professional staff

On the level of academic qualification and experience required of staff, a relevant first degree plus 5–10 years of experience in project procurement was thought to be adequate. The private sector respondents however appeared to lay more emphasis on higher qualifications with some preferring postgraduate qualification for those engaged in the PPP procurement process. The likely implication is that the private sector may increasingly be engaging more skilled professionals and thus developing greater in-house capabilities than sections of the public sector in handling the procurement processes - a situation that may inevitably result in imbalances especially during the negotiation stages. In fact the view held by some of those interviewed was that the public sector needed to sharpen its negotiating skills as this area is a key decider in reaching early financial close.

The results of the Ghana survey did not show the existence of laid down policy guidelines towards private finance. Again only a small proportion of the respondents were aware of any institutional structures at the national level directly responsible for project procurement through the private finance strategy, an indication that if it was there at all then its impact was not being felt. However, the requisite manpower resources exist within the sampled organisation in terms of educational and professional qualifications whose skills may only need sharpening towards this form of project procurement. The outcome of the Ghana survey is indicated in figures 4-7.

Concluding remarks

This study has revealed the importance of institutional frameworks and structures backed by the appropriate policy guidance and training from the centre in addition to having quality staff at the departmental levels in effectively promoting the PPP procurement strategy within the UK. What the Ghana survey has revealed however is that though the requisite manpower resources exist within the sampled organisation, a situation which may be similar to most developing countries, there is the need to establish the relevant institutions tasked with the responsibility of formulating and disseminating the requisite policy and guidelines including staff training in the relevant skills.

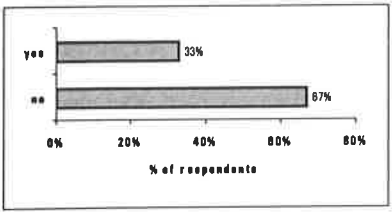

Figure 4. Existence of a national body responsible for private finance.

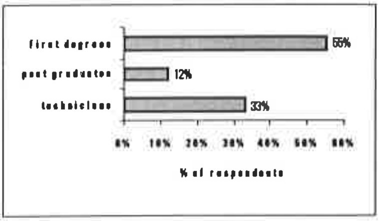

Figure 5. Existence of departmental policy guidelines towards private finance

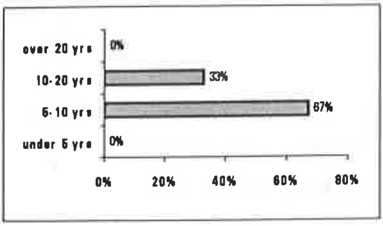

Figure 6. Respondents' experience in privately financed projects

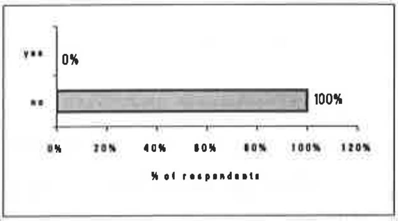

Figure 7. Respondents' opinion on the adoption of privately financed procurement strategy

One other lesson from the UK initiative is that it is not targeted at mega project only. It covers a whole spectrum of projects some as small as IT facilities for high schools at the local council levels, the renovation and continuous maintenance of primary and high school facilities and street lighting. It is these small project areas that countries of the developing world may better be placed to develop in order to build up the local capacity for the bigger projects. A caution however is not to take too many projects on board at a go under the illusion that payments are to be spread over a long period as these become debt for the future.

References:

Ahadzi, M. & Bowles G. (2001a) *The Private Finance Initiative: the procurement process in perspective.* Proceedings of the 17th annual conference of ARCOM, Salford. (forthcoming, September 2001)

Ahadzi, M. & Bowles G. (2001b) *Public Private Partnerships in UK's infrastructure development: the macroeconomic perspective.* Proceedings of the 17th annual conference of ARCOM, Salford. (forthcoming, September 2001)

DETR, (2000). *Government Department's Construction Plan.* Construction Annual Statistics 2000 pp 96-134.

Financial Times, (2001a). *Cut off from the world.* March 10 /11.

Financial Times, (2001b). *Built to last at a price March 23/24.*

HM Treasury(2001) *Modern Government, Modern Procurement.* http://porch.ccta.gov.uk/treasury

Kim, K-H (1997). *Housing finance and urban infrastructure finance.* Urban Studies vol 34 no 10 pp 1597-1620

Ong, H.C. and Lenard, D. (2001). *Can the private finance be applied in the provision of housing.* Proceedings of the 1st International Conference of Researchers in the Built Environment.

PFP(1996). *Risk and Reward in PFI Contracts.* Salford March 2001.

Tam, C.M. (1999). *Build-operate-transfer model for infrastructure development in Asia: reasons for the successes and failures.* International Journal of Project Management Vol. **17** No. 6 pp 377-382.

Wells L.T (1999) *Private Foreign Investment Infrastructure: Managing non-commercial risks.* Private infrastructure development conference proceedings. Sept 8th-10th 1999. Rome, Italy.

White, I. (2001). *Take me too the river*. The Guardian Magazine, UK. 19th May 01 p32

Analysis of Behavioral Parameters in Partnering

Amarjit Singh[1]

Abstract

This paper presents results of a study undertaken to determine the influences on various behavioral project management parameters due to the use of partnering. The detailed and mathematical analytical hierarchy process (AHP) is used to calculate a value for each parameter. The parameters considered are *Commitment, Clear Expectations, Communication, Courage, Excellence, Responsibility, Sharing, Synergy, Trust,* and *Understanding and Respect*. Use is made of the consistency index and consistency ratio. Comparisons are made between partnered and non-partnered projects. Surveys were sent out to public, military, and contracting agencies. Statistical analysis is subsequently done on the scores to make sound evaluations of the influences of partnering. It was found that partnering positively affects the behavioral parameters. Some parameters are improved substantially and significantly while some are not improved much. However, there is an improvement registered for all the parameters, thereby contributing to project success.

Keywords: behavioural parameters, partnering, analytical hierarchy process, surveys

Introduction

It is documented in literature that partnering results in fewer schedule delays, fewer claims, and reduced litigation, but little has been done on management behavior analysis. A study [1] was undertaken at the University of Hawaii to check whether the overall perceived benefits of partnering had a positive influence on management behavior.

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The basic concept of partnering is to maximize the achievement of project goals. It does this by improving working relationships and communications, and promoting synergy and trust. Emphasis is on cooperation, dedication to common goals, and the respecting of each others' values; an atmosphere and culture is created where owner and contactor are at ease with each other [2].

Objectives

The study partially aimed to achieve the following:
1. Determine the management behavioral parameters on which partnering has had the most and least impact.
2. Determine whether perceived benefits vary for different demographics, such as level of management, years of experience, and level of education.

Research Methodology

Questionnaires were circulated to contractors and public agencies. Among public agencies were the, U.S. Navy Civil Corps of Engineers (at Pearl Harbor), U.S. Army Corps of Engineers (who were the originators of the concept of partnering), and Hawaii Department of Transportation. All questionnaires were circulated in Hawaii only. The questions elicited responses on a Likert scale for the ten fundamental parameters. Responses were weighted for importance according to Saaty's Analytic Hierarchy Process (AHP) [3]. The weighting method was checked for consistency using eigenvalues and eigenvectors, as recommended in the AHP method, before being applied to the scores.

The numerical values of the ten fundamental project parameters were recorded. Elementary calculations of mean and standard deviation were undertaken. Then, ANOVA was undertaken for pertinent demographics. The results are provided and discussed.

The Questionnaire

Thirty-seven questions were asked in the survey. This was an original survey prepared specially for this research. These questions were designed to satisfy meanings pertaining to the ten fundamental project management parameters. Some questions contributed to more than one parameter. Respondents were asked to assign a score to these questions for partnered vs. non-partnered projects. The survey can be obtained in Michel (1996) [1].

Target Group and Survey Response

Respondents included vice-presidents, project managers, contracting officers, and project engineers from public and private agencies. A total of 203 surveys were sent out, of which 104 were returned. Only 99 returned surveys were responsive.

The number of responsive responses returned are as follows:

U.S. Navy Corps of Engineers	-	16%
Construction Contractors	-	21%
U.S. Army Corps of Engineers	-	26%
Hawaii Department of Transportation	-	36%

Upper management respondents were 29%, while project level respondents were 71%. Overall, 80% of the respondents had college degrees in engineering; 20% did not have engineering degrees. Of those having education, master's degree holders numbered 11%; B.S. degrees, 82%; Ph.D.'s, 1%; high-school diploma, 5%. Those having more than 27 years experience were 14%; those between 19-27 years, 21%; 10-18 years, 34%; 1-9 years, 29%. Those having worked on more than 11 partnered projects were 7%; 5-10 partnered projects, 11%;

fewer than 4 projects, 82%.

The sample was stratified – in that all major sectors of the construction industry were covered. Owners and contractors were both engaged, thus permitting a complete study to be undertaken. These samples were easily available in Hawaii. These factors contributed to this particular sample being chosen.

The sample size and percent of responses is significant for 95% confidence, allowing a sampling error of 6.87%

Definitions of Variables

The ten fundamental parameters important to project management and the partnering process are (in alphabetical order) Clear Expectations, Communication, Commitment, Courage, Excellence, Responsibility, Sharing, Synergy, Trust, and Understanding and Respect. These are defined below:

1. *Clear Expectations:* Partners must understand each others expectations; goals must be clearly understood resulting in a common vision and shared mission.

2. *Commitment:* Partners must desire to assist the other person achieve goals; partners freely go beyond the call of duty to support each other; timeliness of actions and decision, for RFI's and resolution of disputes, are important [4].

3. *Communication:* Information must be transferred effectively, as a cohesive team; information exchange and other discussions must be open and honest at all levels, based on mutual respect; there is lesser animosity; passing blame is avoided.

4. *Courage:* Partners must be able to confront and resolve conflict; participants must be free of fear when tackling

problems and disputes; partners feel free to innovate, and openly exchange ideas without recrimination.

5. *Excellence:* Parties adhere to the highest standards of performance and conduct. Partners invest their special talents into the relationship without making unnecessary compromises. The partners must have a clear vision and focus on total quality.

6. *Responsibility:* Partners are accountable to each other; they recognize the consequences of their actions and decisions. They also agree on measures for mutual accountability. Partners refrain from finger pointing.

7. *Sharing:* Sharing is undertaken for common goals; they share concerns, problems, needs, and ideas; they also share risks, setbacks, and rewards; discussions on the uncertainties of project life are cooperatively addressed.

8. *Synergy:* Diverse resources and knowledge of the partners creates a relationship that is stronger than the sum of its parts; parties join their ideas together for the betterment of the project. Parties work as a team rather than individuals.

9. *Trust:* Partners rely and depend on one another; they have confidence in each other. Information is freely shared. Parties honor agreements and have faith in one another. There are no hidden agendas .

10. *Understanding and Respect:* Partners value each others' contributions; they have learned to empathize; they know each others capabilities and limitations. They deal honestly; they understand the internal policies and procedures of each other.

Analytic Hierarchy Process (AHP)

The assigning weights for a variable for importance and priority is usually a value-driven. AHP, however, allows the modeler to break down a complex problem and assign weights systematically. Saaty (1980) created a nine-point scale that can be used to determine how much more important one variable is to another [3]. These weights were assigned to questions within each parameter. For instance, if there were five questions comprising the parameter of Trust, then these five questions were weighted among themselves. The score for Trust was therefore only obtained after the internal weighting had been done. No external weighting was done, in that the ten fundamental project parameters were in no way weighted against each other.

Example of the AHP

There were five questions pertaining to Trust. These were

A. Parties actions are consistent
B. Parties actions are predictable
C. Parties honor agreements
D. Parties trust each other while making decisions

Parties have faith in the accuracy and completeness of information.

A matrix was set up as follows:

	A	B	C	D	E
A	1	5	1/5	1/3	1
B	1/5	1	1/5	1/3	1
C	5	5	1	2	5
D	3	3	1/2	1	3
E	1	1	1/5	1/3	1

For Row A, this means that Question E is equally important as Question A; Question D is 1/3 as important as Question A; Question C is 1/5 as important as Question A, and Question B is 5 times more important than Question A. Of course, the diagonal will have values of one, since a question compared to itself has an importance score of unity. The assignment of weights, at this stage, is a partially subjective exercise.

Saaty then recommends the calculation of the geometric mean. He equates this vector of normalized geometric means to the normalized eigenvector of the largest eigenvalue from the above matrix.

The calculation of geometric means for each row is shown below:

Row A:	$(1*5*1/5*1/3*1)^{1/5}$	= 0.8027
Row B:	$(1/5*1*1/5*1/3*1)^{1/5}$	= 0.4217
Row C:	$(5*5*1*12*5)^{1/5}$	= 3.0171
Row D:	$(3*3*1/2*1*3)^{1/5}$	= 1.6829
Row E:	$(1*1*1/5*1/3*1)^{1/5}$	= 0.5818
	SUM	= 6.5062

So, the normalized weights for each question are:

W_A	= 0.8027/6.5062	= 0.1234.
W_B	= 0.4217/6.5062	= 0.0648
W_C	= 3.0171/6.5062	= 0.4637
W_D	= 1.6829/6.5062	= 0.2587
W_E	= 0.5818/6.5062	= 0.0894

Now, consistency of the weights can be checked. To do this, the maximum eigenvalue of the matrix must be determined. This is easily done and found to be 5.38 Saaty then recommends the calculation of a consistency index, CI, where

$$CI = (\lambda max-n)/(n-1) \qquad \text{Eqn. (1)}$$

In this equation, λmax is the maximum eigenvalue of the matrix; n is the order of the matrix. Thus CI = (5.38-5)/(5-1) = 0.095. A Random Index, RI, is extracted using scales developed at Oak Ridge National Laboratory for matrices of order 1 to 15, and provided in Saaty (1980) [3]. The consistency of the weighting scheme is calculated by a Consistency Ratio, CR, where

$$CR = CI/RI \qquad \text{Eqn. (2)}$$

If CR <=0.1 then the weights have been consistently assigned, else not. For a 5th order matrix, such as we have here for Trust, the RI is looked up as 1.22 for the 9-point weighting scale being used. The CR = 0.095/1.22 = 0.077 which is less than 0.10. Hence the weight allocation system is consistent and acceptable. Consequently, the assigned weights are retained in the analysis that follows.

Results for Fundamental Project Management Parameters

Values for all the ten fundamental project management parameters were calculated using the AHP weighting system described above. The results for partnered and non-partnered projects are given in Table 1 and 2, respectively.

Table 1: Scores for the Fundamental Project Management Parameters for Partnered Projects (in descending order of score)

Project Management Parameter	**Mean Score**
Clear Expectations	7.87
Commitment	7.62
Communication	7.57
Sharing	7.46
Courage	7.45
Understanding and Respect	7.34
Trust	7.24
Synergy	7.02
Responsibility	6.96
Excellence	6.76

For partnered projects, Clear Expectations and Commitment were rated highest, whereas Responsibility and Excellence scored the lowest. For non-partnered projects, Commitment and Excelence scored the highest, while Responsibility and Excellence scored the lowest. In both cases, Commitment is scored high, while Responsibility is scored low.

Table 2: Scores for the Fundamental Project Management Parameters for Non-Partnered Projects (in descending order of score)

Project Management Parameter	Mean Score
Commitment	6.08
Excellence	6.04
Trust	5.98
Communication	5.92
Clear Expectations	5.90
Understanding and Respect	5.82
Sharing	5.78
Courage	5.77
Responsibility	5.46
Synergy	5.46

It is visibly apparent, that all parameters record an improvement in their score for partnered projects. In an ANOVA done between the scores of Table 1 and 2, we see that there is a statistically significant difference between the mean scores of partnered projects and non-partnered projects. Significance is valid for $\alpha = 5\%$.

Improvements on Parameter Scores

Some parameters score greater improvements than others for partnered projects. The relative improvements are listed in Table 3, in descending order of degree of improvement. We find that Clear Expectations, an important parameter for understanding project goals and each others' policies and procedures, is significantly enhanced. Next, Courage is greatly increased. This means that partners are more free and open in their dealings with each other and do not fear recrimination from the other. Obviously, this results in greater cooperation and greater good-will. We see that Synergy, which was at the bottom of the list for Non-Partnered projects has a increased

Table 3: Relative Improvement for the Fundamental Project Management Parameters for Partnered Projects over Non-Partnered Projects (in descending order of improvement)

Project Management Parameter	**% Improvement**
Clear Expectations	33.3%
Courage	29.1%
Sharing	29.0%
Synergy	28.6%
Communication	27.8%
Responsibility	27.4%
Understanding and Respect	26.1%
Commitment	25.3%
Trust	21.0%
Excellence	11.9%

by 28.6%. This means that partners are beginning to make use of each others' resources and talents; they are beginning to realize the contributions that each can make; there is obviously greater team-work and greater sharing of ideas. Sharing itself has seen a 29% increase in its score. The overall average increase in scores is approximately 25%. This is taken to imply that the overall behavioral performance is improved 25%.

Whereas Excellence registers an increase in its score for partnered vs. non-partnered projects, the relative increase is not that much. One might have hoped that the quality of the finished product would improve with partnering, but that is not seen to be as well manifest as other parameters. Neither, then, is the overall professional conduct raised impressively high. This might mean that partnering can do little to improve the physical quality of work and professional standard of conduct. Partnering is good as a dispute resolution tool, improving management characteristics by 25%.

ANOVA on Demographics: Partnered vs. Non-Partnered Projects

One-way ANOVA tests were done to see whether the differences between Project Management Parameters are significantly different for partnered projects in comparison to non-partnered projects for the different demographics considered. The demographics for which evaluations were made are:

Organization (Public and Private)
Level of Management (Upper and Lower)
Total Project Experience (For different Years of Experience)
Experience in Partnered Projects (From Few to Many)
Level of Education (No Education to Ph.D.)
Engineer/Non-Engineer.

It was sought to determine here whether these different demographic groups scored partnered projects differently from non-partnered projects. The outcome would decide whether differences were due to chance or could be expected every time partnered projects were executed.

Table 4: Illustration of ANOVA for Clear Expectations by Organization

	Partnered Projects	**Non-Partnered Projects**
Contractors	8.10	5.51
HDOT	7.50	5.82
U.S. Navy Corps of Engrs.	8.09	6.04
U.S. Army Corps of Engrs.	8.08	6.24

F-statistic = 89.99; F? = 5.99; ?=5%. *Conclusion: Differences in mean scores are Significant.*

Table 5: ANOVA Results for Partnered vs. Non-Partnered Projects, by Demographics for Each Project Management Parameter

Groups	Organiz-ation	Level of Management	Total Experience	Partnering Experience	Level of Education	Engineer/ Non-Engineer
Clear Expectations	S	S	S	S	S	S
Commitment	S	N	S	S	S	S
Communication	S	S	S	S	S	S
Courage	S	S	S	S	S	S
Excellence	S	N	S	N	N	N

S = Significant Differences Exist in Scores; N = Differences in Scores are Not Significant

Table 5: *(Continued)*
S = Significant Differences Exist in Scores; N = Differences in Scores are Not Significant

Engineer/ Non-Engineer	Level of Education	Partnering Experience	Total Experience	Level of Management	Organization	Groups
S	N	S	S	N	S	***Responsibility***
S	S	S	S	S	S	***Sharing***
S	N	S	S	N	S	***Synergy***
N	S	S	S	N	S	***Trust***
N	S	S	S	N	S	***Understanding and Respect***

A sample explanation of these ANOVA results for the parameter Clear Expectations tested by Organization is given in Table 4. The partnered and non-partnered projects are the treatments, while the organizations are the blocks. The summary of significant and non-significant results are given in Table 5. Results show that Clear Expectations, Communication, Courage, and Sharing are significantly improved across the board for all groups. Thus the demographics of all groups state that the above parameters are improved with statistical significance for partnered projects.

Excellence is perhaps the only parameter that is not significantly improved for the most part for the groups considered. The other parameters of Commitment,

Responsibility, Synergy, Trust, and Understanding and Respect are fairly improved for most groups, with statistical significance.

When data was arranged by different Levels of Management, it was seen that the different management levels perceived no significant differences or improvements to the parameters of Commitment, Excellence, Responsibility, Synergy, Trust, and Understanding and Respect.

Conclusions

As in the definition of partnering, partnering hopes to make better partners in construction contracting. Good partners will trust each other more, have mutual understanding and respect for each other, share resources and ideas and enjoy synergy among themselves. Good partners are honest to each other, do not hurt each other economically, are committed to each other and business goals, have the fearlessness (courage) to speak openly to each other in a productive, non-hostile atmosphere, and bear their responsibilities dutifully.

The study partially reported here, discovered that partnering has improved all ten fundamental project management parameters. Generally, there is a significant improvement for partnered projects over non-partnered projects. The relative overall improvement can be stated at 25%. Statistical significance of the improvement is recorded for 95% confidence.

The different groups thought that there was no significant improvement for Excellence. However, parameters such as Clear Expectations, Courage, Sharing, and Synergy showed remarkable improvements (more than 28%). Communication, Responsibility, Understanding and Respect, and Commitment exhibited improvements more than 25%.

Acknowledgments

Major portions of this paper were published earlier for the 2nd Intnl. Conf. on Construction Project Management, February 1998.

References

Michel, W. (1996). "Assessment of Partnering's Impact in the Public and Private Sector of the Hawaii Construction Industry by Examination of the Fundamental Elements of Partnering." *M.S. Thesis*, University of Hawaii at Manoa.

CII (1991). "In Search of Partnering Excellence." *Special Publication 17-1*, Construction Industry Institute.

Saaty, T. L. (1980). "The Analytic Hierarchy Process: Planning Priority Setting, Resource Allocation." *McGraw Hill*, NY.

Cook, E. L. and Hancher, D. (1991). "Partnering: Contracting for the Future." *Journal of Management in Engineering*, Vol. 6(4).

Public-Private Partnerships for Infrastructure Development

Case Study of the 895 Connector Project

Mike Vorster[1], Anthony D. Songer[2] & Herb Morgan[3]

Abstract: The economic and social impact of appropriate infrastructure development and the associated needs throughout the world are well documented. Public-Private partnerships as procurement methods are increasingly being implemented throughout the U.S.

Route 895 or the Pocahontas parkway is a major transportation initiative for infrastructure development in the State of Virginia. The public-private partnership project represents a fundamental change in infrastructure procurement from publicly administered design-bid-build to privately controlled design-build. This paper discusses a unique academic partnership created between a State Highway department, private development contractor, and a university to document and formalize lessons learned using public-private partnerships for infrastructure development of the Pocahontas parkway.

Usefulness of the academic partnership results includes enhancing knowledge among infrastructure stakeholders for establishing sustainable procurement and project delivery mechanisms which meet new economy demands and providing a framework for fundamental and formalized changes to existing structures of project procurement and delivery.

Keywords: Public-Private partnerships, Pocahontas parkway, infrastructure development

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Introduction

The use of privatization as a delivery method for public sector infrastructure projects is well documented (Ashley 1998 et. al, Songer, et. al. 1997). U.S. privatization projects are increasingly being used by State highway departments as a procurement mechanism to meet critical public transportation needs in a more timely fashion than traditional procurement processes. As privatization continues to increase, it is important to document the process. This paper describes an academic partnership model to collect, analyze, and document the privatization process for infrastructure projects in the U.S. Specifically, the paper describes the Virginia Department of Transportation project under investigation, the academic partnership, and current lessons learned from the on going project.

Project Description

The Public-Private Transportation Act (PPTA) of 1995 authorized public entities to enter into agreements for project development to acquire, construction, improve, maintain, and operate transportation projects within the State of Virginia. Projects may be solicited or unsolicited proposals from private sector organizations. The provision for unsolicited proposals encourages interested firms to seek out financially viable projects and actively pursue the projects to satisfy the specific transportation needs of the State.

In 1995, the joint venture company of Fluor Daniel Inc. and Morrison Knudsen (FD/MK) submitted an unsolicited proposal to finance, develop, design, and construct the 895 connector project for the State of Virginia. The project selection process was completed with negotiations of a comprehensive agreement between VDOT and FD/MK in the summer of 1998.

The 895 Connector project is the first project implemented under Virginia's PPTA. It is a 4 lane, 8.8 mile user-pay tollway connecting the Chippenham parkway at I-95 with I-295 near the Richmond, VA airport. The project, which includes a high-level bridge over the James River, combines steel, precast segmental, and cast in place segmental structure types. Project complexity requires spanning an existing railroad, freeway, active navigation channel without interfering or disrupting operations. The completed project will include the longest span bridge built in the U.S. using the Design-Build. A detailed technical description of the project is found in Showers, et. Al., 1999.

Given the uniqueness of the procurement process and size and complexity of the project, a novel approach for a project lessons learned model was created. The model, is an academic partnership between the university, public agency, and private development contractor to create and implement a method of collecting, analyzing, and documenting lessons learned during the project. The learning model developed and discussed in this paper provides a method for capturing project lessons during the project as compared to the often-used retrospective case study model.

Academic Partnership

The Academic Partnership was established with the specific objective of improving the planning and execution of complex design build public-private infrastructure projects by ensuring that experience gained on all phases of the Route 895 Connector Project is documented and carried forward to future projects.

The Academic Partnership consists of

- The Virginia Department of Transportation
- FD/MK LLC
- Virginia Tech

The academic member of the Partnership - Virginia Tech, provides faculty members to conduct periodic interviews of key project personnel, study materials produced and review progress so that they can;

1. Record current processes.
2. Document lessons learned.
3. Analyze and review results
4. Make recommendations to improve future performance.
5. Report and present findings.

While recommendations made could be of value to the project, the primary emphasis is on the learning needed to improve future performance.

Learning Process

Implementing the Partnership

Thé principal investigators appointed in terms of the academic partnership agreement between VDOT, FD/MK and Virginia Tech conducted their first interviews with key project participants soon after VDOT and FD/MK finalized the comprehensive agreement, established the Pocahantos Parkway Authority and commenced operations in the field. Initial interviews focused primarily on experience gained:

1. By FD/MK in identifying the project as both technically and economically viable in terms of their business objectives and the Public Private Transportation Act.
2. By FD/MK and VDOT in negotiating the comprehensive development agreement, the design build contract, the fixed lump sum price and the fixed contract performance period.
3. By FD/Mk, VDOT and the financial community in agreeing the covenants, conditions and securities needed to secure project financing in the private bond market.

Subsequent interviews were held as convenient to the progress of the work. In the early stages, these focused on the technical and administrative aspects of design as well as pre-construction activities such as regulatory requirements, right of way acquisition and utility clearances. Later interviews followed the project through the field construction and, when appropriate, through the completion and hand over phases.

An early and significant challenge was to develop the relationship between experiences, lessons and recommendations for improvement. The conceptual framework used is based on the following definitions with the interrelationships, processes and flows shown in Fig. 1.

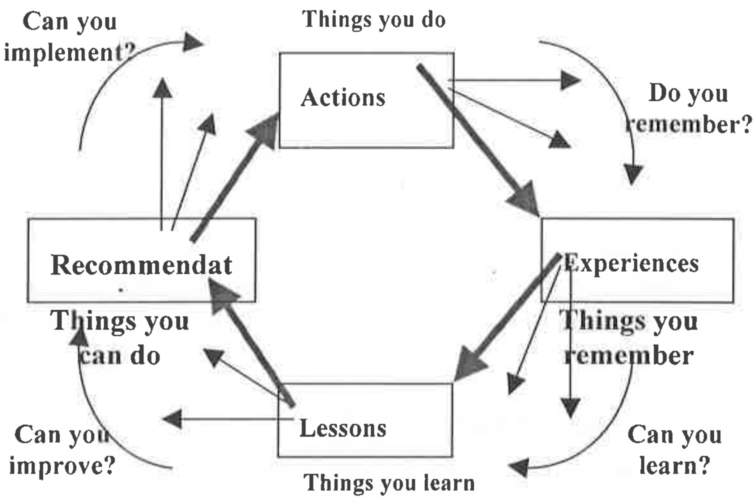

Figure 1. Learning Model

Actions; the "things we do" to carry out the work, complete our tasks and achieve project objectives.

Experiences; the "things we remember" – these flow from what we remember and, while some may be forgotten, the most important will be remembered if captured in a timely manner.

Lessons; the "things we learn" – these are based on our experiences, they represent a high level of distillation and understanding with any number of experiences supporting one or more lesson.

Recommendations: the "things we can do" – lessons are of little value if they can not be implemented and if they do not lead to improvements in the "things we do" in the future.

The interviews focused on actions taken and experiences gained. It was important for both interviewer and the interviewee to distinguish between valid experiences upon which lessons could be based and the emotion of the moment. Time was an ally in this matter and interviews were scheduled after a reasonable period for reflection and understanding.

Lessons learned were discussed with interviewees from time to time but were, in the main, developed by the principal investigators. They repeatedly asked themselves the question "What can we learn from this experience to improve performance in the future". It was seen to be necessary for lessons to be based on one or more experiences, be timeless fundamental and applicable under many conditions. All valid lessons learned should lead to at least one recommendation.

Representing Results

The relationship between experiences, lessons and recommendations was carried to the final format used to present findings and develop a database of lessons learned and recommendations. An example of the format covering one set of experiences, lessons and recommendations concerning the technical aspects of the comprehensive agreement is given as Table 1. This is presented here for illustrative purposes only and, while the recommendations presented are certainly valid, they are better seen in the context of the full report.

The Academic Partnership was established with the specific objective of "improving the planning and execution of

Table 1. Outcome Representation Format

Lesson	
Project identification	L-1.1

Things we learn – Based on our experiences, timeless, fundamental and applicable under many conditions. A lesson learned should lead to a recommendation.

The long range planning done by the DOT is the principal source of information regarding potential PPFDB projects.

Experience		Recommendation	
Project identification	E-1.1	Project identification	R -1.1

Experience

Things we remember - specific to a given event, process, time and location.

The project was identified from a review of the VDOT 6 year plan. It was clearly a required transportation link that could relatively easily be isolated for toll collection purposes. Traffic studies had been done and were positive, the IS had been completed and approved. The local community wanted the road built yet funding in the medium to long term was unlikely.

Recommendation

Things we must do to improve performance and increase or decrease the probability of the event occurring.

Keep informed as to the DOTs 6 year plan to identify projects that can be structured as a PPFDB proposal. These projects will

- Be definable in a manner where revenues can be assessed
- Most likely have some long lead items like the EIS complete

Have institutional and political support that can be strengthened and certainly maintained

complex design build public-private infrastructure projects by ensuring that experience gained on all phases of the Route 895 Connector Project is documented and carried forward to future projects." This is clearly a work in progress. Much has, and will continue to be done.

Preliminary Outcomes

Much of the work to record experiences, develop lessons learned and make recommendations for the early phases of the project has been done and it is possible to report on four preliminary outcomes at this time.

Developing the technical concept.

The importance of early technical decisions has been repeatedly emphasized by many authors (Gibson 1994, O'conner 1996, Russel 1992), . This in nowhere more important than on design build projects of this nature. Early technical decisions on matters such as roadway geometry and bridge structural systems establish boundaries for much of what follows. These boundaries can be severely restricting if the early conceptual decisions follow a more conventional design-bid-build process and do not permit the optimization possible through true design construction integration.

The early active involvement of all members of the design build team in all aspects of the technical concept will result in a true and fundamental integration of design and construction expertise. The detail decisions that bring the technical concept to fruition will create additional efficiencies but none will have the same level of impact.

In addition, involvement builds commitment. An early involvement by all members in the technical concept builds commitment to the concept and to the success of the project as a whole.

Establishing the lump sum price.

Establishing and agreeing the fixed lump sum price for a major privately financed project is no trivial task. VDOT, as the public agency responsible for the provision of transportation infrastructure in the Commonwealth of Virginia, was clearly involved. So too was the financial community who needed assurances that the project could be designed and built for a sum that would not exceed defendable traffic revenue forecasts. Estimating standards and norms for highway construction in Virginia are based almost entirely on unit rate design-bid-build contracts. Under these conditions the design is complete, the scope of the contractor's services is defined and there are established procedures for adjustments to the contract price for changed conditions and the like. Not so on projects of this nature. Design information does not exceed that needed to establish the technical concept, the scope of the contractor's services is defined by their total project responsibility rather than by the narrow confines of a single contract or bid item. Furthermore, adjustments to the contract price are all but impossible.

Two mindsets clearly need to change. First, contractors must develop the skills needed to make, defend, argue and commit to cost estimates based on conceptual designs and incomplete information. This is not easy in an industry where detail unit rate estimating for narrowly defined work items is the norm. Second, owner organizations and others that review, evaluate and accept bid prices must accept that norms established when information is complete and scope is narrowly defined do not and can not apply to a situation where the technical concept is all that is available to fix the price for total project delivery.

Maintaining critical momentum.

Substantial pre engineering work necessary to fix the roadway alignment, obtain regulatory approvals, define right of way and identify utility clearances must be done in order to prepare and present the development proposal. This work is halted once the proposal is presented and remains on hold for a substantial period while the comprehensive agreement and financing plan are negotiated. Momentum in these critical early activities is thus lost and much of what could be achieved in schedule compression falls prey to delays in contract negotiation.

A mechanism must be found to maintain momentum in pre engineering activities while contract negotiations are underway. It would be a great advantage if the negotiating parties could agree an early development contract permitting defined pre engineering work to continue during negotiations. The owner would make funding available with repayment due when the comprehensive agreement is finalized. If the agreement is not finalized and if the project does not go ahead, then the work undertaken under the early development contract would accrue to the owner who would realize its value when the project is constructed at some future date.

Measuring design progress.

Integrating design and construction is the key to success in a design build project. This integration has two dimensions. First, the design must take account of construction means and methods and seek to maximize efficient construction processes. Second, the flow of design information must support the construction schedule and thereby maximize continuity and rhythm in the performance of the work.

Traditional methods of measuring design progress and, particularly, design percent complete, can not be used to ensure a timely flow of design information to construction. Simply put, 85% completion in a design package is of little value if the missing 15% cover the work needed to start construction. This is not an unusual occurrence as we often design "from the top down" while we invariably build "from the bottom up". Metrics to ensure that design progress is consistent with the construction schedule must be developed. Much can be achieved by focusing on the ordered flow of required design information as the principal measure of progress in design.

Conclusion

The academic partnership created between VDOT, FD/MK, and Virginia Tech on the Pocahontas Parkway project provides and excellent model to document and formalize lessons on emerging procurement methods such as public private partnerships. The 4 phase learning model created for the project consists of actions, experiences, lessons, and recommendations. This model provides a formalized structure to capture and analyze project data. A database presentation format was presented. Preliminary outcomes of the project include developing the technical concept, establishing the lump sum price, maintaining critical momentum, and measuring design progress.

REFERENCES

Ashley, D. et al., (1998). "Evaluating Viability of Privatized Transportation Projects", *Journal of Infrastructure Systems,* ASCE, 4(3), 102-110.

Gibson, E., et. Al. (1994). *"Analysis of Pre-Project Planning Effort and Success Variables for Capital Facility Projects*", CII publication SD-83.

O'conner, J., et. Al (1996). "*Improving Industrial Piping through Vendor Data and Package Unit Processes*", CII publication RR 47-11.

Russel, J., et al. (1992). "*Benefits and Costs of Constructability: Four Case Studies"*, CII publication SD-83.

Songer, A.D., Diekmann, J., and Pecsok, R., "Risk Analysis for Revenue Dependent Projects*", Journal of Construction Management and Economics*, CIB, 15(4), 377-382, 1997.

Showers, J, et. al., "*Design of the Route 895 Bridge over the James River"*, TRB paper No. 01-2360.

Design Programming
Implications for Procurement

Christopher J. Marsh,[1] & Morledge, Roy[2]

Abstract

The current trend in construction procurement is to find an arrangement that delivers superior levels of time, cost and value for a specific construction project. In doing so, clients have begun to favour arrangements that overlap design and construction activities, in the assumption that overlap savings will deliver cost and time benefits. This assumption is based upon the notion that concurrent design and construction can be used.

However a review of previous research shows that design programming and design management are currently of both poor quality. Furthermore, the ability to programme design, and therefore establish the correct overlap with a construction programme, is not understood.

The paper explores the issues surrounding the subject of design programming and relates this to current problems in construction. It puts forward a methodology for establishing a suitable time period for design.

Keywords: design programming, technology clusters, concurrent design, design management, procurement programming

Introduction

Current sources used to establish design programmes are out-dated, namely NEDO (1983 and 1988), although these

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documents give overall times, the detailed build up of the required time must be established, to ensure the design and construction overlap is comparable to the procurement arrangement. Knowledge bases within the supply chain need to be captured and introduced at the appropriate time for efficient and quality decision-making. Therefore, the most important element in any design programme may not be the overall duration of the activity, but rather where it occurs in the specific sequence, together with the specific nature of the activity.

Due to the scope and complexity of design, the research concentrated on "institutional" steel framed industrial buildings, varying in size from 1,000m^2 to 12,000m^2 and generally complying with the RIBA Section Class 2 of buildings.

Synopsis

Savings in time can be achieved by overlapping the design and construction phases, and non-traditional procurement routes allow this to be more easily carried out. Most procurement guides reiterate this point, showing graphical representations on how design and construction can be overlapped (Masterman 1992, Turner 1990 and RICS 1996). What these authors fail to recognise when showing the overlap is the class of building involved. Sub-programme issues affect overall programme times within the procurement stage. For example steelwork is limited by available section sizes in the market place and the fabrication time required.

The strength of any model of a design system lies in the ability to apply to all levels, as each element of a building is a sub-system requiring its own design and procurement process as a self-contained item (Murdoch and Hughes 1992). Good management, and therefore good programming, must identify these elements and the information sources, normally from the specialists, and co-ordinate their timely input. The timing of this input by a specialist is critical (Gray 1997 and NEDO 1983). Designers and suppliers of specialist services should be brought in at an early stage in the design process as their expertise in advising on the best solution would ensure that their own contribution could be fully integrated into the project design and construction programme at the appropriate time (British Round Table 1994). By not appointing the specialist in time, usually caused by the chosen procurement route, a hiatus in design can occur (NEDO 1988). Therefore the design programme and programme route are inseparable and must be considered together

Gray (et al 1994) and Reading (1996) have put forward mutual observations regarding technology clusters. Both recognise that a building is built up from a series of elements that can be gathered into lumps, based upon the technology and performance criteria of the various elements.

Reading (1996) states that a typical building can be divided into 7 such clusters, namely:

1. sub-structures	2. structure	3. envelope
4. service core/risers/plant	5. horizontal surface finishes	6. vertical surface finishes
7. entrance and vertical circulation spaces		

Reading (1996) states that by organising the project into such clusters, the correct information from specialists and consultants can be input at the correct time and level.

The RIBA Architects Appointment (1983) breaks the architects work into the stages shown in the Table below.

If the fee stages are proportional to the man-hours required to complete the phase, then the framework for a design programme exists. It is interesting to note that the stages break down into fairly equal units suggesting that each phase of design takes a relatively equal amount of effort and therefore time. It should also be noted that if production information is not carried out until stage F and G, theoretically any overlap between construction and design cannot commence until 75% of the design phase has been completed.

Work stage	**Fee proportion**	**Total**	
A - C	15%	15	outline proposals - sketch plans
D	20	35	scheme design - sketch plans
E	20	55	detail design - working drawings
F G	20	75	production information - working drawings
H J K L	25	100	site supervision

Research carried out by Nicholson and Naamani (1992) into commercial buildings showed there was little relationship between fee income and cost of providing the required services for a specific project. Their research showed that projects between values of £1-3 million showed a steady level of staff costs of £30,000 (1989 prices). It can be reasonably assumed that man-hours also remain constant. If this is so, then it is assumed that design programmes remain constant for a given type of building, regardless of its size.

Part of the reluctance or non-use of design programming is due to the nature of the architects contract with the client. There is no requirement in the standard RIBA Appointment (1986) for the architect to programme their work, other than to 'prepare an outline timescale'. Section F of the Architects Job Book (RIBA 1983) states that architects should develop a register of drawings and schedules required for the project. The interesting point about this is it is recommended to occur at Stage F of design, that is, after detail is completed.

Preparation of design must be directed towards facilitating on-site progress, as construction is directly affected by design coherence and timely communication of information. Therefore the compatibility of both design and construction programmes needs to be established from the outset of construction. The NEDO reports (1983 & 1988) found there was a direct correlation between the speed of a project and the flow of well co-ordinated design information. Therefore the components of a design programme must not only establish the overall feasibility of an overlap, but also ensure the model of individual pieces of information are co-ordinated in a timely manner.

This aspect of information delivery is currently becoming more complex due to the involvement of specialist contractors. Therefore the design programme does not merely have to deal with the consultant's information outputs, but be able to co-ordinate and state the requirements of the specialist's contributions. Continuity of design is severely affected by timing of appointments, research shows site operations were severally affected by delayed documentation due to inconsistent sequencing of design and specialist input/information (NEDO 1988).

Research Application

Primary data was gathered through the extensive analysis of 40 projects (later reduced to 7 for detailed analysis) produced by the in-house architectural department of a major Plc property developer. These were analysed in detail for design programme attributes and methodologies. The project time sheets were evaluated to show the patterns of time spent, with detailed design and schematic design being shown separately. The results were surprising. All of the projects showed the same time period patterns, together with sub-patterns of unique time peaks.

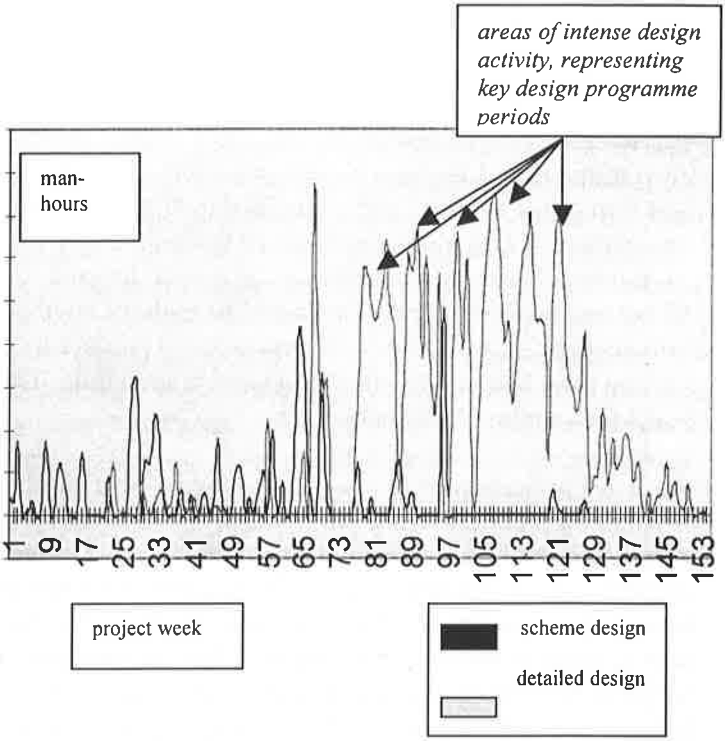
Two time patterns emerged from the data (Diagram 1):

general pattern - the time taken for design showed the same general pattern for all projects. Scheme design formed a typical asymmetrical distribution curve, showing a middle period of intense activity, together with a secondary activity just prior to the commencement of the working drawings. The working drawings section also showed an asymmetrical distribution curve, which was characteristically larger than the first and was also the mirror image. The working drawing curve commenced with high period activity, which was then followed by a general declining level of man-hours input over the remaining project time.

sub-pattern - a distinguishable sub-pattern was evident in both of the two design curves. These are evident from the isolated periods of sudden activity, followed by a diminished period of activity. Ones occurring within the scheme design were mainly caused by alternative design solutions being explored. The frequency of these patterns was normally affected by changing client requirements and re-designing caused by external factors. These same factors were also one of the major reasons for the often-long periods of zero activity. Planning permissions and client indecisiveness of the required product were the two most common cited reasons.

As Diagram 1 shows, the design activity is clearly divided by the extended frenzied activity of concept deign and the periods of intense detailed design. This period is characterised by intense design clusters, representing the major key stages in each project. All project reviewed showed this same intensity of sub-phasing. The overlap time between scheme and detailed design is another key indicator. Projects showing expedient construction had minimal overlap.
An analysis of the scheme design showed certain trends within the data. These were compared with overall trends for building construction and show that there is a direct relationship between speed of construction and building size.

Diagram 1 – showing typical design programme times



Scheme design periods were analysed in order to identify if this same trend was evident. It was believed that larger buildings would take longer to design due to the inherent number of variables that would be applicable as the building size increases.

The results were surprising, showing a wide distribution of results that appeared to be independent of both building size and value. The application of a polynomial trend curve showed a fairly even distribution curve averaging between 1000 to 1750 hours to produce the working drawings. This curve reached its peak at a building of approximately 5,500m^2 floor area. At first it was believed this was caused by an optimum time to produce the drawings that was directly related to office size and other variables. However detailed analysis showed this curve was related to other factors, mainly the time taken on site for supervision and the overlap between design and construction.

Adjusting for external works drawings, the number of drawings produced for each project remained constant, circa 10 drawings for external works and 20 drawings for building. The output of a larger number of projects show design output per drawing does vary from 20 to 35 hours per drawing, with the average being 30 hours. This is in line with the BDP (1982) document that shows the typical time taken to produce a drawing is 20 hours, plus 40% for administration time. This would give a total of 28 hours.

The seven projects were analysed for drawings that were common for all buildings. From this analysis 27 drawings were identified as both being common and to be the most influential on the design programme. Their influence was two fold - either through the sequence in which they were developed or through their required development in order to allow another area of design to be realised. Certain drawings were found to be facilitators of information to allow concepts to be developed, i.e. wall sections had to be developed in order to check elevation dimensions and interrelationship between support steelwork and external cladding materials.

Time taken in the scheme and detailed design stages show discrepancies when compared separately but show remarkable consistency when compared together. This is mainly due to differences in design methodology, i.e. sketchy design requiring translation vs. analytical designs that are able to be used for direct development of details. Certain architects produced sketch designs of sufficient quality and scale that allowed direct use as a working drawing. Therefore although produced in the scheme stage, resulting in a longer period, the working drawing period was shortened due to lack of rework by a technician.

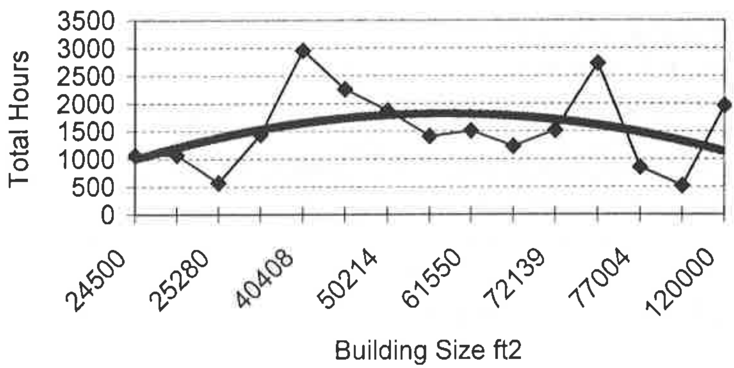


Diagram 2 – showing design time trend line for a series of projects

The ability to implement concurrent engineering successfully relies on the ability to have compatible design, procurement and construction programmes. However it is not possible to have totally concurrent programmes as the project must commence with design. Therefore some stepping of programmes is inevitable. An analysis of time taken in design prior to construction (Table 1) shows an interesting pattern of similarity. Koskela (et al 1996) and Ibbs (1997) have stated that construction in concurrent projects could not start until 27% or 40%, respectively, of the overall design period had elapsed. An analysis of the actual design programme showed no similarity between projects or evidence of being affected by any major project variable. However when the combined times of scheme and detailed design are considered a fairly consistent ratio of 45 - 50% becomes evident.

In industrial building design steelwork deliveries are the most critical time in both construction and procurement programmes, as it provides the framework for all other building elements and normally has the longest lead in time for materials. Of the seven projects identified in detail, three projects had steelwork ordered at the 20% period, while three others commenced at the 27 - 35 % stages (Table 1 refers). However these three later projects were multi unit's projects, and realistically times would be longer for multiple buildings. Although subjective, it is a sensible conclusion that the 20% design stage is a clear milestone.

Table 1 - analysis of percentage of time taken prior to construction commencing

	Percentage of time taken prior to commencement of construction			Steelwork tender	
project	detail	combined		week no.	
A	13%	27%		18	
B	36%	50%	averages	44	
C	28%	45%	detail 29%	20	
D	36%	51%	combined 45%	20	
E	26%	46%		27	3 units
F	32%	50%		35	5 units
G	18%	59%		35	3 units

The notion of technology clusters appears to be very relevant to the aspect of design programming. The study of man-hour input shows that design was carried out in a series of linked clusters. These clusters appear in the same sequence, regardless of design solution or specific project factors.

The seven clusters identified by Reading (1996) have been mapped on the developed design programme. The programme shows the clusters are indeed self contained within the specific design stages and therefore this readily lends itself to major aspects of design management. Design programming can be approached not as a whole entity, but as a series of linked steps, most of which are self-contained by their function, unity of time and means (Koskela et al 1995).

The developed man-hours graphs together with the programmes of drawing production were then compared against the stages of the RIBA Plan of Work (1983) to test the relevance of the criticised document. The resulting design programmes were then broken down into the respective RIBA design stages. The results of the comparison are outlined in Table 2. The developed figures show little consistency with RIBA guidance within the Plan of Work. A heavy inconsistency is displayed between the RIBA document and stages A-C and D.

Table 2 - Percentage of time spent on various work stages

Stage	RIBA Recommended Percentage	Project Actual Percentage of Time Taken							
		A	**B**	**C**	**D**	**E**	**F**	**G**	**average**
A-C	15	5	5	5	3	7	3	14	6
D	20	10	7	8	13	13	15	13	11
E	20	43	53	49	62	53	56	37	50
F-G	20	15	10	7	13	14	12	10	12
H-K	25	27	25	30	10	14	15	25	21

Architects typically spent 35-40% of their time on management issues rather than design. This figure is backed up by BDP (1982) document which states that the following percentages should be added to any calculated design times for the administration / management duties:
13% recommend as addition for checking time
14% recommended as addition for general administration
13% recommended as addition for scheduling

The total percentage therefore shows that architects are expected to spend up to 40% on non-design duties. This is probably a leading problem in programming in that it is largely a management issue, rather than planning a tangible output.

A provisional design programme has been developed based upon the analysis of the collective data.

The result of the research has identified 9 key stages of design development that were common to all projects.

1) ***concept proposals*** - initial concepts based upon pure design principles, typically the most creative part of the design. The specific duration of this sequence typically only took between 3-6 % of the total design man-hours, but the specific time period varied considerably. The affect of planning regulations and clarity of brief were influencing factors.
2) ***2D concept check*** - the site was specifically laid out with the initial concepts cross checked to ensure the logic of the building design and site layout were comparable
3) ***3D concept development*** - this stage develops the concept into sketch 3D drawings where both elevations and floor plans are cross-assembled to determine the overall logic and feasibility of the design.
4) ***2D horizontal co-ordination*** - with the specific building design developed in the last stage, the site is specifically laid out and the feasibility of the building design is checked against site constraints
5) ***2D dimensional co-ordination*** - this stage commences the working drawing stage with the layout of properly dimensioned and drawn plans of floors, elevations and cross-sections. These are laid out to scale taking into consideration actual construction arrangements and dimensions.
6) ***3D dimensional co-ordination*** - at this point the design programme becomes complex due to the multi sequence of differing design programmes. Sufficient information is produced at this point to allow structural, civil and certain major elements to become designed in parallel.
7) ***finishes layout*** - this stage forms one of the largest area in which time is spent within the programme. The finishes layout includes different forms of drawing for detailed joinery drawings, to schedules of finishes, through to conceptual drawings for contractor-designed elements
8) ***component layouts*** - most programmes showed that these

type of drawings were produced at the later stages of the design programme, but were not specifically sequential. Their detail and number produced was directly related to the specific requirements of the design.

9) ***construction supervision*** - although not specifically design orientated, the last stage is the on site supervision of the executed design. It is also one of the largest areas in which an architect's time is spent.

Table 3 - Design Programme

Stages								
Initial Concept		Secondary Concept				Drawing Production		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
concept proposals	2D concept check	3D concept develop	2D horizontal co-ordin	2D dimension co-ordin	3D dimension co-ordin	finishes layout	component layout	supervise
Programme Time								
7	2-3%	4-7%	2-4%	10-20%	15-25%	15-25%	5-10%	17-30%

engineering concept commences

engineering detailed design commences

construction commences /procurement overlap

The sequential ability of the design development is upheld by comparison of the actual times taken within the project programme studies. It showed that parallel working by more than one individual only occurred during the later stages of the design programme where sequencing of design is possible. This occurs after stage 5 where grouped sets of unrelated drawings are produced.

Conclusion

Design management was cited as being one of the most important areas for programming as nearly 40% of an architect's time is spent within a pure management role.

Current design programming is inadequately being carried out by the industry. The result is projects which are being built with an undue influence of poor design management. Sub-programmes of the procurement stage limited the possible overlap between construction and design, which is a key factor in proper procurement selection.

Acceleration of the design programme may be detrimental to both the concept and detailed design stages. The result may be an inferior built product, which is a disservice to all parties involved within a project.

The developed design programme begins the process of developing a framework for further research and development of a useable programming technique. It further allows the establishment of correct fees for a given project as the fees stages have been clearly identified. The developed programme has made considerable progress in identifying key design stages and the percentages of time taken for each stage.

Bibliography

British Round Table, 1994, *Controlling The Upwards Spiral*, London, The Business Round Table

Eldin, E.,1991, Management of Engineering/Design Phase, *Journal of Construction engineering and Management*. Vol. 117 no.1

Gray, C., 1997, Iterative Design - Essential or Poor Management, *Journal of Architectural Management*, September 1997

Ibbs, C.W., 1997, Quantitative Impacts of Project Change : Size Issues, *Journal of Construction Engineering and Management*, September 1997

Koskela, I., Lahndenpera, P., & Tanhuanpaa, V., 1996, Sounding The Potential for Lean Construction, Birmingham, *Proceeding from Fourth Annual Conference of the International Group for Lean Construction*

Masterman, J.W.E., 1992, *An Introduction to Building Procurement Systems*, London, E & F Spon

Murdoch, J., & Hughes, W., 1992, *Construction Contracts - Law and Management,* London, E & F Spon

NEDO, 1983, *Faster Building for Industry*, London, National Economic Development Office

NEDO, 1988, *Faster Building for Commerce*, London, National Economic Development Office,

Nicholson, M.P., & Naamani, Z., 1992, Managing Architectural Design - A Recent Survey, London, *Construction Management and Economics*, volume 10 pages 479-487

Reading Construction Forum, 1996, *Value for Money*, Reading, Reading Construction Forum and The Reading Production Engineering Group

RICS, 1996, *The Procurement Guide*, London, Royal Institute of Chartered Surveyors

Royal Institute of British Architects, 1983, *Architects Appointment* , London, Royal Institute of British Architects

BDP - Building Design Partnership ,1982, *Planning The Work: Forecasting Production Information - Architect RIBA Stages F and G*, In-house Document, Building Design Partnership, unpublished

Turner, A., 1990, *Building Procurement*, Basingstoke, The Macmillan Press ltd.

The Quality of Design in Design and Build Contracts in Ireland

Joe G. Gunning[1]

Abstract

This paper presents the results of a survey of Clients, Consultants, Contractors and Sub-contractors, to investigate their views on the quality of design on projects which were procured through the Design & Build method. A postal questionnaire and structured interviews were used, and the sample was limited to the island of Ireland.

The majority of respondents were of the view that design quality is influenced by the procurement method, and that Design & Build produced the lowest design quality of all procurement methods. Many suggestions were put forward to explain this, including rushed decisions, lack of effective briefing, poor communication and cost cutting for short term gain. However, the definition of "good " design itself provoked controversy.

The paper concludes with a series of recommendations for improving the quality of design in the Design and Build process, emphasising functionality, adequate time and budget, effective briefing and subsequent communication, and an ethical, partnering approach from all stakeholders to a Design & Build project.

Keywords: Design & Build, Quality, Ireland.

Introduction

The construction industry has been the subject of many reviews, none of which reflected well on its performance. These criticisms are mostly well founded and are a good indication that a change in approach is indeed necessary. All

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were critical of the results being achieved and each report recommended changes in procurement arrangements. However to a large extent they were ignored, primarily because of their lack of direct legislative effect.

Directly or indirectly, Design and Build re-emerged in the early 1980's to answer some of these criticisms. The main benefits offered are single point responsibility, speed and savings in cost. According to Cox and Thompson (1998) Design and Build developed in the 1980's from being a novelty to as much as 40% of all new building work. Rowlinson (1986) has highlighted the difficulty in accurate evaluation of the market share of particular procurement methods. Bennett et al (1996) suggested that 23% of the market for all new construction work is Design and Build. This decline highlights its shortcomings, and the growth of public private partnerships in the supply of construction.

A developing approach to Design and Build is the hybrid method of Novation as discussed by Morledge (1996). This sees the client employing a design team to advance the brief to a stage of development much further than is normal, and then invites the contractor to accept the novated design team into their organisation. This system now accounts for fifty percent of the total Design and Build market; however it has not achieved a high satisfaction rating with clients as a survey carried out by Bennett et al (1996) established that it only achieved twenty-eight percent of client objectives. Another hybrid is the Develop and Construct method used by notable clients such as the Ministry of Defence, Tesco and the Norwich Union. However, this is deemed by Ashworth & Hogg (2000) to limit the potential for buildability improvement, which is often an added benefit of Design and Build.

One area of Design and Build that is heavily criticised is the subject of design standards. It is an issue that gets a substantial amount of media coverage and not all of it complimentary. The importance of this topic can be best explained by the fact that a client will measure a project against a set of principles - namely time, cost and quality. Design plays a key role in all three and to get the best results in terms of time, cost and quality means to get the best design achievable. Design and Build offers one possible means to achieve the best design solution, and also allows for change in the client's needs.

Buildings in the United Kingdom have tended to cost more and take longer to design and build than those in other major economies. Consequently the integration of design and construction within the Design and Build process provides an opportunity to take advantage of modern technological developments and avoid the disruption caused by the separation of the two activities. This should be able to provide buildings with a more consistent acclaimed level of appearance and quality, coupled with the other advantages of this one stop service offers.

It is interesting to note that the 1996 report from the Centre for Strategic Studies in Construction ['Designing and Building a world-class industry'], does not identify high levels of functionality or quality as a benefit when using this method of procurement. This result undoubtedly reflects the prevailing attitude among architects, that design and build is most suitable for simple uncomplicated projects, and the belief that the aesthetics and quality of the finished product when using this method is lower than that achieved by other systems of procurement. Architects tend to support the view of Pevsner (1943) that the term "architecture" applies only to buildings designed with a view to aesthetic appeal.

The fact that aesthetic design quality has not been widely considered as an important issue in procurement selection can be exemplified by the fact that "quality" appears only twice in the index to the definitive text on Procurement Systems by Rowlinson and McDermott (1998). Even these two appearances deal more with ISO 9001 and TQM than true design quality. Buildability does not appear even once as an indexed factor. Songer et al (1996) also found that aesthetic design quality or buildability did not appear in the ranking of success criteria on Design and Build projects by 137 building clients in the UK and USA.

The Advantages of Design and Build

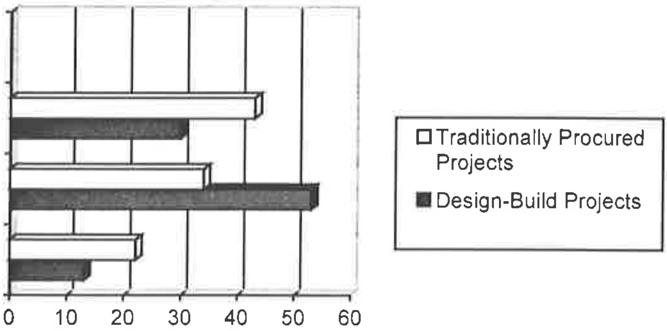
In the guidelines for major projects issued by the Treasury Central Unit in Procurement in 1992. *'Design and Build was recognised as having clear advantages in terms of cost and time certainty, offering a single point for project responsibility and, if things should go wrong, for damages recovery'.*

When compared to other procurement routes projects undertaken through the design and build route tend to be completed in a shorter time period. A contributory factor for this is the considerable overlap which can be incorporated between the design and construction phases in design and build projects as well as improved communications between the various members of the project team, the integration of the two basic functions of design and construction and the improvement in buildability and the use of contractor's resources resulting from this latter characteristic. (Masterman, 1992).

In a dispute as to any alleged defect between the employer and contractor, it is the latter who then has the problem of fault allocation as between, architect, engineer, subcontractor and so on. The basic theory highlights the fact that, under the arrangements of design and build, the contractor holds full responsibility and therefore, there is no one else to blame for such defects. A high level of price certainty also pertains, assuming no significant client changes.

Figure 1

(The Industry Today, 1996)



It is believed that the increase in design and build contracts in the last 20 years can be partly attributed to the advantage of offering a single point of responsibility. It was quoted in Building, (17 July 1987) that the traditional procurement route is seen by many clients as:
'*...A horde of squabbling consultants, surrounded by a sea of disorganised contractors, sub contractors and suppliers, with the client left to sort out the problems and foot the bill*'.

The Possible Pitfalls of Design and Build

Although the advantages of the design and build procurement route have been emphasised, it is important to mention several disadvantages which may influence the client's decision on which procurement route to select. Comparison of tenders, which are based on different design alternatives, is frequently a fundamental problem.
The client's preparation of their project 'requirements' is a prime example of where a difficulty may arise. The client's requirements must be set out very clearly and precisely in order that no ambiguous circumstances are allowed to present

themselves. These requirements are best conveyed through a performance specification. Preparing such a document is difficult, as it requires the client to specify the criteria that must be satisfied. This is a far greater task than simply specifying particular materials and workmanship to be used. Consequently, the quality of design produced by the design and build procurement route depends greatly on the quality of the performance specification. The client usually finishes up buying a building that is yet to be fully designed.

Additional problems may arise when the client wishes to alter the design during the construction process. Client's variations are often difficult to incorporate into the contractor's design, construction and programme schedule. The client is often likely to be charged excessive rates for any changes, because of the lack of a bill of quantities upon which to value the variations. Turner (1995) has criticised the vague allocation of design responsibilities in this procurement method. Ashworth & Hogg (2000) indicate the potential for extending design liability beyond " reasonable skill and care" to include "fitness for purpose". Aesthetic design quality is rarely considered.

Structure

The research programme took the following structure:

- The collection of primary data to corroborate key points through questionnaires and structured interviews on the topics of;
    1) The meaning of 'good' design
    2) Influential stages of a project programme on design quality
    3) Design quality under design and build
    4) Effect of procurement method on design quality
- Analysis of primary data collected, and comparison with secondary data
- Determination of conclusions and recommendations based on the data presented.

Design Quality

Once a client's requirements for a proposed building are defined there is a need to analyse the alternatives of satisfying these requirements. This is where the design phase of a project first begins. Thus when the requirements or brief are put forward the designer has this as his goal. The search is for a physical solution to a series of perceived and generally understood problems. However occasionally these are not perceived correctly and consensus within the team may be difficult to achieve.

Building design decisions must address amongst other things, existing technology, materials, finance, time and human resources. In building design attention must be given to the primary driver of design, the client. Before design work begins the context, objectives and constraints of the client and his organisation must be considered.

The concept that buildings should be viewed as systems is central to defining design. The purpose of good building design is the optimisation of the architecture supporting that system. Modern buildings are often highly complex systems and contain many elements that are linked together to create a completed project. Thus it can be seen that it is the arrangement of these elements in geometric or spatial form and operational relationships that comprises the architecture of a building. It is at the early stage in the lifetime of a project that there is a need to draw together the functions that will impact on design.

The main problem is defining quality is that the meaning of the words can be very abstract. In particular situations it can have a different meaning for different people. Thus for some people quality may involve "goodness", "expensiveness", "having class", or "satisfying". These interpretations are however imprecise and are at best an example of how abstract a definition of quality may be.

People have different perceptions of design quality, due to their own particular interests. Therefore to define "design quality" in the construction industry, the characteristics of the industry must be considered. Design quality is often used to signify or express the "excellence" of a particular building or project. The many definitions of quality may not be applicable to each project. Two popular definitions of building quality are; *"A dynamic process within which each party to that process conforms to the requirements of the project, resulting in the satisfaction of client expectations"* and *"The successful integration of the components and practices that comprise a project, reflected in the resolution of a client's expectations through conformance to requirements"*.

In the words of Egan (1998), quality must be fundamental to the design process. However, he goes on to emphasise that "defects and snagging need to be designed out before work starts on site." In other words, he does not really value the aesthetics of design, showing great enthusiasm for standardisation and a "right first time", Zero defects approach. This view is shared by many in the construction industry, but not by architects.

Survey Results

The majority of responses to questionnaires distributed were received within three weeks of distribution. Generally it appeared that respondents had carefully considered the questions, and in a few instances there were invitations to discuss the topic further. The data as presented is specific to group and a further breakdown was possible in the consultant group between architects and quantity surveyors, to give an understanding of any biases that may exist and point out areas of agreement/conflict between professions or groups.

Influences on Design Quality

Respondents were asked which stages of a project programme are the most influential when design quality is considered. The initial stages of a project were seen to be the most influential when design quality is considered with production information, and tenders were second. From this data it is important to note that detailed design was placed fourth, which suggests that the important qualitative decisions are taken prior to this stage of a project.

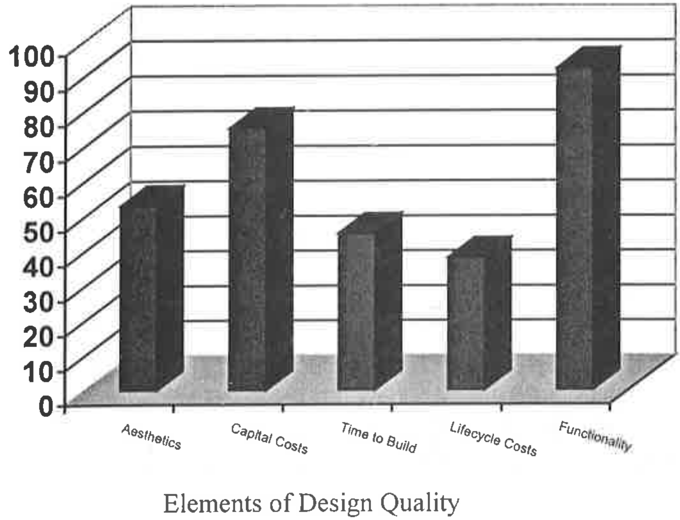
Table 1. Responses to the Questionnaire

	Number Sent	Returned Completed	%
Client	25	7	28
Consultant			
Architect	15	6	40
QS	15	5	32
Contractor	25	8	32
Sub contractor	20	4	20
Total	100	30	30

Respondents were asked to rank given elements according to their influence on design quality. They were to be ranked in order, and indicated that functionality is the most important influence on design quality, with lifecycle costs the least significant.

The most notable feature of these results is the importance placed on functionality; also of note is that architects place aesthetics as the most influential element in design quality, the opposite of the other three groupings. This is not surprising; also of note is the far lower level of importance that contractors and sub-contractors attach to life cycle costs compared to the other professionals. The increasing importance of lifecycle costs and building for the long-term, now an important factor for many clients, has not yet been fully realised by contractors and sub-contractors.

Figure 2. Weighted Influence of Elements on Design Quality by Complete Sample



There was a general consensus among the respondents on three of the factors adversely affecting design quality,

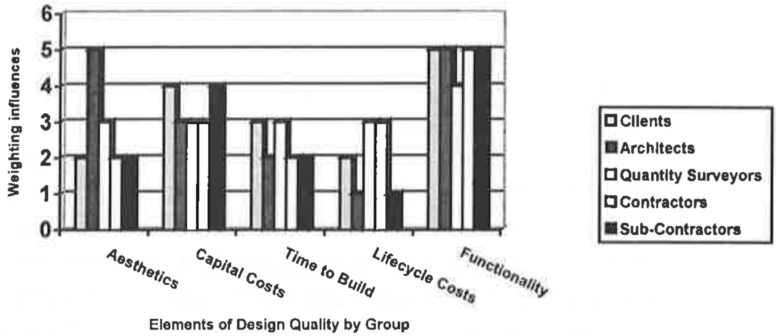
- All groups identified lines of communication as being unsatisfactory
- Short timescales had a negative impact
- Cost cutting was seen as directly affecting design quality

Design Quality under Design and Build

A most critical question is the definition of design quality. The response to the questionnaire identifies that there is a lack of consensus among the participants. Indeed there are some notable differences between the various groups of respondents as to what specifically constitutes design quality.

The architects among the groups gave various definitions ranging from the poetic to the practical. In contract quantity surveyors were more specific in their appraisal of the question. Here the definitions were based more around familiar terms and examples. Again, there is the specific lack of a clear consensus as to what design quality actually involves.

Figure 3. Weighted Influence of Elements on Design Quality by Group



Contractors and sub-contractors among the respondents took the view of satisfying the clients' expectation. On analysis this group has come closest to the theoretical definition that the quality experts put forward. Their instinctive need is to satisfy clients because as Latham, (1994) points out "*without clients there is no industry*" (although this should apply to professionals in equal measure).

On the question of influential elements in design quality there is a clear view that the most important is functionality. The picture painted is another corroboration of the client objectives identified by Walker (1996) where, in the preparation of a brief by the client, the functionality aspect should be ranked highly. Analysis however indicated that there are areas of conflict.

These differences are more to do with professional influences than objective reasoning. In the view of the architects surveyed the element of aesthetics is uppermost, whereas in the view of the contractors it is placed third. For the sub-contractor the element of capital costs is the most important and this group equates quality with '*expensiveness*'.

The perception by both quantity surveyors and contractors that lifecycle costs are of more importance is in contrast to the view given by architects and sub-contractors. The close involvement of these two parties (quantity surveyors and contractors) in the post contract stage of Design and Build projects may be the reason for this lack of consensus.

Timescales for design would appear to be an important factor to which insufficient consideration is given according to the respondents. This may stem from the need of a client who is financing a project to have his outlay returned in the shortest possible time, and to get onto site at the earliest possible juncture. However it could be argued that in doing so the issue of design quality is negated and consequential losses due to design problems may arise after completion. That these would involve potential costs to the client that may outweigh any benefits he gained in cutting the design time short.

As Harkin & Gunning (1999) point out, quality is not something that can be specified into design in the way that materials are specified. Quality cannot be inspected into the design process or produced simply by compliance with ISO 9001. Lawson (1997) declares that there are no optimum solutions in design. Quality, in the words of Pirsig (1974), is both subjective and objective. Design quality needs to be managed sympathetically, with regard for more than efficiency and utility, and this applies particularly to Design and Build projects – where these two parameters usually dominate.

Effect of Procurement Method on Design Quality

Respondents were requested to indicate if procurement method has an effect on design quality. The results are presented below:

Table 2. Design Quality affected by Procurement Method

	Client	A	QS	C	SC	Total
Yes	6	6	3	3	2	20
No	0	0	0	4	0	4
Undecided	1	0	2	0	1	4
Other Opinion	0	0	0	1	1	2
Total	7	6	5	8	4	30

The table endorses the view that design quality is influenced by procurement method, with 67% of the respondents saying that the procurement route chosen for a project will have an influence on the design quality of the finished development, with only 13% expressing the view that it would not.

Respondents were invited to indicate if design quality was better or worse under Design and Build. The results are presented below:

Table 3. Design Quality better or worse under design and Build

	Client	A	QS	C	SC	Total
Better	0	0	0	2	0	2
Worse	6	5	3	2	3	19
Neither	1	1	1	2	0	5
No response	0	0	1	2	1	4

That only two of the respondents, or 6.5% of the sample, came out in favour of Design and Build (with 63.5% saying that it was worse), forces home the view that design quality is poorer under this procurement method. This is a serious problem and one that will have to be addressed if Design and Build is to maintain and increase its share of the procurement market. That the professionals of the construction industry should have such a negative opinion of design quality under Design and Build needs to be worked on at all levels in the supply chain.

The use of novation may be seen as a means for the client to pass on more of the risk than is equitable whilst still expecting the same level of commitment from the contractor. The 'design and dump' mentality of contractors to novated Design and Build is in many respects understandable. For the contractor the benefit of his involvement in the later design process is removed as the client seeks a guaranteed price and programme for preliminary designs with which the contractor has had no involvement, but must still bear responsibility.

Bennett et al (1996) also established in their research that Design and Build has a poorer performance in terms of meeting clients' quality expectations than traditional procurement methods. *"Only 50% of design build projects met clients' quality expectations, compared to 60% of traditional projects".* However, Bennett's report is somewhat ambiguous or contradictory on this issue, and suggests that "lower targets for quality are often set for design and Build projects". It also found that "the tougher the client's quality requirement, the more likely is a successful outcome".

The qualitative statements of the respondents describe a procurement route that is less than satisfactory where design quality is concerned. Architects amongst the respondents speak of *'fragmentation', 'too many masters and cooks', 'difficulty in monitoring final design and detailing', 'poor communication'.* These descriptives point to problems and dissatisfaction in this area. There is a particular problem with quality where novation is used.

Most quantity surveyors amongst the sample, along with contractors and sub-contractors, hold the view that it does result in poorer design quality. The argument that they put forward ranges from *"lack of continuity"* to *"cutting corners* *for short term cost gain"* to *"effects on durability"* and *"rushed decisions".* These are persuasive arguments as to why design quality is worse. In support of these arguments the results of a research interview suggest that where it becomes a choice for a contractor between cost and quality, then quality will inevitably lose out. The interviewee considered that the contractor will seek to maintain his profit level at the expense of quality. Indeed Hyett, (1997) further supports this where he claims that the contractor will manipulate design to maintain profitability again at the expense of quality. Architects tend to judge the quality of all buildings more harshly than contractors.

Conclusions

The meaning of good design has been defined as follows: *"The successful integration of the components and practices that comprise a project, reflected in the resolution of a client's expectations through conformance to requirements".*

The most influential stages of a construction project programme upon design quality where Design and Build is the method of procurement are the earlier stages. This encompasses the pre-planning phase and covers the areas of inception and sketch design up to and including outline design. Functionality is regarded as the key requirement to satisfying client expectations, but an appropriate level of aesthetic quality must be achieved in doing so.

This research has identified several factors in the process of Design and Build that have a negative impact on design quality.

- Poor communication amongst the parties to Design and Build contract.
- Insufficient time to analyse and consider design.
- Imprudent cost cutting of budgets.
- Difficulty in comparison of tenders based on

incomplete design.
- Clients' reduced ability to control design quality.

The findings of this study concur with the conclusions reached by Bennett et al (1996) and with corroboratory evidence from various published authors and texts as indicated. Bennett et al found that only 1% of clients rated quality as their top priority, and only 10% viewed it as important. Architects are alone in the construction industry in having aesthetics as their top priority.

This conclusion does not exclude the fact that Design and Build may in some instances produce good design. Indeed it has been established that Design and Build may well produce buildings and design quality of a high standard in particular situations. However the conclusion of this report is that, based on the empirical evidence presented, Design and Build does not generally result in good design. The implications of this conclusion for the Design and Build sector are for all to see. Without the best designs being achieved, clients will look to other methods of procurement to satisfy their needs. Unless these issues are addressed the efforts of the last twenty years will be wasted. An opportunity to progress Design and Build to the leading edge of procurement should now be grasped by the industry.

This study has limited itself to the assembly of empirical information within Ireland and the compilation of a supportive literature review. It does not claim to be an exhaustive study of the topic. The reasons for implying that its conclusions are valid is based on the primary research presented and the arguments developed with the support of secondary data.

Recommendations

Procurement procedures remain a dynamic activity; the construction industry will continue to evolve and adapt its procurement systems to meet the changing and challenging needs of society and the circumstances under which the industry will find itself working. There is little doubt that Design and Build has developed into one of the preferred procurement options of the industry to-day. It is expected that in the future building designs will become increasingly complex, costs will continue to escalate, projects will increase in size and clients will continue to make even greater demands upon the industry. As a result, the proliferation of procurement systems will continue.

It has however been suggested that as human behaviour is unlikely to change dramatically, clients will continue to choose the procurement systems they use from a narrow range of the numerous methods that are likely to be available in the future. Should this forecast prove to be correct, it will become even more important that clients are made aware of all the available procurement alternatives available, and make their choices by the use of more sophisticated methods of selection than are currently utilised.

The entrepreneurs of the construction industry are always seeking out new ways of satisfying the increasing demands of clients. The area of communication within the Design and Build sector should be researched in detail. The importance of this issue is identified many times in this study. The fact that poor communication was identified as a factor leading to poor design also suggests that where there is a problem with one aspect of a project, then the others must be affected also. In to-day's information age, problems of communication should not occur. However as one research interview revealed: *"Every single problem in the construction industry is on the join, the joining of people, of companies, of materials and of process".*

The challenge for Design and Build is to maintain and improve its strength in delivering buildings on time and within budget, whilst learning how to be more innovative and stylish. In other words Design and Build should become more broadly and genuinely design-led. After all; Certainty of Price, Time and Functionality + Design Flair = Satisfied Customers.

Further research and development into the areas outlined is required if the construction industry is to sell more of its products and improve efficiency and profit levels, within the wide range of Design and Build procurement systems. The notable absence of consideration of design quality in the body of research into procurement systems, needs to be rectified quickly.

Acknowledgement

The author wishes to acknowledge the contribution by M Shortall to the preparation of this paper.

References

Ashworth, A, Hogg, K (2000). *Added Value in Design and Construction*. Pearson Education Ltd., Harlow, UK.

Bennett, J, Pothecary, E, Robinson, G (1996). *Designing and Building a World Class Industry*. The Centre for Strategic Studies in Construction, University of Reading, RG1 5AQ UK.

Cox, A & Thompson I (1998). *Contracting for Business Success*. Thomas Telford, London UK.

Egan Sir, J (1998). *Rethinking Construction. The Report of the Construction Task Force to the DETR*. HMSO, London UK.

Harkin, F & Gunning, JG (1999). Evaluating Quality in Construction. *Journal of Financial Management of*

Property and Construction. Vol 4 No 3.

Hyett, P (1997). Narrow Objectives of Design and Build. *Architects Journal*, UK 19th Feb 1997.

Latham, M (1994). *Constructing the Team – Joint Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry*. HMSO, London.

Lawson, B (1997). *How Designers Think; The Process Demystified* (3rd Ed). The Architectural Press.

Masterman, JWE (1992). *An Introduction to Building Procurement Systems*. E & FN Spon, London.

Morledge, R (1996). *The Procurement Guide*. The Royal Institution of Chartered Surveyors London,

Pevsner, N (1943). *An Outline of European Architecture*. Pelican, London, UK.

Pirsig, R (1974). *Zen, and the art of Motorcycle Maintenance*. Vantage, Random House, London, UK.

Rowlinson , S (1986). *An Analysis of the Performance of Design – Build Contracting in Comparison with the Traditional Approach*. Unpublished PhD Thesis, Arundel University, UK.

Rowlinson, S & McDermott, P(1999). *Procurement Systems – A Guide to Best Practice in Construction*. Routledge, London UK.

Songer, AD Molenaar, KR and Robinson, GD (1996). Selection Factors and Success Criteria for Design-Build in the USA and UK. *Journal of Construction Procurement*, Vol 2 No 2.

Turner, DF (1995). *Design and Build Contract Practice* (2nd Ed) Longmans Scientific & Technical, Harlow, UK.

Walker, A (1996). *Project Management in Construction*. (3rd Ed) Blackwell Science, London

Pro-active Building Management
Improving the quality of airport terminals.

Michael Pitt[1],

Abstract

This paper summarises the current position with airport design and suggests that efficient use of facilities cannot depend upon shareholder return alone but must be based on national interest and efficiency demonstrated through external benchmarking. The paper suggests that facilities managers must be aware of the expectations of the airlines and passengers and the indicators used in the assessment of performance. The paper outlines the reasons that influence an airport's decision to upgrade or replace its terminal facilities.

Keywords : Airport, Design, Facilities Management, Performance.

Building Concepts

Although many different configurations exist for airport passenger terminal buildings virtually all can be placed into a few primary categories based on their geometrical characteristics. Two major passenger terminal building concepts have emerged in today's new, major and high volume airports. These may be defined as follows:

a. centralised passenger processing terminal building with finger piers as at the proposed second Bangkok international airport or Schiphol Airport in Amsterdam.
b. centralised passenger processing building connected by people mover system to satellite buildings airside as at the new Kuala Lumpur International Airport or Denver in the US.

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Although different types of passenger terminals exist, this paper concentrates upon the finger pier type such as that at Changi Airport in Singapore.

Expansion of terminal facilities is required to meet seemingly ever-increasing numbers of passengers in the aviation industry. This has meant that more air-bridges and finger piers have been required. This can be achieved through either new construction or alterations to existing structures. As a result extensions of existing finger piers are quite common. Walking distances and overall travel time must also increase as distances between check-in and departure gates also increase. Over time the standard of service offered to passengers will be affected. Subject to there being no land constraints there is potential to ever increase the distance that must be walked or over which baggage must be transported. This raises the question as to whether a maximum viable size exists for passenger terminal buildings.

Terminal Size Determination.

This paper concentrates on nine factors which are seen as essential to the determination of the size of airport terminal buildings.

Walking Distance - This factor has a direct bearing on optimum size and takes into account both user psychology and the human scale. The maximum walking distance recommended by the International Air Transport Association (IATA) is 300 metres unaided. Beyond this a moving walkway or other people mover system is recommended. Other localised bodies have their own recommendations. In the UK BAA have a policy of no greater than 250 metres unaided with an overall journey of 650 metres being permitted where a maximum of 30% is unaided. Singapore's Land Transport Authority suggests a maximum walk to a bus stop of 300 metres.

Level of Service For Passengers - It is important to determine the level service that can be sustained at any specific capacity level. It may for example be easy to sustain a high level of passenger service at 1000 passengers per hour but only a low service at 1500 passengers per hour. This is a strategic decision which should be made in advance of design and operation. It may be that different levels of passenger service are acceptable at different times. Hence in general a higher level of service will translate into a lower capacity for a terminal building of given size.

Performance Standards - Most airport owners or aviation authorities set themselves targets for the purposes of measuring performance. In the general area of facilities management the benchmarking of various organisations against others continues to be a matter of much discussion. In airport management the two most important measurements of performance success tend to be the time it takes passengers to clear the airport upon arrival and the time it takes for baggage to be delivered.

Traffic Peaking Characteristics - it was mentioned earlier that a trade-off may be necessary in terms of service to enable capacity to equal demand for passenger throughput. Efficient use of facilities is dependent upon avoiding the tendency for passenger throughput to peak. A constant throughput of passenger numbers allows efficient use of all facilities with no reserve capacity being required. A tendency towards regular peaks means that for much of the time the facilities are being left idle whilst still representing a cost.

Transfer Volume - This factor will affect the need for capacity in certain areas. A higher transfer volume will mean a greater need for airside facilities such as circulation space and transfer counters but a proportional lesser need for landside facilities such as check-ins and baggage claims. Minimum connection times become of greater importance with growing transfer volume.

Hubbing - Efficient hubbing is best performed from within one terminal and certainly one airport. In the UK British Airways have experienced considerable problems from being unable to hub at Heathrow in is entirety (Pitt,2001). The need to move passengers between terminals does not allow for efficient transfer times

Uncertainty of Demand - many factors affect the future demand for air travel both on a global and local scale. These factors include economic crisis, volatile transfer traffic, the continued relevance of hubbing in the light of longer range aircraft and the significance of airline alliances. These factors and others mean that it may be prudent for an airport developer not to overbuild (Wai & Teck, 2000). Consideration may be given to constructing flexible buildings in a modular form which can be modified in the light of unforeseen factors.

Sophisticated and Costly Airport Systems - some systems become so complex that the maintenance and redundancy back-up costs become prohibitive. Much like the size constraints mentioned earlier , technology too can be a restraining factor in the size to which airports can grow.

Wayfinding - the larger the airport the greater the need for effective and clear wayfinding.

Defining Optimum Capacity

It can be seen that optimum capacity is a subjective concept. The cosmopolitan origins of passengers on long haul air journeys are less likely to be prepared to tolerate crowded unpleasant public areas. In simple terms what the average flier will not tolerate will simply not do. This is of course far too simple a definition as the tolerance level of the holidaymaker is famously more (even though they may not know it) than the business traveller.

According to Blow (1991) the maximum capacity of a terminal with finger piers designed for hubbing is around 30 million passengers per annum with 50 gates. Wai and Teck (2000) point to the six fingered pier terminal as being the optimal design in terms of efficient aircraft and passenger movements. They conclude that the optimal capacity for a six finger pier terminal is around 25 million passengers per annum. This capacity figure can only increase if trade-offs are made in performance related issues.

Airport Performance

Much has been learnt about the design and construction of new airports as the massive expansion in air travel continues. Modern airports such as Changi in Singapore provide a better and more efficient experience for travellers than some of the more cramped facilities that are found elsewhere in the world. The location of the airport is often a major factor in its efficiency. The contradiction between the need to invest in airports and the form of ownership was identified by Pitt (2001). The need for some airports to answer to shareholders and not governments has led to the peculiar situation where privatisation has been a company success but a national failure. Airport design advancement has been fast and achieved largely in the last twenty years meaning that many airports across the world and particularly in the UK require replacement and/or relocation. In order to demonstrate the efficiency of airports both the airport owners and the airlines use performance measurements. These measurements are only meaningful if they are benchmarked against other similar facilities. It is for example virtually useless to compare London Gatwick with London Heathrow and conclude that their performances are similar as they are both to some extent outdated facilities in the same ownership. What is needed is benchmarking external and internal to the country and to the company.

An Airport's Multi-Customer Base

Airports may be defined as multi-customer based facilities in two distinctly different dimensions. Firstly, Airlines themselves are interested in monitoring the performance of airports to ensure that overall operations are efficient and cost effective but also that the passenger receives a good service from the airport airline and any combination of the two (for example : the provision and manning of check-in desks). Airlines are acutely aware that when a passenger flies regularly the choice might be airport first and airline second.

Maintaining a presence at a popular airport might be seen as essential by a network carrier such as British Airways. This ability for passengers to decide to fly from different airports represents the second dimension of an airport's customer base. It may be a decision to route through Amsterdam instead of Heathrow or to fly from Heathrow instead of Gatwick. In any event maintaining competing airports in different ownership is essential for competition to operate effectively. The extent to which an airport is ready and able to respond to the results of any benchmarking exercise is strongly dependent upon the form of ownership (Pitt, 2001).

As the requirements of the airport's customers are essential to its continued viability airports must be familiar with the latent grading that is adopted through research undertaken by airlines and the ratings placed upon airport performance by organisations such as the ICAO and IATA.

Airlines

The performance measurements used by an airline are often tools to bring shortcomings to the attention of airport staff. Very often the problem will be one over which the airline has no control. If airports want to avoid the exposure of weaknesses within their built facilities or management thereof they must be aware of what is being studied by the airlines and deal with these matters before they affect the competitiveness of the business. One of the main problems presented to airports is the difficulty in responding to the differing needs of the different types of airlines that are emerging (Pitt & Brown, 2001). Tables 1 and 2 below shows the customer service effectiveness measures that have been put in place by Aer Lingus the Irish national carrier and the resource utilisation measures used. These measurements are different to those undertaken by some other carriers but serve to illustrate the fact that airlines study airports and the interrelated, mutual and collaborative services that are provided.

Passengers

As much as airlines can move from airport to airport so passengers can choose a departure point. In the case of levels of service IATA has developed a framework which permits the comparison of airports and sub systems through the use of common terminology. Table 3 below shows the category definitions from A to F.

Many airports, such as the new Hong Kong International Airport are designed to meet level C standard as it denotes good service. The fact that the aim of one of the world's newest airports was to achieve only level C suggests that a compromise was reached between expenditure and service.

The level of attainment on this scale is an indication of the likely overall experience that passengers will gain at any airport. The decision to achieve a certain level of service is a strategic one.

Table 1 : Customer service - effectiveness measures

Dimensions	Why?	How - Aer Lingus
Design	relate problems to marketing with reference to conflicts between desirability and feasibility	correlate customer feedback - make it relevant and ensure it is fed back to source in this case check-in as well as marketing
Performance	are the frontline agents delivering as the organisation thinks they should be?	use customer relations information to monitor performance. Use an outside agency . staff appraisals - a function that is so people orientated that it is essential. The staff need to know what is expected and if they are performing
Reliability	if we are capable of delivering what % of the time is there a short fall?	establish metrics - e.g. throughput of passengers per day, amount of passengers dealt with per staff member, complaints per 1000 pax, % of check-in errors that caused delays.
Cost Reliability	staff should be aware of providing value for money i.e. delivering the specification.	it is important that the cost passengers are paying overall is noted. Likewise it is important that staff know the importance of yield.
Delay	are queuing times too long or could we have them longer.	measure queuing times in minutes not amount of people.
Duration	how long is exchange - could it be shortened and/or re-engineered?	study the actual exchange. It may be possible to speed it up if more attention was paid to transaction timing particularly during training
Timing reliability	what percentage of time is a recognised standard delivered?	establish standards and review if these are not being met e.g. no queue plus transaction time to be longer than 5 mins. Feedback from customers regarding specification will show what is acceptable.

Table 2 : Resource utilisation - efficiency measures

Dimensions	Why	How - Aer Lingus
Machinery/IT Equipment	it is necessary to see if there is downtime for the IT equipment. This could impact on capacity.	monitoring by staff to see the rate of systems failure
Labour	emphasis is put on "softer" elements. However it is necessary to maximise available labour. It may be possible to provide the same level of service with less staff.	it is the main expense because it is fundamental to the specification. However closer attention has to be paid to productivity as an organisation the balance has got get closer to 50/50 in customer satisfaction versus resource utilisation.

Table 3 : Level of Service Framework

A Excellent level of service; condition of free flow; no delays; excellent level of comfort.

B High level of service; condition of stable flow; acceptable delays; high level of comfort.

C Good level of service; condition of stable flow; acceptable delays; good level of comfort.

D Adequate level of service; condition of unstable flow; acceptable delays for short periods of time; adequate level of comfort.

E Inadequate level of service; condition of unstable flow; unacceptable delays; inadequate level of service.

F Unacceptable level of service; condition of cross-flows; system breakdowns and unacceptable delays; unacceptable level of comfort.

NB : Level of service C is recommended as the minimum design objective as it denotes good service at a reasonable cost. Level of service A is seen as having no upper limit.
(Source AACC/IATA,1990,5)

Construction of New Facilities

Airports can influence their positioning on any benchmarked scale by cutting passenger numbers but the reality is that this is not usually possible in the airport business. Making decisions on new facilities must come as the norm or the industry benchmark is significantly above that at the subject airport.

Decisions to upgrade or replace airport facilities will depend upon the following factors :

1. Benchmarking outcomes
2. Form of ownership (Pitt,2001)
3. The extent to which the airport is publicly perceived as being outdated.
4. Changing customer needs (Pitt & Brown, 2001).
5. Environmental issues
6. Political pressure both internal and external
7. Economic climate in country of origin
8. Any other industry changes

Conclusion

The time has been reached on the world stage where many of the world's major airports are outdated. Modern construction techniques and design concepts have pushed the capacity and performance levels of new airport terminal buildings to new heights (Pitt, Wai & Teck, 2001). The barriers to the renewal and upgrading of airports are many. Some of these such as forms of ownership are government created, others are simply due to the growth of the air transportation industry itself.

References

AACC/IATA (1990). *Guidelines For Airport Capacity - Demand Management* 2nd Edition.

Amaratunga, D & Baldry,D. (2000). "Assessment of facilities management performance in higher education properties".

Facilities. Vol.18 No.7/8 293/301.

Blow,C. (1991). *Airport Terminals*. Butterworth : Oxford.

Brown, A, Hinks, J, & Pitt,M. (1999). "*The role of the FM in the delivery of capital building projects*" RICS Cutting Edge Conference. St Johns College Cambridge. Sept 1999.

Kaplan,R.S & Norton,D.P. (1996). *The Balanced Scorecard.* Harvard Business School Press: Boston Mass.

Pitt, M. (2001). "Strategic Direction in the Airport Business - Enabling or Diabling?" *Facilities.* Vol 19. No. 3 / 4.

Pitt, M. & Brown, A.(2001). "Developing a strategic direction for airports to enable the provision of services to both network and low-fare carriers". *Facilities* Vol 19 No. 1 / 2.

Pitt, M, Wai, F.K. & Teck, P.C. (2001). "Strategic Optimisation of airport passenger terminal buildings" *Facilities* Vol 19 No's 9/10.

Wai, F.K. & Teck, P.C. (2000). "Optimum size for an airport Passenger Terminal Building With Finger Piers". *Journal of Aviation Management* No.1.

The performance concept in road construction
A follow-up of a real project

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Abstract

The environment and the basic conditions of the Swedish civil engineering sector are changing. To be able to meet the new expectations on quality, sustainability and efficiency, the sector has to develop new procurement methods and new production technologies. The Swedish National Road Administration (SNRA) has taken an initiative to initiate a number of innovative pilot road projects. One of these projects has the aim to refine and develop the performance concept, which differs from traditional Swedish procurement mainly through the change from extensive technical specifications to requirements on road performance. This will also lead to expanded time for contractor responsibility. A group consisting of experts within the SNRA and private technical consultants has designed the procurement documents in the pilot project. The aim of this paper is to investigate if the designed procurement documents contains enough degrees of freedom for the contractor, in other words if it gives increased possibilities for the contractors to apply new methods and new technology.

Keywords: Performance concept, procurement documents design, public performance procurement

Introduction

The Royal Swedish Academy of Engineering Sciences presented in 1998 a report investigating the structure of the Swedish civil works sector. The report "Knowledge development within civil engineering: Civil Works in Focus" stated that the Swedish civil works sector needed development

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with regards to efficiency and knowledge. Furthermore the report proposed a selection of measures to develop the sector and to improve the above mentioned areas. The measures were to be applied in pilot projects such as partnering projects and performance procurement projects. The majority of these are infrastructure projects to be procured by SNRA (Swedish National Road Administration, from here on referred to as the SNRA). The SNRA is the public procurer of civil works and Sweden's largest client within the sector. Therefore the SNRA has a sector responsibility appointed by the Swedish Government. The sector responsibility means that the SNRA, amongst other issues, carries the responsibility to put efforts into R&D, and it is from these causes natural that these pilot projects is procured and ordered by the SNRA.

This paper aims to evaluate if the performance concept applied to a pilot project facilitates the possibilities to develop skills and efficiency within the sector, thus if the procurement documents contains enough degrees of freedom for the contractor to take in consideration. The procurement documents was finished in late June 2001, which implies that the study focuses on the documents and what can be found out through studying the process. This paper is a part of a larger study that will follow the pilot project throughout the construction and further on into the usage/maintenance stage. Interviews with contractors have not yet been done.

The Performance Concept

In Sweden the performance concept has been studied and applied on real-life projects since the mid 80's. The prompter has been Professor Torsten Grennberg (Luleå University of Technology, Sweden) who in an SNRA publication 1995 defined it as "The performance concept contract is a contract where the client describes the product *traffic space* in terms of measurable performance requirements and the contractor choose the *technical solution.* The contractor is responsible for that the *traffic space* will be well-functioning during a long time".

The performance requirements can be looked upon as qualitative objectives whereas procurement documents traditionally have consisted of mostly quantitative specifications. In an approach to visualise the existing range of procurement specification levels a figure has been designed:

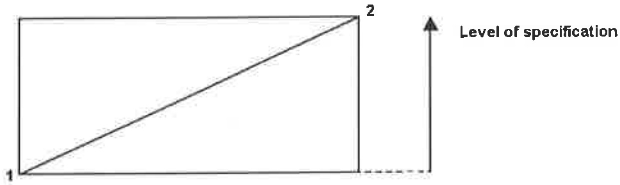

Figure 1. The existing range of procurement specification levels.

The positions 1 and 2 describes the extremes, the high level specified procurement with detailed specifications on materials localisation and executions (2) and the refined performance concept procurement with only qualitative objectives and no specifications on materials and executions (1).
Traditionally the SNRA has procured constructions very close to (2) which according to the report by The Royal Swedish Academy of Engineering Sciences does not facilitate development of the sector in the way that procurements close to (1).

Development within Construction

Based upon the work of David M Gann and Ammon J Salter (2000) it can be seen that "government regulatory and procurement policies have a strong influence on demand and play an important role in changing the direction of technological change". Assuming that this thesis also is applicable on the change of contractual forms a model can be used to understand what parameters influences the design of the performance procurement document.

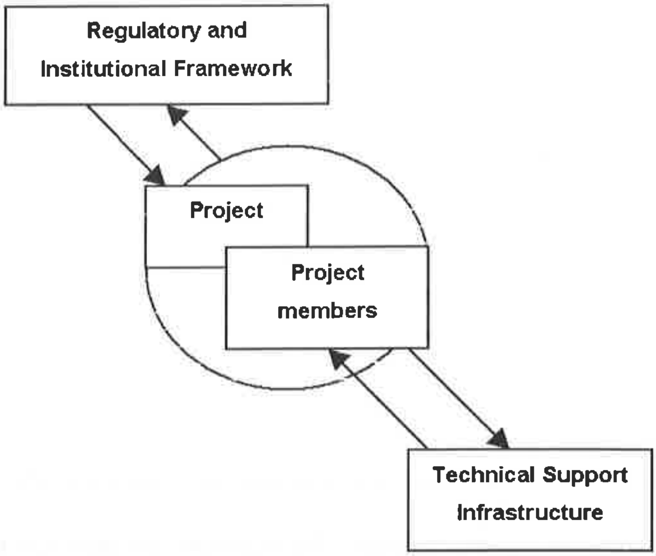

Figure 2. Model describing what influences development within project-based activities (modified model based on Salter A J. and Gann D M., 2000).

One way to look at it is that the client has to deal with the regulatory and institutional framework to design the procurement document in a way that it lies within the laws and policies set by the Government and the stakeholders whom it concern. Contractors then have to be able to use a well-functioning infrastructure for technical support to come up with innovative technical solutions and try them against the regulatory and institutional framework. The latter is not further discussed in this paper since it is focused on the procurement document design.

Previous Performance Procurement Projects in Sweden

In Sweden there have been test activities in the field of performance concept contracts since the mid 80's. The performance concept has been applied to road projects of various sizes and level of complexity. A uniform image of the results is therefore hard to compile. On the other hand the opinions shows a similarity, both concerning advantages and drawbacks. The opinions on what would be the advantages indicate that the performance concept is a way to reach the areas of improvement that The Royal Swedish Academy of Engineering Sciences appoints.

The participants of previous projects states that the performance concept leads to efficiency concerning both time and economy, furthermore it requires increased knowledge within the contractor's organisation. They also state that the bureaucracy is decreased and that prerequisites for technical development are provided.

The drawbacks can mainly be derived from the lack of experience to work this way. The procurement documents are said to be indistinctively formulated and the existing ground conditions have not been sufficiently described. When interviewing the project manager of one of the projects, which is accepted to be very successful, he appoints the relay of requirements to be the key factor in designing a distinct procurement document. The requirement relay is the chain of methods needed to handle a performance requirement (fig 3).

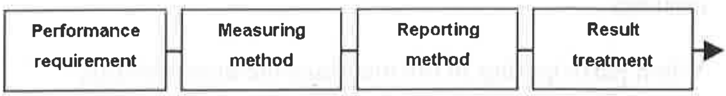

Figure 3. The performance requirement relay.

Case study – Regional Road 610 Southwest of Sweden

During the year of 1999 a suitable project was found and the project manager procured a consultant to design the performance procurement documents. Simultaneously a group of technical experts and procurement advisors within the SNRA was formed to support the design. The first meeting was held in March 2000.

The road project contains construction of an about 10 km long stretch divided into two parts, where one is to be procured traditionally, with detailed specifications, and one according to the performance concept. The project is regarded to be a fairly simple construction with low risk concerning ground conditions.

The process of designing the procurement document can generally be described as in fig 4 below.

March 00	May 00	June 00	Aug 00	Oct 00	Nov 00
Introduction and presentation of the project and the participants	Performance descriptions and incentive formulations	Technical issues	Geotechnical field examinations	Conceptual documents finished	Revised conceptual documents, time schedule for procurement
Dec 01	**Jan 01**	**Feb 01**	**April 01**	**May 01**	**June 01**
Financial issues, demands on bids	Procurement documents referred for consideration	Revisions of the documents and new referring for consideration	Revisions of the documents and new referring for consideration	Final revision and refining of the documents	Distribution of the procurement documents for tender

Figure 4. Issues discussed on the procurement document design meetings.

When participating in the meetings the most obvious observation has been that the attitudes towards the performance concept have changed. In the beginning of the process the work was influenced by scepticism mainly towards the fact that a great deal of the responsibility for the project was shifted from the client (the SNRA) to the contractor. The scepticism depends mainly upon the widespread distrust in the contractors' skills. Throughout the process the project leader was able to change the attitudes and convinced the group that there will be no development without taking risks. This was also simplified by the low amount of risk in this specific project.

Description of the Designed Procurement Documents

The documents are designed with the starting point in the work plan, which is a prerequisite to allocate funds within the SNRA to the project. The work plan is also settled legally, and must be followed throughout the project. The work plan consists of background and motives for construction, a rough road stretch and a design proposal, consequences of the proposal considering land usage, environmental issues etc. Furthermore a plan for land acquisition has to be made and before the work plan can be settled a public consultation has to be done.

The procurement documents are constructed with performance requirements on the pavement and the body of the road. There are two bridges within the stretch which are treated traditionally, where contractors submit proposal sketches for approval. The safety issues are mainly treated traditionally whereas the contractor receives a plan for marking and signs, but for safety in terms of i.e. drainage and flatness of the surface there are performance requirements.

The performance requirements are distinctively illustrated and there are measuring methods attached. The contractor will be responsible for the performance requirements throughout a 7-years period of time after the road is opened for traffic. The contractor will also be responsible for the maintenance during this period. There are incentives attached to the requirements, and measurement results within and at the end of the period will decide whether bonuses or reductions will be at hand.

The location of the road is roughly settled through the work plan, but there are degrees of freedom in terms of levels and to some extent in horizontal directions.

Approaching roads and slipways are procured with a high level of specification, this is to avoid inconvenience for third parties. Additional work will be procured according to the contractor's price lists.

Conclusions

The history of performance concept projects in Sweden has shown that it is important to put a lot of effort into designing the procurement documents, most of the drawbacks appointed by actors have been that the documents have been indistinct. Furthermore a distinct requirement relay is regarded to be a basic condition to succeed. The examination of the finished documents and the observation of the process give by hand that these parameters have been treated seriously and with precaution. Furthermore the distribution of responsibility through the project is distinctively defined. The conclusion is hereby that the performance requirements have been designed in a way that promotes the possibilities for the project to become a successful pilot study.

According to the Royal Swedish Academy of Engineering Sciences it is of greatest importance that the procurement documents contain enough degrees of freedom for the contractors to take in consideration. The degrees of freedom are the key to development of efficiency and skills within the sector. When positioning this project in the range of procurement specification levels (fig 5) it turns up somewhere in between. The regulatory and institutional framework increases the level of specification through the work plan.

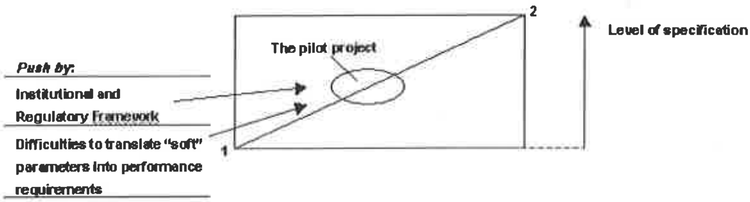

Figure 5. Pilot project position in range of procurement specification levels.

The difficulty to translate safety and environmental issues into performance requirements also increases the level of specifications.

Conclusively it is evident that the procurement documents have been designed with the amount degrees of freedom possible at the current level of experience and knowledge. The future procurement and construction of the project will show if this is enough.

References

The SNRA, 1995. "*Byggande och skötsel på funktionsentreprenad – Upphandlings- och kontraktsmodell*". The SNRA Borlänge 1995:49.

The Royal Swedish Academy of Engineering Sciences, 1998. "*Kompetensutveckling inom samhällsbyggnad: Anläggningar i fokus*".

The SNRA, 1996. "*Fyra vägbyggen på funktionsentreprenad*". The SNRA Borlänge, Stockholm och Härnösand.

The SNRA, 1999. "*Funktionsentreprenad, ombyggnad av väg 770 delen Spångenäs-Totebo i Kalmar län*" The SNRA Borlänge 1999:110.

Hansson, B, 1994 "*Motorväg som funktionsentreprenad, utvärdering av Gammelsta-projektet*" Department of Building Economics, University of Lund.

Kjessler och Mannerstråle AB, 1994. "*Funktionsentreprenad Försöksprojekt. Ombyggnad av väg 713 delen Vena-*

Väderum i Kalmar län"
Ohlsson, U., 1994. "*Funktionsentreprenad för drift och underhåll av vägar och gator*", Division of Construction Management, Luleå University of Technology.
Hedin, U. Et al., 2001 "*Granskningshandling 2001-01, väg 610 delen Brotorpet-Heagård Funktionsentreprenad*", The SNRA objectnr 325320.
Gann, D. M. and Salter A. J., 2000. "*Innovation in project-based, service-enhanced firms: the construction of complex products and systems*", Elsevier Science B.V.

A Comparison of Construction Contractual Arrangements

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Abstract

There are various types of contract in the construction industry which include design-build, traditional, and partnering contracts. Partnering contracts are used so that a client, an engineer and a contractor can form a mutually beneficial contractual arrangement to complete a construction project. In the past few years, many privately funded partnering contracts for infrastructure projects have been completed. This type of contractual arrangement is often part of a government procurement policy to create a build-own-operate-transfer arrangement. There are several public-private procurement strategies and systems available to the client. The paper reviews and examines the public-private procurement (PPP) systems available and comments on different contractual arrangements. The paper also describes research which investigated the effects of change orders on different types of contract. Construction project information and data were collected from a total of 40 public sector projects in New Brunswick. A local contract is described where the arrangement was changed from a privately financed contract with tolls to a contract without direct tolls.

Keywords: public-private procurement, contractual arrangements, public sector projects, tolls

Introduction

Contracts are used to legally bind two parties into a predetermined agreement. In construction, there are various types of contracts which include design-build, traditional, and partnering contracts. Design-build contracts are a type of

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contract where the client appoints a single firm or a consortium of companies who are responsible for the design and construction of the project but where the client does not form a partnership with the consortium. In traditional contractual arrangements the client enters into two contracts by employing an architectural or engineering firm to design the project, and the construction is then performed by a contractor. One contract is between the client and consulting engineer or architect and the other contract is between the client and the contractor. Another type of arrangement can include the client appointing a project manager to manage the project. Partnering contracts are contracts where the client, engineer and contractor form a mutually beneficial relationship to complete the project.

Two other arrangements, at each end of the spectrum, include the in-house owner design and build arrangement, for example, highway maintenance and rehabilitation, where there is no contract involved, and at the other end, complete privatization with no transfer of ownership until after a stated period of say 25, 35 or 50 years.

Partnering is the fastest growing procurement system in the construction industry due to the demand for new infrastructure and the limitations of available public funding. This type of contract aims to create an efficient, better schedule controlled and cost-effective project, with an improved quality system and a better opportunity for innovation. Partnering has not yet fully matured in the industry and there are questions concerning its appropriateness for some types of contracts. Generally, partnering means a cooperative contractual arrangement between a client (government, owner) and a contractor for a specific project. Other partnering arrangements can include a contract for a time period extending over several projects or, for example, the continuous maintenance of a transportation system. Mutual objectives are enhanced such as open relationships, a combined systematic approach to problem resolution, mutual trust, a dedication to common goals, more effective communications, a prevention of adversarial attitudes, the avoidance of litigation, best practice, and through it all, a means of achieving the best value for the owner and user.

In the public-private partnership (PPP) arrangement, the public sector transfers a significant level of risk and responsibility to the private sector over a long term arrangement. The contractual arrangements emphasize performance based outcomes rather than relying solely on specifications. There are several types of arrangements which generally involve the design-build process, but finance and operation can also be involved. Sometimes the project financing is secured by real user tolls rather than some form of taxation. The scope of this paper is restricted to a general discussion of partnering contractual arrangements, a description and discussion of a specific project which intended to incorporate real tolls but then eliminated the proposed tolls after commencement of the project, and a small scale investigation into the link between contractual arrangements and change orders.

Public-Private Partnerships (PPP)

Public-private partnerships (PPP) have not been restricted to one type of construction or engineering project.

PPP arrangements have involved the following types of projects:

landfill and waste disposal	prisons
ports and harbours	railways
highway maintenance	utilities
hospitals	schools
highways	bridges
water and wastewater treatment systems	airports

Other significant PPP arrangements, although not in the construction or engineering area, have included the following:

Recreation	Utilities management
Land development revitalization	Property management
IT systems	Health care services

There are various PPP arrangements such as:

Operate-maintain	Design-build-operate
Build-own-operate-transfer	Build-own-operate

In the operate-maintain contract a private operator operates a publicly owned infrastructure for a fixed term. In the design-build-operate arrangement the infrastructure is still owned by the public but after the design-build contract is complete an operating and maintenance contract follows. Sometimes the asset is bought by a private company usually under a contract that specifies the asset should be well maintained and operated. A private company finances, builds, owns and operates a facility in perpetuity in the build-own-operate arrangement, but often the facility is transferred back to the public sector after a specified period of time.

A common framework for PPP projects should be developed which ensures common contractual terms and guidelines for selecting advisors and consultants. The output requirements, and the analysis and division of the risk should also be specified.

Public-private partnerships - process

The fundamental objective of PPP is the formation of a team from several organizations which commits to mutual goals and thereby creates a collaborative group synergy. The goals must be clearly and concisely stated. The PPP arrangement attempts to prevent budget overruns and schedule extensions.

Consulting engineers have sometimes felt that clients can waste significant resources because the clients are unsure about choosing the best procurement arrangement for a particular project. Their decisions are usually based on their individual experience. PPP is not a panacea for all contracts and often traditional procurement methods will continue to be appropriate for some projects. PPP can be cost-effective under certain conditions when the projects are large and complex and where it is better for the private sector to assume some or most of the risks. If the life-cycle costs are on a small scale, however, traditional procurement methods may still be the most cost effective because of extra PPP costs.

The PPP process includes identifying the specification, contract strategy, financial strategy and the evaluation criteria. Following pre-qualification procedures, a request for proposals, including the terms and conditions, is necessary. A group must then be formed to evaluate the proposals and consider the proposed partners, and the preferred offer, before the selection and recommendation are made. Negotiation may be necessary before a final award is made.

The Canadian Council for Public-Private Partnerships, in cooperation with Industry Canada has selected and documented 100 PPP projects in Canada. (ref. 1)

A PPP Highway and Bridges Project

The Fredericton-Moncton Highway Project in New Brunswick, Canada, is a build-lease-operate-transfer type of PPP project. The project was initiated because the Province of New Brunswick recognized the inadequacy of the existing Trans-Canada Highway between Moncton and Fredericton. The need to build and finance a new highway more quickly than would be possible through traditional means was therefore considered.

A “Request For Proposals” was issued in 1997 to three private sector / developer operator proponents for the submission of

Technical Specifications, a Quality Management Plan, and Financial/Legal/Economic Plans.

To finance infrastructure projects in New Brunswick, a Crown Corporation called the New Brunswick Highway Corporation (NBHC) was created. NBHC represents the Province in a partnership to finance, build and operate the new highway. In 1998, it signed a concession agreement with the New Brunswick Project Company Inc. (NBPCI), a not-for-profit company created to manage and operate the Fredericton-Moncton Highway as a toll highway for 50 years. The company has representatives from the government and the private sector developer/operator, Maritime Road Development Corporation (MRDC).

MRDC=s shareholder companies included Miller Paving, Dragados FCC Canada Inc., and Janin Atlans Inc. (formerly GTMI Canada). The project included a 195 km four-lane controlled-access highway with a total of 20 interchanges, 28 overpasses and will be completed by November 2001. With a construction cost originally estimated at over $650 million (Canadian), MRDC implemented state-of-the-art quality assurance and quality control methods to fulfil its mission statement for the project.

There are also two major bridges within the contract limits. A four-lane twin deck bridge crosses the Saint John river. The bridge comprises fourteen spans for a total length of over 1 km. The bridge consists of two independent substructures which include piers and deck but share common foundations. Spans vary from 56 m near the abutments to 120 m at the main span which gives a 24.4 m navigating clearance at summer water levels. Nearby, another bridge crosses the Jemseg river and is similar in design and general configuration to the Saint John river bridge, but comprises eleven spans, with an overall length of almost 1 km.

Real tolls can be a potential source of revenue for highway and/or bridge projects. However, the acceptance of tolls depends on the general public and government perception. Public acceptance of tolls can be initially important. General taxation, or specific taxes such as fuel taxes and license fees are more common in Canada, although tolls are used in a neighbouring province, Nova Scotia, and on the well known 12.9 km Confederation Bridge between New Brunswick and Prince Edward Island (also a build-lease-operate-transfer contract arrangement). Because of the relatively low traffic density on most highways in Canada a tolling system is only likely to be considered a reasonable alternative by the general public when they are linked to large scale projects, relatively high traffic density urban highways leading to low tolls, or very long bridge projects (replacing ferries).

The capital cost of the Fredericton to Moncton highway was to be financed through two types of debt: toll-based debt and lease-based debt. $540 million was to be raised in lease-based debt, which would be paid back through the sub-lease payments. $149.5 million was to be raised in toll-based debt, which was to be paid back through toll revenues (estimated at about $22 million annually over the life of the project). NBHC and NBPCI have a 30-year operating contract with MRDC during which time the financing is to be repaid. Under the lease agreement, the province will have the option to buy the highway at fair market value after 30 years, or after 40 years, or ownership automatically reverts to the province in year 50. MRDC is paid as the work is carried out. Payments on the lease-based debt will not begin until two years after the total length of the highway is open. The consortium is responsible for all cost overruns and delays.

There was extreme pressure against the provincial government who proposed tolls for the Fredericton to Moncton highway project. The highway tolls became the main issue during a provincial election and the incumbent government lost the election. As the construction of the highway proceeded the proposed tolling system was eliminated and this debt was transferred to the government. To replace the tolls the government implemented a traffic counting system whereby traffic volumes will be monitored and classified according to the type of vehicle. Corresponding monthly payments will be made to NBPCI to pay for its toll-based debt.

The guaranteed maximum price for the construction bid by MRDC was $584 million. The total capital cost is approximately $872 million. Annual sub-lease payments from NBHC to the NBPCI are estimated at $58 million for 26 years (years 5 to 30 of the lease).

Effect of Type of Construction Contract on Change Orders

The effects of changes on the performance of three different types of contracts: traditional, design-build and partnering were investigated (ref. 2). Construction project information and data were collected from a total of 40 public sector projects in the Department of National Defence and the New Brunswick Department of Transportation. It was found that the average cost of design changes was larger than the average cost of construction changes for all types of contracts. It is therefore important to spend time and effort to make sure design changes are kept to a minimum.

The classification of changes was based on the nature and origin of the changes and whether the changes were construction or design changes. Construction changes were classified as:
changes resulting from unforseen site conditions, but did not require redesign (Type 1C); and
errors and omissions (Type 2C).

Design changes were classified as:

- changes that were made due to the update of requirements within the original scope (Type 1D);
- a change of requirements not within the original scope (Type 2D); and
- changes in design made necessary by unforeseen site conditions (Type 3D).

The cost of the projects ranged between $100,000 and $23 million with an average cost of $5 million.
The combined project data for the research project consisted of 10 design-build projects, 22 Traditional projects and eight partnering projects. The number and average cost of changes for each type of contract is shown in Table 1.

Table 1. The Number and Average Cost (C$) of Changes in Each Type of Contact

Type of contract (1)	Total number of projects (2)	Number of Changes					Average Cost / Design Change (C$) (8)	Average Cost / Construction Change (C$) (9)
		Type 1C (3)	Type 2C (4)	Type 1D (5)	Type 2D (6)	Type 3D (7)		
Design-Build	10	36	34	152	16	0	6 150	8 250
Traditional	22	129	486	139	29	10	4 050	9 000
Partnering	8	120	25	46	5	25	340	680

The research findings supported the premise that partnering projects result in a lower cost when changes are required. It is felt that this is due to the mutual cooperation of all parties involved in the project. Further research is required to expand the sample size and investigate in greater detail the impact of changes on partnering and other types of projects.

Conclusion

Changes are taking place in relationships and roles between clients, engineers and contractors in design and construction. One trend is from method to end result / outcome specifications and another trend is in the distribution of risk and liability in PPP construction projects.

A PPP project will not be considered a success unless the client, contractor, operator and user consider that the project has been successful. For success, the right situations and the right projects are required.

There have been examples of PPP projects not working well in the information-communication technology and health service areas but often PPP projects can guide value-added benefits in cost saving, risk sharing and other improved efficiencies for the right type of construction project.

References

Industry Canada. 100 Projects: *"Selected Public-Private Partnerships Across Canada"*. The Canadian Council for Public Private-Partnerships. Toronto. 2001.

J. Christian and A. Cariappa. "Change Orders, Project Performance and Cost of Quality for Different Contract Types". *Proceedings CSCE Conference*. Vol. 3, p 309-318. Regina. 1999.

Procurement strategies for complex projects

The Italian situation in the field of public works.

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Abstract

Design and construction of public works are evolving from mere engineering services into complex multidisciplinary activities.

The quality concept itself is extending from the simple compliance of a project to the specifications to a more comprehensive approach to the project as a whole, guaranteeing technical, social, and economic requirements in full conformity with all legal and administrative constraints.

In several countries, although effective regulations exist, responsibilities for their enforcement are fragmented among many public bodies that often do not communicate between each other. This sometimes makes it difficult to effectively apply such regulations. Procurement strategies are a typical case: particularly for complex projects they require time and the synergic effort of several specialists of different skill, ranging from technical to administrative and legal.

This paper presents a procurement strategy based on the above synergy, which was recently successfully adopted in Italy for several complex projects (over 50 million US$).

Present Situation and Current Problems

Design and construction activities of public works entail in Italy several aspects ranging from traditional technical and economic requirements to more recent legal-administrative constraints and managerial issues.

Until recently, engineers' activities basically consisted in

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providing technically and economically sound designs based on best engineering practices, acknowledged experience in the specific field, and compliance with existing standards and regulations. Later social-economic and cultural changes brought substantial modifications.

Awareness of ecological and sustainable development, as well as importance of safety and health matters in civil works construction increased, and important changes took place in the legislative and administrative fields to adapt old fashioned national and local regulations to the new Directives issued by the European Communities on those matters. One could say that in Italy a new culture is being brought into the picture. Civil works sector is still in a period of transition: while, on one side, involved parties (such as contracting agencies, contractors, and consultants) are not yet conversant with this new culture, on the other side failure to comply with the new regulations may cause, and has actually caused, serious effects on project implementation.

Absorption of the new culture in the field of civil works is likely to require much more time than originally expected. A way to speed up the process preventing at the same time the above drawbacks is to adopt sound management procedures covering the entire project cycle from initial design to commissioning and, were applicable, subsequent O&M.

This is a substantial step towards the Total Quality of the project, that is: extending the quality concept from the simple compliance of the project to the specifications, to a more comprehensive approach to the project as a whole, guaranteeing technical, social, and economic requirements in the full conformity with all legal and administrative constraints. Total Quality would:

- ensure the technical, economic, financial, and administrative feasibility of the project;
- pave the way to ensure compliance with the planned

time schedule, budget and quality;
- foster the flexibility of design solutions, so that they be capable to allow for those changes that might conceivably become necessary during the economic life of the project because of medium- or long-term modifications of its usage;
- minimize claims and disputes between contractor and client.

The Proposed Procedure

The following bidding and awarding procedure was developed during the last five years of our consulting activity to several Italian public contracting agencies in the field of large infrastructures, e.g.: hospitals, universities, mass transport systems, solid urban waste incinerators, etc. The highlights of the procedure are:

- the Guidelines of the entire procedure, to be set out at the very beginning of the project cycle;
- tenders based on a preliminary or definite design;
- contracts awarded to the economically most advantageous proposal;
- restricted bidding procedures.

The bidding procedure outlined above was successfully adopted in Italy for several large projects including transport infrastructures, hospitals and university buildings, with construction cost ranging from 15 to 200 million US$.

The Guidelines

The implementation of a large project involves a great number of different activities and requires several important decisions such as: to define the main features of the project, assess the financial resources needed and identify their sources, decide which strategy to adopt for the procurement of all required services, goods and works, determine which are the formal approvals, permits, and no-objections to be obtained by the involved local and national authorities, etc. The attentive definition of the entire procedure is vital for a smooth implementation of any project, more so in the Italian still unsettled context as depicted in chapter 1. The Guidelines take care of this: they not only state what has to be done in order to guarantee the successful outcome of the project (this would be a mere check-list), but also identify who (whether a structure, authority, organisation, etc.), should do, check and/or approve what and with what specific responsibility; state when each such activity should be done, in compliance with which standards and procedures; what kind of documentation should be set up, by whom and when.

The Guidelines are integrated with a time schedule highlighting the completion times of all activities and their mutual relationships; they also provide tools to ascertain and guarantee that all specified actions are being actually carried out according to the schedule.

In Italy the responsibility for the enforcement of the several laws and regulations related to civil works is fragmented among many public bodies that often do not communicate between them; this makes it difficult to effectively apply such laws and regulations. Moreover, any modification to an already approved procedure may jam the whole process even for a long period of time. In such a context the early, careful and detailed planning of the entire procedure achieved by the Guidelines lowers substantially the project risks.

The preparation of the Guidelines for a complex project is a demanding activity requiring time and a variety of interconnected legal, administrative and technical skills. The selection of the most convenient strategy and procedure for each project implementation step as well as each chain of activities, needs to be validated in all its aspects through a continuous dialectic process. The team of experts in its whole should enjoy a very good practical experience in the design and implementation of complex projects and in its related administrative and legal aspects. Only people endowed with such direct experience can produce effective procedures and related tender and contract documents, and promote their continuous updating and improvement.

The Procurement Strategy

For a long time, public works have been a ground for debate in the Italian media, and the object of extensive, hot discussions even out of the traditional field of experts in the subject. This resulted in the widespread conviction that every layman can express his judgement on the matter.

Particular criticism was aimed at those bids which are not awarded on the sole basis of the lowest price; and this, because of the conviction that only awards based on the lowest price could avoid the scandals which have occurred in Italy in the recent past. This is reflected by the recent Italian law on public works that, except for a limited of special cases, compels to call tenders based on the detailed design of the works and to award the contract on the sole basis of the lowest offered price. In our opinion not enough attention was paid to the fact that actually, what caused the scandals was not the awarding method adopted, but rather the lack of specific experience and sometimes professional ethics of the officials who managed the process.

True experts in the implementation of public works prefer to award the contract to the bidder presenting the most economically advantageous tender, that is considering both the offered price and other technical, managerial, and operational aspects of the proposal. This in compliance with art. 30, clause 1, of the European Directive 93/37 of June 14th, 1993 which co-ordinates the procedures for the awarding of public work contracts. The Directive, in addition to guaranteeing transparency of the procedure and equal opportunities to all tenderers, safeguards the client's interests much more effectively than the lowest-price award does. In fact, when the concept of the most economically advantageous tender is adopted, only the essential features of the project are established by the design on which the tender is based (usually a definite design) and the tender documents, and bidders are required to propose the solutions they intend to adopt for all other aspects. The winner will then develop the detailed design of the project based on the solutions he proposed. Competitors will exploit their experience and strive in looking for the best possible compromise between quality and cost (best value for money) in order to prevail over their competitors. This does not happen when the contract is awarded on the sole grounds of the lowest offered price, because in this case the tender has to be necessarily based on the detailed design of the works, and no room is left to bidders' improvements.

In some recent cases, a further procedure improvement was obtained by adding to the tender for the design and construction of the works the operation and maintenance of both civil works and equipment for a given period (e.g.: five plus five years). This proved to be an effective way to minimise the risk of bidders proposing low quality technical solutions to cut offered price, thus charging the client with higher operation and maintenance costs during the life of the project.

The Restricted Bidding Procedure

To engage in a tender to be awarded with the concept of the most economically advantageous proposal requires a notable outlay of time and resources. In fact, bidders shall have not only to carefully examine the design on which the tender is based, but also select the most convenient solution according to their experience and evaluation criteria set forth in the tender documents, and work it out to the level of detail required. Therefore a pre-qualification should be made, in order to admit to the tender only a limited number of selected bidders. This leads to the adoption of the restricted bidding procedure provided for in art. 1, letter f, and art. 22 of the Directive 93/37/CEE. The restricted procedure allows a better flexibility than the open one, as it allows the client to know the tenderers and consequently to call a pre-bid conference. In the pre-bid conference bidders are encouraged to ask all clarifications they could need on the tender documents, and the client provides the necessary answers. Very often, as a result of the conference, tender documents are improved incorporating bidders' suggestions. The pre-bid conference is an essential tool for obtaining high quality bids which, in their turn, are a precondition to the good outcome of the project.

In Italy, it is usual to prepare all tender documents in their final version before bids are called and the pre-bid conference is practically unknown, making the entire procedure very much rigid. On the contrary, the solution we have currently adopted in the last years fully exploits the advantages granted by the Directive 93/37/CEE: restricted bidding procedure, tender documents discussed with the selected bidders in the pre-bid conference, and full understanding of the rules of the game by all parties involved before proposals are received. This procedure is still rigid as far as its basic principles are concerned (strict observance of the European Directives, full compliance with all transparency, legality and equal-opportunities requirements), but flexible enough during implementation in that it allows the contracting agency to adapt tender documents to the actual needs as they emerge during the process. This grants a more efficient management of the relationship between client and tenderers, allows the latter a better response to the tender requirements, and minimizes the risk of claims. The same flexibility applies to contract finalisation: after the tender is awarded, technical aspects of the winning proposal that are not fully satisfactory can be discussed and modified so as to meet client's expectations, and the agreed modifications incorporated into the contract.

One could say that this tender procedure brings the procurement process back to its natural pattern, giving all parties their congenial role. This is particularly important in the Italian context were contractors have been for a long time subordinate to clients, and their autonomy and responsibility gradually diminished to a point where the contractor became a mere executor, often void of any will or professional prestige.

The suggested procedure gives full importance to the contractor's capability. Besides building the project, he is required to exploit all his capabilities to the client's and project's interest during the whole process. When presenting his capabilities in the pre-qualification stage, the tenderer lays out the base of the relationship he wants to build with the client in case of success. During tendering, conditions are provided to induce bidders to offer their best possible services, making them active subjects to help the client to improve tender documents; the bidder's skills turns into concrete facts (technical solutions, construction methods and techniques, work organization, etc.).

After the contract is awarded to the best bid, the client will integrate the draft contract included in the tender documents with the techniques, procedures and methodologies displayed by the contractor in his proposal. These same features that allowed that specific proposal to be ranked first in the combined quality and cost evaluation, will become contractor's obligations. This will make difficult for the contractor to ascribe to the client problems that could arise during construction, since construction is carried out by the contractor based on his own detailed design, procedures, techniques and methodologies. He could claim only when in a position to prove that something went wrong due to the client's interference, or because of events outside his control. Instead, when a tender is awarded to the lowest bidder and is consequently based on the detailed design of the project, the contractor could much easily found his claims on actual or fictitious design flaws.

This technique allows for various levels of involvement of the contractor. Case by case the client, depending on the strength of his technical organization, and nature and complexity of the project, will decide what should be the most convenient responsibility level to be assigned to the contractor.

Conclusions

The procedure proved successful in overcoming some important problems affecting the civil works sector in Italy such as: (i) the inconsistencies between the recent Italian regulations and European Directives, (ii) the fact that the subjects involved are still not familiar with European Directives, (iii) the contentiousness resulting from (i) and (ii) which hampers projects implementation, and (iv) the inadequate involvement of the contractors which prevents them from making full use of their experience for the project benefit.

Re-engineering Construction Procurement

Summary of Scottish casestudy findings

John E. Tookey[1], M.D. Murray[2], C. Hardcastle[1] and D.A. Langford[2]

Abstract

Building procurement decision making has presented significant problems for many years in both the UK and the remainder of the world. This paper presents the final results of a 2.5 year study funded by the Engineering and Physical Sciences Research Council (EPSRC) entitled "Re-engineering the building procurement decision making process". The research was conducted jointly by the University of Strathclyde and Glasgow Caledonian University in Central Scotland. A sample of 12 case study projects of various size and engineering configurations, was used. The research was a longitudinal study, incorporating a significant number of interviews with all the 'key players' in the construction process. The study also facilitated the formulation and piloting of a number of novel research tools. This paper will present a summary of all the critical findings of the study and begin to discuss the future impact of the findings on the nature and conduct of research in construction procurement in the future.

Keywords: procurement, case-studies, research methods

Introduction

The building procurement decision making process has been recognised for many years as presenting significant problems to the effective delivery of projects within the time, cost and quality requirement of clients. The highly fragmented, transient, peripatetic nature of the construction team has been highlighted as significant since it places huge responsibility on

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this 'team' – albeit possibly having never worked together before - for creating an appropriate organisational system in order to facilitate design, construction process and successful completion of the project (Sidwell, 1982). Frequently it is thought that construction is unique among complex assembly processes (i.e. manufacturing), which prevents the use of best practices pioneered elsewhere. Indeed the need to remedy this situation has been a key driver in developing new 'Best Practice' (e.g. M4I initiative, Construction Best Practice Panel, National Construction Creativity Clubs etc) methods of organising construction following the Egan report (1998). All these issues are now addressed in formulating construction teams so as to deliver projects at target cost, within projected construction time. Responsibility for creating an effective construction team in an effective contract system to deliver these requirements remains largely with the client - part of 'the amalgam of activities undertaken by a client to obtain a new building' (Franks, 1984) or in other words the selection of a building procurement system.

Different generic procurement routes have been created to satisfy the diverse requirements of diverse clients. These procurement systems (Masterman, 1992) are usually defined as: separate / co-operative (e.g. traditional open tendering); integrated management (e.g. D&B) and management oriented (e.g. management contracting). Research indicates clients and their advisors select procurement systems in an illogical, inappropriate manner (Masterman, 1992) – to an extent that this failing is cited as a principal reason for poor performance (Skitmore and Marsden, 1988). Benefits and problems associated with each procurement system have been variously reported upon over many years, e.g. Banwell Report (1964) and the Latham Report (1994). A repeated theme in these reports is criticism of design and construction separation inherent in 'traditional' procurement. The Egan (1998) report recently introduced further dimensions to the procurement puzzle by advocating 'partnering the supply chain'. This attempts to integrate conflicting needs of design, construction and supply to increase client satisfaction, reduce wastage and costs. An implicit criticism remains that procurement route selection is generally inappropriate and largely inefficient.

To optimize construction performance, it is vital to understand all aspects of procurement. Traditional approaches to procurement have evolved organisational structures, which carry with them assumed but, arguably, unproven ideas of roles, responsibilities and communication patterns. As procurement evolves, clarity in role, responsibility and communication blurs. New approaches do not benefit from previous experience. Clearly one aspect of any procurement process needing careful definition is selection of an appropriate organisational structure as a basis of the development process (Turner, 1990). The task of assembling materials, labour and finance in the right place, time and order to construct a building implies a huge amount of information being passed among project participants. Construction teams therefore spend a lot of time directly in some form of communication, requiring highly-organised communication since effective networks speed information flow and accuracy (Hardcastle, 1992) – increasingly important as sub-contracting, less skilled labour and reduced margins have increased growth in alternate forms of procurement. These trends are justified on grounds of reduced costs, but recently attempts have been made to rationalise the burgeoning supply chain so created. This has manifested itself in the use of a system of preferred suppliers (e.g. BAA Framework Agreement).

Although similar in using 'preferred bidders', recent PFI (and PPP) procurement methods have created problems in structure and communication pattern. Whichever approach is used, communication networks are essential to project success - allowing organisations to work effectively. Arguably, in traditional procurement, limited sub-contracting and unsophisticated technology allowed networks and communication patterns to evolve. This is no longer the case. Integrating design and construction through D&B and partnering approaches may be unsuitable for all projects. They may be less effective than traditional methods since there is no time to develop consistent patterns of communication. A need remains to define elements and structure of communication networks transferable to all project types. Recent steps taken by large and experienced clients such as the MoD - i.e. the 'Building Down Barriers' initiative (Nicolini, 2001) – could be regarded as 'post-modern' procurement, significant of yet further evolution in procurement systems. The selection of a procurement system by the client largely defines the manner in which communication takes place. Several mainstream management authors (Conrath, 1973; Roberts and O'Reilly, 1978) argue that organisational structure is defined by the communication that takes place. Weick (1987) particularly notes communication's importance to the management structure, stating '[communication] is the essence of organisation because it creates structures'. Given that the client in conjunction with their advisors select the procurement route and its accompanying contract, this in turn creates formal lines of communication and therefore by definition, organisational structure. It could be argued that this is in actual fact a 'quasi-structure' since the reality of project communications will tend towards a less rigid social or 'informal' structure. Indeed, the value and importance of this form of communication to the efficacy of the project, and ergo organisational sub-structure, was identified by the Tavistock Institute some time ago (Higgin and Jessop, 1965).

Significantly, even the criteria by which it should be possible to objectively evaluate a 'successful' project is difficult. Hewitt (1985) established that each category of clients (experienced, inexperienced, public, private etc) determine their project's success by different criteria. Hewitt went on to recommend that industry should be aware of, and fully understand, the individual characteristics of groupings in order to assist them in the selection of the most appropriate procurement system for their particular project. Success refers to the extent client's objectives, in terms of time, cost and quality are met. Time and cost dimensions may be quantitatively measured using pre set standards, but quality issues will be perceptual and client determined. To achieve client time, cost and quality objectives, this research also sought to improve the understanding of organizational structures and the decision-making processes associated with each methods of building procurement. Recently Liu and Walker (1998) cast doubts on such previous studies. They contend that variability and individuality of project goals, measurement and evaluation of project critical success factors (CSFs) are likely to be so individualistic that any search for generalisable CSFs is likely to be misplaced.

Research Objectives

The research sought to deliver the following objectives:-

1. Determine how client objectives are formulated and how they influence the choice of procurement system.
2. Establish how and why procurement systems are chosen and their relationship to embedded organisational structures.
3. Determine communication patterns resulting from organisational systems.
4. Examine the decision making processes in each of the above inter-related systems.

Supporting Methodology

Summary of Original Methodological Approach

The original methodological framework for the research saw the construction project as consisting of three decisional and communication domains. These were firstly, the determination of client objectives. Secondly, the determination of the procurement system. Finally, determination of the project organisational structure. Given that these domains could be considered to be subsystems within the project in and between which decision and communication takes place, the flow of information and therefore decision-making and communication needs to be timely and effective in order to expedite construction. Originally the research set out to use a case study format, with sufficient industry support to provide a total of 20 cases - considered to be an adequate sample for the intended study. The intention was to investigate procurement processes from conception through to completion; it was recognised that although the majority of data collection could take place in 'real time', some would necessarily have to be retrospectively captured (particularly for pre- and early contract phases).

A number of different variables were identified as requiring measurement in order to fully explore the nature of the procurement and decision-making processes taking place. These included client objectives, selected procurement method, the organisational paradigm, client satisfaction, communication and decision making. A variety of research tools were identified as being pertinent to quantifying each of these variables for further analysis (Hardcastle and Langford, 1996). However the reality of conducting such involved research in such a complex area required a re-evaluation of the most effective methods of research and indeed on the nature of the variables to be measured. This ultimately created a significantly revised methodological framework in which to work in order to deliver the objectives of the original proposal.

Revised Methodological Approach Adopted

The methodological approach adopted by the study followed a more qualitative vein than originally intended. A number of different research tools were selected for use with each case study. The primary source of information was via semi-structured interviews of 'elite' members of the construction team members of the various consultancies taking part in the projects (i.e. the project manager, structural engineering, M&E

engineer, quantity surveyor, architect and main contractor). This initially utilized the COMPASS communication assessment tool (Tucker et al, 1997) that provided a useful comparison between the various projects of six critical communication variables – including timeliness, accuracy, completeness, understanding, barriers to communication and procedures. Subsequently, after the initial 'getting to know you' interview, the researchers returned to each participant to review the progress of the project and assess the communications taking place. The nature of these subsequent interviews became that of retrospective 'story-telling' of the happenings on the project in the intervening period. It was found after an analysis of the preliminary case studies that these 'stories' followed a uniform set of typologies (see Murray et al, 2002) common across all projects. This subsequently became a key finding of the study and the method for utilising this finding is entirely new. By analysing the frequency of repetition of different stories in each of these various typologies a 'footprint' was created (see Murray et al, 2002) for the project that was unique. This allowed an objective description of each project in terms of either being a high or low frequency of a particular project typology. In the future it is anticipated that this technique or a revised version of it will form the basis of many different studies. Indeed it is expected that a follow on study is likely to be created at GCU particularly aiming to use this analysis tool for benchmarking purposes. The critically important aspect of this study that makes it unique amongst its peers is the breadth and depth of access gained into the projects forming the case studies. This allowed the research team to review and amend the original epistemology and adapt it in order to gain a deeper understanding of the reasons behind the pragmatic decisions made. The new methods developed during the project for recovering usable data from case studies will no doubt be a valuable tool for researchers in the future.

Selection of Case Study Projects

As a result of the significant time delay between initial submission of the research bid and the confirmation of funding, the support gained from various client and contractor organisations prior to the initiation of the project proved to be difficult to capitalize upon. All of the case study projects originally intended to form the basis of the study were either already completed or alternatively well under way and therefore not suitable to be researched. So as to make a start on the research without wasting too much time securing a full set of projects to form the study, an initial group of three pilot projects were secured close together in Edinburgh. These pilot studies allowed the research team to fully develop a set of research tools that would be used on all the projects forming the body of the work. The pilot projects were also useful in that it was found that in order to be able to develop depth and texture in the data, and also to not lose contact with the rapidly evolving situation on site, realistically no more than 2 or 3 projects should be running concurrently. The numbers of key personnel involved on each project and the diverse geographic locations of their respective offices made travel time a significant factor. Furthermore their time on site was so limited that interviewing at that location was unfeasible. This finding had significant import for the study in that the originally planned upon sample of 20 case studies became logistically impossible to support by the research team. In order to maintain the continuity of the highly effective research techniques applied, it was therefore decided to reduce the overall number of projects in the sample. Therefore a completely new set of projects was selected instead of the originally plan set. In the end a reasonably diverse sample of 12 projects was secured that included a representative cross-section of the various procurement routes available to the modern construction client, including ‘traditional’, D&B, management and partnered forms of procurement. It is accepted that the sample of projects secured is based on those projects that were willing to participate in the study and cannot therefore be considered to be a randomly based sample. In view of the depth and breadth of access allowed into the projects, this non-randomness was considered an acceptable aspect of the study.

Results

A number of key advances can be attributed to the research described in this paper.

Key Advance 1 - New Paradigm in Construction Procurement

Research has shown that industry is well in advance of academia in being able to adapt to the reality of new construction procurement methods. This is both a new finding and in a very real sense a validation of the Mintzberg contention that industry sets the agenda and academia acts as a recording medium. An analysis of the selection criteria of clients use in conjunction with their advisors showed that the Client/advisor combination usually select 'correct' procurement method given the normally accepted standards of 'appropriate' procurement route for given client requirements. The Masterman (1992) based analysis tool showed a strong propensity for clients to select the most 'appropriate' procurement method (Tookey et al, 2001). Moreover, analysis of the second and third most appropriate form of procurement in the given project circumstances showed that these secondary and tertiary 'appropriate' methods were addressed using additional contract clauses in the main contract. None of the procurement systems fitted into an easily recognisable procurement system *per se*. The results demonstrate a new paradigm in the description of procurement systems in operation today. Currently it would seem that a 'post-modern' approach to procurement has emerged, an approach that does not fit any of the commonly accepted procurement descriptors, but instead adopts the 'pick and mix' approach to procurement – procurement through 'preferred modalities' of project delivery. Effectively clients and their advisors, create unique contracts and procurement forms suited to the particular circumstances in the project by taking the 'best' (i.e. most pertinent) terms of generic contracts available (Tookey et al, 2001). This implies for researchers that it is impossible to objectively compare the results of two projects that are notionally procured under the 'same' system. This has significant import to the *weltenschauung,* or view of the world, that should be adopted by procurement researchers in the future, since it has opened a new territory for research. Indeed this has highlighted the need to delineate and map this new region. Fundamental questions have been raised:-

1) What is the 'geography' of this new procurement territory?
2) What are the perils and rewards for explorers in this new land?
3) What are the natural resources that may be exploited in this terrain?

This new knowledge above all others establishes a possible future agenda for CIB W92 procurement systems commission.

Key Advance 2 - Novel Understanding of Architecture of client requirements and procurement methods

The architecture of a fixed set of client requirements feeding into a fixed, delineated procurement route – historically the standard model for procurement research – does not exist. This is new knowledge. Client requirements for a project do not fit into any pattern assumed or found by previous research. No case study projects could be comfortably fitted into any of the pre-existing procurement 'types'. This resulted from adaptive methods of tailoring procurement to the specifics of problems and requirements on each project. To have attempted to compare the results of two 'identical' procurement methods would trivialise the impact of project specific factors in the outcomes. Very simply, client requirements either gradually (the incremental model) or dramatically (the quantum model) evolved during the life of the project. Each procurement routes therefore became so unique with site specific problems requiring bespoke solutions that 'off the shelf' or 'one size fits all' procurement was never an option. In each case the procurement route 'selected' had in actual fact to be specially created hybrid, incorporating the 'mix and match' principle outlined above. Indeed all participants in the case study projects reported that the original contract had been either moderately or significantly amended to reflect this trend. This challenges the notion of seeking to establish generic process protocols for all projects since there is now evidence that each project can and must establish unique protocols reflecting its particular circumstances. Indeed, this could be seen as strong evidence to support the notion that procurement is metaphorically more closely related to evolution than to replication. A model in which construction is a metaphorical ecosystem, construction projects are food sources and procurement systems are animals competing for food. The idea can be expanded further to incorporate contractual clauses as the DNA that can be amended, adapted and combined to create an infinite variety of procurement 'animals' to exploit every possible source of food available. The relationships in this system are dynamic, and as such Darwinian competition will mean that certain procurement 'animals' will thrive, others will face extinction. Within each 'species' of procurement, infinite local sub-strains and variations will exist in order to take advantage of particular conditions. As in the ecosystem analogy, procurement 'animals' will never stop evolving while environmental change continues and possible advantages can be achieved.

Key Advance 3 - New Paradigm Procurement Uses Traditional Communication Patterns

Communication patterns demonstrated in the projects appeared to adopt the same accepted and understood network as the 'traditional' method of procurement. This was as a result of expediency in the fast moving environment of each of the projects. The dilemma faced by participants was either to observe the protocols of formal communication along prescribed channels, or alternatively to speak to the participant with the necessary skill set to get the job done. This second option required the retrospective observation of the formalities of communication (i.e. creating the paperwork covering the decision made or information transferred). Unsurprisingly most participants chose to take the latter approach – producing paperwork detailing decisions after the event in order to maintain the integrity of the audit trail associated with the project. This scenario was most commonly played out on D&B contracts in which novated consultants regularly went outwith the reporting chain of command (i.e. through the main contractor).

Key Advance 4 - A New Generic Project Typology 'Footprint'

An analysis of the interviews in progress discovered a number of recurring themes within the 'stories'. It was eventually found that a total of 14 distinct typologies for stories could be identified; these typologies could be grouped by either being 'Project generated' (i.e. specific to decisions taken on the project) or 'Non-project generated' (i.e. external factors impinging on the project that could not be predicted). A further refinement of this concept was to classify incidents as either being enhancing or detrimental to the project. The frequency with which these stories were repeated throughout the project allowed for the development of a frequency histogram or 'footprint' for each project. This was found to be particularly useful in getting an understanding of critical aspects affecting the performance of the project. Looking at the 'footprint' could quickly identify projects in which communication was the biggest problem, or that in which supply chain management created most problems. It is felt that this technique, although in its infancy and needing some development, could provide an extremely useful tool for future researchers in organizational structures and performance. This key advance is a finding that was not originally anticipated by the research and therefore not an explicit research objective (examples of 'footprints' can be seen in Murray et al, 2002).

Key Advance 5 - Formal and informal communications

A marked difference was found to be evident in the nature and structure of formal and informal communications taking place in the construction team. To some extent this is related to key advance (3) in that much of the informal communication was taking place in order to expedite the unwieldy nature of the formal communication network. There is preliminary evidence that a higher level of formality in communication takes place as a result of problems that are likely to result in litigation.

Key Advance 6 - Satisfaction & effectiveness in decisions

It was found that there was no correlation between each of the various procurement routes examined in the research and the satisfaction shown by participants and clients in the decisions made. The finding here is closely related to the research objective 4, examining the efficacy of the decisions emanating from the various organisational structures seen.

Conclusions and Further Research

The twelve projects studied provide a microcosm of the changing nature of relationships in the project procurement process. The research has mapped these changes, but an insight is that industry really reflects the changes taking place in contractual arrangements (prime contracting, partnering contracts etc). These new contractual forms are either attempts to reflect the new behaviours or control the pattern of relations. The research has pioneered the prospect of contractual forms which make sense of the current codified contractual chaos existing in the industry today. The research can be considered to be the first step on what may be a long road towards matching the evolution of academic understanding with the rapidly developing ideas adopted and implemented by practitioners. The research outlined in this report has formed the basis of a number of successful grant applications both nationally through funding councils and locally through university research grants.

References

Banwell, H (1964) *The Placing and Management of Contracts for Building and Civil Engineering Work*, HMSO, London

Conrath, W. D (1973), *Communication Patterns, Organizational Structures and Man: Some Relationships*, Human Factors, Vol.15, No.5, pp459-470.

Egan, J. (1998) *Rethinking Construction*, Final Report of the Construction Task Force, HMSO, 1998.

Franks, J (1984) Building Procurement Systems- A Guide to Building Project Management, CIM, Ascot, UK

Hage, J., Aiken, M and Marrett, C.B (1971) *Organization Structure and Communications*, American Sociological Review, Vol. 36, pp860-871

Hardcastle, C. (1992) *An Information Model of the Construction Cost Estimating Process*. PhD Thesis Heriot-Watt University, UK.

Higgin, G. and Jessop, N. (1965) *Communication in the Building Industry: The Report Of A Pilot Study*, Tavistock Publications.

Latham, M., (1994) *Constructing the Team*, Final Report on the Joint Review of Procurement and Contractual Arrangements in the UK Construction Industry, HMSO.

Liu, A. and Walker, A. (1998) *Evaluation of project outcomes*, CM&E, Vol. 16, pp 209-219.

Masterman, J.W.E. *A Study of the Bases upon which of the Construction Industry Choose Their Building Procurement Systems*. PhD Thesis UMIST 1994

Murray, M.D., Tookey, J.E., Langford, D.A. & Hardcastle, C.

(2002*), Construction Procurement Systems: Don't Forget Murphy's Law!*, proceedings of CIB W92 procurement systems symposium, Trinidad and Tobago, January 14-17.

Nicolini, D, Holti, R. and Smalley, M., (2001) *Integrating project activities: the theory and practice of managing the supply chain through clusters*, CM&E, Vol.19, pp37-47.

Roberts, K.H. and O'Reilly, C.A. (1978), *Organizations as Communications Structures: An Empirical Approach*, Human Communication Research, Vol.4, pp283-293.

Sidwell A.C. (1990) *Project Management: Dynamics and Performance*, CM&E, Vol.8, pp159-178

Skitmore, R.M. & Marsden D.E. (1988*) Which Procurement System: Towards a Universal Procurement Selection Technique*. CM&E, Vol 6, pp71-89

Tookey, J.E., Murray, M.D., Hardcastle, C. and Langford, D.A., (2001) *Construction Procurement Routes: redefining the contours of construction procurement*, ECAM, Vol 8, No.1, February, pp20-30.

Tucker, R.L., Kelly, W.R. and Thomas, S.R. (1997), *An Assessment Tool for Improving Project Team Communications*, Research Report 105-11 to the Construction Industry Institute, University of Texas at Austin.

Turner, A. (1997) *Building Procurement*, 2nd Edition, Macmillan, UK

Weick, K.E. (1987) *Theorising about Organizational Communication*, in F.M. Jublin, L.L. Putnam, K.H. Roberts and L.W. Porter (editors), *Handbook of Organizational Communication: An Interdisciplinary Perspective*, Sage Publications, pp97-122.

Construction Procurement Systems

Don't Forget Murphy's Law!

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Abstract

What can go wrong will go wrong! The rule of 'Murphy' can strike any unsuspecting project team and is best not forgotten. This is especially so if we consider the current UK construction industry agenda for performance improvement through a culture of eliminating waste (time, money, labour, materials) and a desire for 'zero defects.' This paper demonstrates (using 11 case study construction projects) that Murphy is alive and well on many projects and may indeed be visiting a site near you today. Design and construction professionals were interviewed on each project and information gathered resulted in the formation of a typology for each project. The typology indicated both project enhancing and detrimental events, which had taken place on each project. The typology allowed for the creation of 11 individual project 'footprints.' The footprints are compared and contrasted in this paper and reference is made to the procurement route (traditional, D&B and management) used on each project. The concepts of project risk, uncertainty, procurement systems and project success are also discussed.

Keywords: Procurement Systems, case-studies, Murphy's Law, project typology, footprints, risk, success

Introduction

Murphy's law states that "what can go wrong, will go wrong". The law's namesake, Capt. Ed Murphy, was a development engineer who worked for the Wright Field Aircraft Lab. Frustrated by a transducer that was malfunctioning because of

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an error in wiring, Murphy remarked: "If there is any way to do it wrong, he will". Murphy was referring to the anonymous technician who had wired the equipment. George Nicholas, who was Northrop Aircraft's project manager on the job, immediately labeled Murphy's offhand remark "Murphy's Law" (Marino, 1999). The specific call for improvement in the UK construction process, and thereby reduce the likelihood and impact of Murphy, has, in recent years come from both the 'Latham' (1994) report *'Constructing the Team'* and the Egan's (1998) *'Rethinking Construction'*. Latham challenged the industry to increase productivity by reducing costs by 30%, use more partnering arrangements between clients & contractors and adopt less adversarial dispute resolution methods. The 1998 'Egan' report can be said to have acted as a catalyst for change within the construction industry. Anecdotal evidence seems to suggest that many of Latham's proposals for improvement are only now being met as a result of the Egan's initiatives being enacted. Egan challenged the industry to reduce time and cost by 10% annually, defects by 20% per year and accidents by 20%. Such need for change does come against a backdrop of an industry that suffers from an 'image' problem. Table 1 shows that Murphy continues to blight projects.

Project Risk and Uncertainty in the Project Process

No construction project is risk free. Risk can be managed, minimised, shared, transferred, or accepted it cannot be ignored' (Latham 1994). But contractors rarely quantify uncertainty and systematically assess the project risks (Al-Bahar et al 1990). Indeed, Flanagan and Norman (1993) recognize that the risk management in construction is poor compared with other industrial sectors. Akintoye and MacLeod (1997) suggest this is due to contractors and managers lacking knowledge of risk management techniques To combat this predicament, Reid (2000) suggests that senior site personnel should, on a daily basis, ask 'what could go wrong on this job today'.

Smith (1999) recognizes that the terms 'risk' and 'uncertainty' if used rigorously, have different meanings, but that in construction projects the difference will have little significance and that they are commonly used interchangeably. The construction industry has adopted many methods in attempting to reduce uncertainty in the process. The use of 'apparently' standard forms of contract is intended to rationalize the construction process. Project planning with its associated Critical Path Networks is another example as are the use of BS5750 and today ISO 9000 quality procedures.

Heathrow Express Tunnel Collapse (1994)	British Library (London)
HSE reports errors were made 'leading to poor design and planning, a lack of quality during construction, a lack of engineering control and most importantly a lack of safety management' (New Civil Engineer 2000).	300% cost overrun and quality problems with electrics, wiring and sprinkler system. The Public Accounts Committee said it as a 'model of how not to manage a major construction project'. (Construction News 1997).
London's Guy's Hospital (Phase 3)1997	Cardiff Millennium Rugby Stadium
Completed 3 years and £68.7 m over budget, blamed on failure to freeze design, significant design changes, delays to works packages, major package contractor(s) insolvency and corrosion of copper pipework requiring £3-5m replacement cost (Contract Journal 1998)	Contractor Laing go £26m over budget due to committing to GMP while design undergoing major changes. Row between client and its neighbour also led to major design changes (Building 1999).
Thames' Millennium Footbridge	British Museum
£18m bridge close shortly only days after opening after huge crowds caused it to sway violently. Bridge is likely to be closed for a year while £5m solution is retro-fitted.(Contract Journal 2000b)	A Portico was restored using French limestone rather than the more expensive British Portland stone which matches the courtyards existing fabric (Building 1999).

Table 1 Murphy was Here!

Other techniques used to reduce uncertainty include the application of time and motion study principals to construction and its recent predecessor developed by the Building Research Establishment in the UK, CALIBRE (Vassos 2001). In addition, the UK industry can be seen to have extended its capabilities in this quest, and largely as a result of the 'Egan' report, now embraces a 'learning culture' vis-à-vis' such initiatives as benchmarking, demonstration projects and Key Performance Indicators (see M4I web site). Furthermore, new procurement philosophies such as 'Prime Contracting' (Holti et al 2000) lean construction and Supply-Chain-Management are all intended to eliminate wastage (time, materials, money, labour) by denying Murphy a visit to site and thus reducing uncertainty in the construction process.

Selection of Optimum Procurement System (Keeping Murphy Out!)

For a number of years many UK construction clients have demonstrated their unhappiness with the capabilities offered by the construction industry and available procurement systems (Contract Journal 1999). Such availability of choice does however suggest that clients can recognise the difference and benefits between each procurement method. For example, property developer Hammerson UK Properties use Design &Build for simple contracts, an amended version of JCT 80 (traditional) for contracts between £10-15 million and anything above this figure is procured through construction management (Construction News 1997b). However, Hall (2000) thinks that some clients are wasting vast amounts of money and experiencing long delays because they are not educating themselves on how to chose the right method of procurement. He suggests that 'too many clients are using JCT contracts even if it is not the most appropriate'. Indeed, Cain (2000) suggests that radical reforms taking place in the industry can be easily blocked by clients. Cain notes that 'procurement arrangements of many clients still continue to reinforce the structural failings of the industry'. However, as will be seen below, the assumption that a particular procurement / contract strategy can guarantee project success is by no means failsafe.

The definition of whether a project is a success or a failure is not always an easy one (Morris and Hough, 1996). Indeed, projects are often termed a technical success despite being behind schedule and over budget. Conversely, projects may be ahead of schedule and under budget but still be a technical failure (Larson and Gobeli 1987). Of more significance, Bresnen & Haslam's (1991) research with a 138 experienced clients revealed no significant association between the type of contract / procurement system used and project performance (time, cost, delay). Moreover, in reviewing many studies of this topic they argue that there is no great weight to the argument that any one method will help guarantee improved performance or greater satisfaction, at very best, the results are inconclusive and ambivalent. Liu and Walker (1998) also cast doubts on previous studies regarding the evaluation of project outcomes and observe that the concept of project success has remained ambiguously defined and can lead to disagreements between project participants.

Murphy Makes a Site Visit:

The cost of 'making good' Murphy's mischief can be excessive. Table 1 indicates some of the heavy financial penalties that can have an impact on companies involved in projects that go wrong. Much of the additional costs attributed to such projects involves rework. Love and Li (2000) found that during the construction stage of two case study projects in Australia, rework arose out of incomplete and erroneous project information. Josey (1998) in referring to the defects in the construction of a new hospital building blames 'careless and sloppy working practices' and argues that the high level of subcontracting in the UK has resulted in bad buildings, dissatisfied employers and writs. Such inefficiencies are noted by Taywood (1997) who suggests that the construction industry has a particular culture in which defects are tolerated via practical completion certificates, post-handover snagging and defects liability periods. Such criticism of the construction industry seems to suggest that many of the quality improvement slogans (i.e. get it right first time, zero defects, quality built in and continuous improvement) are indicative of the wide use of rhetoric in construction

Case Study	Procurement Method	Project description
1 (pilot)	Management Contracting	Exhibition and Conference centre
2 (pilot)	Design & Build	New Multi-storey office building
3	Design & Build	New Build city centre Hotel
4	Traditional	60 Bedroom extension to 4* Hotel
5	Design & Build	Leisure Complex with multi-client units
6	Traditional	Conversion of 'old' city centre hotel into retail units
7	Traditional	'Fit-Out' of completed 'shell and core' office building
8	Traditional	Construction of new sports hall for a University client
9	Construction Management	Extension and Refurbishment International Airport
10	Traditional	New Build 4.5* Hotel in city centre
11	Design & Build	Construction of new office building (low rise) on green-field site.

Table 2 Case Study Descriptor

Research Methodology

11 projects in Central Scotland were selected to be representative of the various procurement routes (Traditional, D&B and Management methods) in order to collect data for the study. The study was longitudinal, recording events recalled by the main project actors during the construction of each project. These main project actors or 'Elite' members (Marshall and Rossman, 1995) of the design and construction

team (i.e. Client, Architect, Project Manager, Contractor, QS, Services & Structural Engineers) were interviewed on a number of occasions.

The actors were requested to recollect project incidents which they regarded to be either project enhancing or detrimental. The Critical Incident Technique (CIT) of data collection was used (Flanagan 1954), although like Hussey and Hussey (1997) this research technique was initially employed without realising its origins. Project incidents were recorded using short hand note taking. The notes were 'typed up' after each interview and it was often at this time that other recollected data was put to paper. Sonnewald (1996) also used this approach in combination with the CIT to collect data. Gabriel (1998) also comments on this particular method of data collection (recollection) and suggests that it is a 'legitimate' method, especially when stories are committed to paper shortly after they were heard. After several visits to the case study projects it became necessary to develop a framework for the analysis of the data (critical incidents). It became evident that the incidents had recurring themes and were a result of internal project issues (typologies 1-9) and external events having an impact on project performance (typologies 10-14).

It was decided to formulate these issues into a typology framework, the results of which are shown in Table 3. The procedure for establishing, into which type each incident would fit, was essentially a pragmatic one. Notes were scrutinised after each interview and allocated a position.

It can be seen that the majority of incidents fall under 'project detrimental' issues (D = project detrimental) and thus the purpose this paper on Murphy's law (It is worth noting that Morris and Hough (1987) discuss whether one should study project successes or failures). It should be noted however, that all interviewees were encouraged to recollect incidents that

Case study																						
Type	**1**		**2**		**3**		**4**		**5**		**6**		**7**		**8**		**9**		**10**		**11**	
	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E
1	21	2	12	5	20	3	14	2	6	0	4	1	9	0	8	0	2	3	3	0	2	0
2	3	1	1	0	2	2	0	0	0	0	0	1	0	0	1	2	0	1	1	0	0	1
3	6	0	6	1	19	2	16	2	18	1	7	1	15	3	17	3	7	3	5	3	6	3
4	7	1	6	4	5	11	3	3	11	1	5	0	9	4	5	6	2	6	3	1	0	0
5	14	3	14	3	16	5	10	2	14	1	8	1	11	2	11	4	7	0	5	0	8	2
6	25	1	16	5	11	6	8	0	9	0	3	0	16	2	14	1	4	0	9	1	16	2
7	6	0	1	0	5	1	2	0	20	0	0	0	11	0	3	0	0	1	0	0	2	2
8	8	0	16	8	13	5	5	2	7	0	4	0	6	1	21	5	1	0	2	1	4	0
9	14	0	6	8	7	0	4	0	4	0	3	0	9	0	12	2	1	0	3	3	6	0
10	3	3	4	1	3	1	1	0	3	0	0	0	1	0	1	0	5	0	0	0	0	0
11	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0
12	2	0	3	0	0	0	3	0	12	0	2	0	0	0	2	0	0	0	2	0	1	0
13	6	0	5	0	3	0	1	0	3	0	0	0	1	0	1	0	2	0	0	0	0	0
14	6	0	2	0	6	1	7	0	19	0	5	0	18	1	9	1	2	0	3	1	7	0

(1+15) Location of team members **(2+16)** Effectiveness of team member **(3+17)** Teamworking **(4+18)** Communication issues **(5+19)** Design / detailing issues **(6+20)** Organisational politics **(7+21)** Supply-chain management **(8+22)** Sub-package integration **(9+23)** Project location **(10+24)** Historical trade loyalties (Edinburgh mafia etc) **(11+25)** Macro-economic pressure**(12+26)** Building and Planning control issues **(13+27)** Client Internal Issues **(14+28)**

Table 3: Case Study Typology

demonstrated a successful project (E= project enhancing). Indeed, many of these incidents recalled did in fact have an element of 'duality' to them. Thus, a problem, which by its nature tended to have a detrimental impact on the project (in terms of cost, time and performance) would on some occasions also present a window of opportunity to improve the project process. In addition, the allocation of a project incident (scoring) to the typology also includes multiple listings. For example, an incident which would be initially scored under a design / detailing category may also have been the result of communication and teamwork problems and would thus be scored under all three headings.

On completion of each project, a method of visually conceptualising the critical incidents recorded was thought necessary. The intention was to provide both the research team and the interviewee's with a 'pictorial descriptor' of the perceived project enhancing and detrimental qualities. The conversion from tabular form into a histogram was used and thereafter recorded as a 'project footprint' (see Figure 1).

Results and Discussion

It is not the intention here to conduct an exhaustive analysis of all detrimental incidents in each case study project. It can be

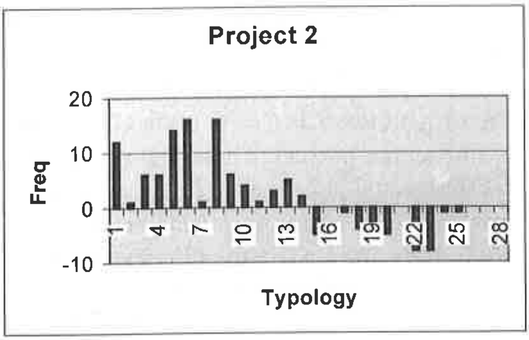

Figure 1: Example of Project Footprints

seen from Figure 1 that in each case study detrimental column the 4 highest numbered boxes have been selected (shaded). It should be noted here that the difference in numerical terms between each box (case study) is not under discussion and does not form the basis for inter-case study analysis. The number of interviews conducted on each project was not evenly distributed as a result of difficulties in gaining regular and continuous meetings with individual project actors. Thus, the quantity of recalled incidents cannot be used as a measure for analysis or indeed as an indication of project success or failure. Table 2 shows a typology hierarchy based on selecting 4 commonly cited incidents (highest totals) in each project. Each typology is discussed and reference is made to the procurement system adopted in each project.

Communication Issues

It is perhaps not surprising that all 11 projects should have suffered from this problem given that it has been frequently cited as being a weakness in construction. As early as 1965, Higgin and Jessop showed communication difficulties existed at several levels in the industry. Particular difficulties relevant to this paper are firstly, communications in the design team; secondly, contract related communications; finally construction team communications. Recently Boudjabeur and Skitmore (1996) provide details of untimely, inaccurate and insufficient information in D&B projects. With regards to this research, several communication difficulties are worthy of comment. The client in case study no.7 developed a project organogram to be used by the project team as a communication structure 'aide-memoire' during the project. This document acted as a buffer between the internal clients and the project team and to smooth problems in communication roles. This was however abandoned early in the contract (by the client) due to changes in personnel within the client body. The majority of communication difficulties did however involve inter-personnel issues between project team members.

Actors (project No.1) had problems maintaining contact on some projects and paradoxically even where teams were co-located on site (project No.6) communication problems were evident. Many communication problems were reported at contractor-sub-contractor-Architect design interface(s). The tendency for projects to involve sub-contractor design input (not withstanding the D&B projects) manifested itself in 'grey' areas of role and responsibility for design detailing. The impact of such insufficient design information only becoming apparent at construction stage. Such conditions in themselves were seen to generate further requests by the contractors for design details during construction with the resultant 'as built drawings' being finalised post construction. This situation in itself is endemic within the industry and is clearly not appropriate in a culture where 'rethinking construction' is taking place.

Typology	**Traditional (out of 4 projects)**	**D&B (out of 5 projects)**	**Management (out of 2 projects)**	**Total (out of 11 projects)**
Communication	4	5	2	11
Effectiveness of Team Members	4	4	1	9
Design / Detailing	3	3	2	8
Roles & Responsibilities	2	3	1	6
Client Internal Issues	2	2	0	4
Supply-Chain Management	1	2	0	3
Organisational Politics	0	1	0	1
Sub-Package Integration	0	0	1	1
Project Location	0	0	1	1

Table 2: Case Study Hierarchy of Typologies

Effectiveness of Team Members

This category is used to emphasise where construction team members have performed in a less than satisfactory manner. It s to some extent an extension of typology no 3 (Teamworking) but relies heavily on a judgmental perception which the researchers have of the incidents cited in the interviews. In addition, interviewees would often apportion blame at each other and this has also been scored. This typology essentially takes the view of 'if only the actors had behaved in an optimum manner' this problem may not have arisen. It views each case study project as being devoid of organisational, institutional, personal, contractual and procurement boundaries and categorises the 'mistakes' made by the actors. As noted earlier in the paper, many of the incidents are scored under more than one typology and this category therefore includes scorings, which have also, be taken into account under typologies 1, 2, 4, 5, 6, 7, 8,and 9.

Design Detailing Issues

Due to the nature of constructing a hierarchy of typologies in Table 3 it can be seen that 8 of the case study projects suffered from design / detailing problems. However, reference to Table 2 will show that all of the eleven projects were in fact blighted with such conditions. Two projects (3 and 10) demonstrate such an issue in that they were both designed 'on the hoof' so to speak. Both these hotel projects were originally to be 3* and 2* category respectively and were designed as such. However due to case study no 3's project location (close to now confirmed new Scottish Parliament) and change in clients brief in case study no. 10 (from backpackers hotel to quality accommodation) both these projects involved significant design changes when they were upgraded to 4* hotels. In both cases it was left to the contractor to chase design information. Since both these projects were used D&B arrangements this was to be expected. However, given the difficulties which developed in co-ordinating work packages as a result of missing information it does emphasise the unsuitable nature of D&B procurement to projects where design briefs change significantly from prevailing socio-economic conditions.

Roles and Responsibilities

Several construction writers have commented on the difficulty in detailing roles and responsibilities in projects. Bennett (1985) notes 'conditions of engagement' prepared by each professional institution (CIBSE, RIBA, CIOB, RICS etc) are typically used to detail what services the client receives from each consultant. However, and to the detriment of teamwork, these conditions standardise the obligations to the client, not between the other project parties. Murdoch and Hughes (1996) argue that this situation misses the value of teamwork and how fragmentation created by terms of appointment compromise this. Hellard (1995) also comments on such confusion when he notes that that those engaged in building are 'frequently left to work out their own objectives'.

Only one case study project (no.9) had instigated a project procedure manual describing roles and responsibilities 'expected' of participants. However, given that this experienced construction client has in many ways championed the reforms demanded by the 1998 'Egan' report this should not be so surprising. Such control over the project process was not evident on any other project. Actors were assumed to know their role and how to do their job. The main contractor in case study no. 3 did develop a series of teambuilding workshops as part of the partnering philosophy on the project. The initial workshop involved the project team completing the Myers-Briggs psychological test and developing a communication protocol for the project. This approach to building a team can be contrasted with case study no. 11 where the close knit nature of the team gave a flexibility in the roles and responsibilities demanded within a construction project. The team on this project had worked together on several projects for this client before and had built up amicable relationships with one another. On several occasions actors referred to not 'dropping [him] in the shit!' It was understood that they would meet again on future projects (for various clients) and that they had sour future co-operation by accusing one another of incompetence. An unwritten and informal (or gentleman's) code was thus enacted whereby the team would sweep up any problems which arose due to fuzzy areas concerning responsibilities. Interestingly some clients are frightened of such team cohesion and perceive it to acting as a cartel against their best interests. The client in project no.9 for example referred to the 'Edinburgh Mafia' and had commissioned an English project manager to keep an eye on his interests.

Client Internal Issues

The range of client experience with construction procurement in the eleven case study projects ranged from experienced to very experienced. That is to say no clients were novel to this industry. In particular, two projects were beset as a result of Murphy adopting the guise of a client. Project no. 5 involved the contractor working under a D&B contract for a property developer. Difficulties arose in this client body when the ownership (ergo risk) of the project changed hands at half way through construction. In addition, the multi-outlet nature of the building resulted in different sub-clients wanting late design variations on many occasions. The additional cost and time attributes exacerbating the already politicised nature of this project. Moreover, at least two members of the design team were also acting as consultants for these sub-clients clients and thus wearing 'two hats' on the project. This put a large strain on the established protocol of a novated D&B project and many instances of 'grapevine' communication took place. It is interesting to note that a new KPI has been established to monitor such client led design changes. Termed, 'change orders' it will allow contractors to pinpoint who is to blame for delays or cost increases in projects (Contract Journal 2000a).

Project no. 7 also presented difficulties for the project team as a result of what may be described as inappropriate client behaviour. The original plan on this office 'fit-out' project was for the clients internal project manager to act as a buffer (between internal client departments and design & construction team) and be the clients sole communicator with the project team. However, this manager was moved to another part of the client organisation (and not replaced) with the result that the project management consultancy employed by the client were now responsible for co-ordinating all internal client change requests. Again, in similar to the above project, these were many, and often in conflict with one another thus demonstrating how a power struggle within a client organisation can impinge on the smooth running of a project. Both of these projects suffered as a direct result of sub-optimal client intervention. Perhaps this should not be so surprising as Thomas (2000) argues that too many clients want 'something for nothing'. He puts the blame for construction's inefficient and dispute orientated culture firmly at the feet of clients by suggesting that they have got the industry they asked for. However other clients such as a representative of a regular purchaser of new office buildings has criticised construction for inadequate design, poor information, delayed handovers and defective work (see Ward 2001) and thus it can be seen that a culture of 'contractor bashing' continuous to exist.

Supply-Chain Management (SCM)

In the wake of the Egan (1998) report, Supply Chain Management (SCM) has become the 'flavour of the month'. Egan identified SCM as being an historically weak function in construction with overly confrontational relationships between project participants. The hard bargaining 'we don't give them an inch' or 'they don't make a penny on this project' mentality inherent in construction is often a source of great pride amongst construction professionals. Since Egan and other authors have noted particular problems in construction SCM, it was anticipated that such problems were likely in the case study projects selected. Indeed it was unsurprising when SCM became a significant issue in three (Nos. 2, 3 & 8) the projects investigated. Although both Project 3 & 8 did have SCM issues arising, Project 2 could be considered the 'pinnacle' (in so far as the word can be used in the context!) of how NOT to organise a project for SCM.

The pre-amble to the catalogue of disasters came about through the inability of the clients to settle on a procurement route. The project started by being a management contract; but the contractor was taken off the job when the project director decided to go to a rugby international match in preference to going to a meeting with the client! Subsequently a traditional contract was drawn up to govern the project, but again this too was superseded before finally a D&B contract was selected. Ultimately a single decision made early in this procurement process created catastrophic effects in the supply chain and on the delivery of the project overall. As part of a design feature of the building, the *in situ* casting of the concrete vaulted ceilings required the manufacture and delivery of precisely detailed and sized fibreglass moulds. These moulds also had to be delivered on time and in the correct order to facilitate the construction process. Only two companies tendered seriously for the contract to supply these moulds; one was large and well known in the industry for having a high level of expertise in the particular speciality. The other company to tender was much smaller with no 'name' in the area, but who did offer a substantially lower unit cost in order to win the contract. Unfortunately the decision was taken to select the 'low cost' contractor to manufacture the moulds. These moulds immediately became the critical component in the process, without which operations on site stopped. Frequently the moulds were delivered out of sequence, late and in too few numbers to allow a concrete pour. As the programme slipped behind schedule and the contractors put as many men on the site as possible to speed up production, they could do nothing without these moulds.

Impact of Selected Procurement System

What should be clear from the above discussion is that Mr. Murphy makes no distinction as to which project he will visit next. Each project was beset with a number of incidents, which resulted in some form of time, cost and quality wastage. The procurement system adopted (and in most cases adapted and thus 'hybrid') did not form a boundary or shield to these problems. Indeed, it could be argued that the adoption of a formal risk management framework (no project had this) on each project would not have prevented the projects being exposed to the trickery of this Irishman. What however is evident is that each case study project investigated operated under a named procurement route. However, the group behaviour of the actors during the project process would appear not to be determined by such formalities. For example, if we look at Table 3 it can be seen that the most common incidents to arise on projects involved issues involving communication; effectiveness of team members; design / detailing and roles & responsibilities. Very little distinction can be made on comparing these between the different procurement routes used in this study. These issues are however perhaps the key to project success and it is interesting for example that new forms of procurement (i.e Ministry of Defence Prime Contract) has developed out of the behavioural research undertaken by the Tavistock Institute (Holti, 1997; Nicolini et al 2001). Indeed, a recent quote from a construction management provider can be seen to lend support to this thesis; 'it revolves around a building, [service offered to a client] not getting hung-up on the procurement method' (Paxford 2001).

Conclusions

Josephson and Larsson (2001) suggest project errors (a visit from Murphy) happen recurrently and to avoid old errors, people must learn. This emphasises a need to collect and disseminate knowledge (i.e. Knowledge Management) within and between projects and organisations. It also emphasises the human dimension to increasing the likelihood of project success. However, although U.K. construction is making headway with reducing repeated failures in projects (i.e KPI's, CALIBRE and Demonstration Projects etc) no projects examined here demonstrated a culture of continuous learning. The issues discussed in this paper have been addressed, on occasions, quite whimsically (playing on Murphy's Law as the root cause of project problems). Although wastage (time, materials, labour etc) attributed to Murphy's site visits has not been quantified in this study, the results have serious ramifications for the construction industry. Indeed, the call for a 'sustainable' construction industry (DETR 2000) must surely be in jeopardy if the majority of projects undertaken in the UK cannot meet the requirements of Egan's (1998) agenda for change. However, let us not be complacent and regard projects claiming to have 'zero defects' as being free from Murphy's work. UK construction cannot benefit from projects which are handed over 'defect free' but which huge wastage during their construction. This is to deny Murphy's work and could be said to be akin to 'spin doctoring' the reality of the industry.

References

Akintoye, A and MacLeod, M.J (1997), Risk Analysis and Management in Construction, *Int. Journal of Project Management*, Nol.15, No.1, pp31-38

Al-Bahar, J.F and Cradall, K.C (19900 Systematic Risk management Approach for Construction Projects, *CEM Journal*, Vol.116, No.3, pp533-546

Bennett, J (1985) *Construction Project Management*, Butterworths, London

Building (1999) Building review: Millennium Stadium Cardiff, 17 Sept, pp42-45

Building (1999) British Museum Rumpus Over 'Wrong' French Stone, 1 Oct, pp14

Boudjabeur, S. and Skitmore, M. (1996), *Factors affecting performance of design build projects*, ARCOM 12th Conference, Sep 11-13, Sheffield UK, pp101-109

Bresnen, M.J and Haslam,C.O (1991) Construction Industry Clients : A Survey of their attitudes and project management practices, *CM&E*, Vol.9,pp327-342

Cain, C (2000), *Contract Journal*, Was the Gain Worth the

Pain?, 1st Jun,pp32-33
Construction News (1997a) New British Library: A Comedy of Errors, 6 Mar, pp48
Construction News (1997b) Preferred Entry to the Bull Ring, 18th Dec, pp20
Contract Journal (1998) Guy's is On the Sick List, 17 June, pp12-13
Contract Journal (1999) Clients Frustrated at Industry Performance, 14th Apr, pp 1
Contract Journal (2000a) New KPIs Scrutinise Client's Performance, 9 Feb, pp1
Contract Journal (2000b) £5m to Cure the Wobble, 22 Nov, pp8
DETR (2000) *Building a Better Quality of Life: A Strategy for More Sustainable Construction*, HMSO, London
Egan, J. (1998) '*Rethinking Construction*': The Report of the Construction task Force, HMSO, London
Flanagan, R and Norman, G (1993) *Risk Management and Construction*, Blackwell.
Flanagan, J.C (1954) 'The Critical Incident Technique', *Psychological Bulletin*, Vol.1,pp 327-358
Gabriel, Y (1998) The Use of Stories, In G. Symon and C. Cassell (eds) *Qualitative Methods and Analysis in Organizational Research*, pp135-160
Holti, R, Nicolinoi, D and Smalley, M (2000) *The Handbook of Supply Chain Management: The Essentials*, CIRIA, London
Josey, B (1998) Why not Just get it right First time? In, *Building* 21 Aug, pp42-47
Hall (2000) In, *Contract Journal*, Clients Lose Money Due to Ignorance of Procurement, 15th Mar, pp 3
Hellard, R.B (1995) *Project Partnering: Principle and Practice*, Telford, London
Higgin, G. and Jessop, N. (1965), *Communication in the Building Industry: The Report Of A Pilot Study*, Tavistock Publications.
Holti,R. (1997) The Lost World: Virtual Organization in the UK Building Industry, *Tavistock Institute Review* 1996/97,

pp44-49
Josephson, P.E and Larsson, B (2001) *The Role of Early Detection of Human Errors in Building Projects*, Proceedings of CIB World Building Congress: Performance in Product and Practice, 2-6 April, Wellington, New Zealand, Paper HPT 08
Larson, E.W. and Gobeli, D.H. (1987) 'Matrix management: Contradictions and Insights', *California Management Review* Vol. 29 No.4, Summer, pp126-138
Latham (1994) 'Constructing the Team': Final Report on Procurement and Contractual Arrangements in the UK Construction Industry, HMSO, London
Liu, A.M.M. and Walker, A. (1998) Evaluation of project outcomes, *CM&E*, Vol. 16, pp 209-219
Marino. S (1999) 'Murphy's Laws are poor excuses for mismanagement. *Industry Week*, 4 Oct, Vol.248, pp20
Morris, P.W.G and Hough, G.H () *The Anatomy of Major Projects*, John Wiley & Sons, Chichester
Murdoch, J and Hughes, W (1996) *Construction Contracts: Law and Management*, 2nd Edition, E&FN Spon, London
New Civil Engineer (2000) HEX Tunnel Dogged by Errors-HSE, 6 July, pp5-7
Nicolini, D, Holti, R & Smalley, (2001) Integrating Project Activities: The Theory and Practice of Managing the Supply-chain Through Clusters, *CM&E*, Vol.19, pp 37-47
Paxford, C (2001) Whatever Happened to Construction Management, *Building*, 11 May, pp36-37
Reid, J.L (2000) *Crisis Management: Planning and Media Relations for the Design and Construction Industry*, John Wiley & Sons, Inc, New York
Sonnewald, D.H (1996) Communication Roles that Support Collaboration During the Design Process, *Design Studies*, Vol.17, pp 277-301
Taywood Engineering (1997) *Towards Zero defects*: Report No 1303P/97/9974
Thomas, K (2000) Clients 'are to blame' for the state of the industry, *Contract Journal*, 18 Oct, pp2
Vassos, C (2001) *CALIBRE- The Toolkit for Facilitating World*

Class Performance in the UK Construction Industry, CIB World Building Congress, 2-6th April, Wellington, New Zealand, Paper: HPT 02

Ward, S (2001) Call to End Poor Practice, In *Contract Journal*, 6 June, pp7

From 'Procurement System' to 'Delivery System'

An Important Step in the Process of Construction Business Development

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Abstract

Building procurement has been defined as "the amalgam of activities undertaken by a client to obtain a building" (Franks, 1990), or "the organisational structure adopted by the client for the management of the design and construction of a building" (Masterman, 1992). These definitions were most appropriate while referring to the traditional design-bid-build method, emphasising as they did the client role in initiating and organising the process. However, there has been a move away from the traditional building business processes and an increasing use of alternative delivery methods for the construction of facilities. This change has been client led, for the most part, however, contractors have also championed the use of non-traditional systems such as management contracting, design-build and build-operate-transfer. These systems have had the effect of changing the business perspectives of construction firms, from passive participants in a prescriptive process, to proactive problem solvers who deliver construction products.

Long accustomed to traditional consultant-led contracting, construction companies have had to adjust their thinking to take charge of the entire process from design to handover and in some cases, initiating the process, financing, building and managing the finished product. This is more in keeping with the prevailing practice in other industries where innovation springs from the supply side of the industry in response to changes in demand.

This paper describes the shift in thinking that is needed for construction firms that wish to 'evolve' and the effect of this

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phenomenon in terms of construction delivery. It contends that the effect of these trends in construction has been such that building procurement systems are now more appropriately referred to as project delivery systems.

Keywords: Project delivery systems; Building procurement systems; Business process development; Change.

Introduction

It is common cause that the principal cause of interest in the development of alternative procurement systems in recent years has been pressure emanating from customers / clients of the industry. This is especially so for those frequent buyers of buildings (experienced clients) who have become dissatisfied with the outcome of the traditional set of services and the lack of value for money in the resultant product. In effect, demand side pressure rather than supply side innovation. Indeed, in countries where the construction industry evolved in much the same way as in Britain or who have adopted this model, construction is thought to be a 'basket case' of an industry (Bowley 1966, Ball 1988, Groak 1993, Egan 1998). One that has neglected process development for more than one hundred years, primarily because of a social structure shaped by traditional professions with a legal monopoly to act as gatekeepers to market entry and, in this way, to become surrogate customers for contractors (Lewis & Cheetham 1993, Hindle 1998b).

These role-players have resisted change, demonstrated leadership incompetence and have stifled process innovation (Hindle 1998a and 1998b), resulting in an industry that fits Porter's (1980) definition of a 'Fragmented Industry' that is 'stuck'. So 'stuck' that, unlike other modern industries it is thought to be incapable of self-development, (Bowley 1966, Ball 1988, DPW 1997). Evidence of this is to be found in the fact that in many countries government has intervened to form a 'Development Board' tasked with construction industry development. This includes many developing countries where they wish to build capacity, such as Kenya, Tanzania, Malaysia, Singapore and South Africa but also in developed countries such as Britain. Despite this, there has been very little evidence of success (Ofori 1991), however, recent developments in Singapore are noteworthy and in Britain where much change is taking place by virtue of the Governments promotion of it through procurement policy and encouragement, resulting from the initial impetus generated by the reports of Latham (1994) and Egan (1998).

Despite the severe disadvantages and barriers to development resulting from the structure and practices of the construction industry, there are some role players who could be said to be 'evolving', through the adoption of 'proven business practices' found in other industries. In most cases, it starts with the simple realisation that there is a customer for each project. Such is the case of the British firm Bovis, evidenced by the words of its then CEO Sir Frank Lampl who stated:

> "If you ask me what is the basis of our success, it is the recognition that there is a client. Without a client you are nothing. For years the construction industry has worked as if there wasn't a client. If they did recognise him, it was as the enemy." *Lampl (1999)*

Bovis could be classified, together with a select group of other construction firms, as 'leading-edge' in terms of business development. These firms that have 'taken-on-board' sound business practices found in other disciplines, particularly marketing. An example of this is to be found in the fact that their business strategy is one of building relationships with customers and of counting success in terms of 'repeat business'.

The role of procurement research

Since the advent of the term Building Procurement Systems in the UK in the 1980's there has been much growth in the number of alternative procurement systems but more so in the body of knowledge. This can be evidenced by the number of books, related journals and research papers, most emanating from the formation and work of Working Group-W92 'Procurement Systems' in the International Council for Building Research Studies and Documentation (CIB). However, despite the fact that this is a very popular and productive research area there is an impression that though much is being written we are not finding significant developments in the direction of the discipline. In fact, we seem to have undone some of the earliest work because, as yet, there is no commonly accepted definition of construction procurement (McDermott 1999:18). Indeed, a discussion took place at the Ching Mai conference that resulted from Green's (1999) presentation when he suggested that the discipline seemed to have 'plateaued'.

The growth in procurement systems theory and practice, offer the most tangible sign that construction process development is indeed taking place. However, there are few signs that this is the primary focus of research in this area, an observation based upon the apparent lack of linkage to the wider body of knowledge of business science and proven business practices in particular.

A demonstration of this shortcoming can be found in Cox and Thompson (1998) who dismiss present construction procurement theory because it falls short of proper procurement practice, e.g., consideration of all variables in the commercial environment to maximise purchaser's objectives including issues of outsourcing, make or buy decision, optimal sourcing relationships and supply chain management. This assumes procurement decisions need to be all encompassing, or consider matters of the environment in depth, which may not be the case as the cost implications to the client of the purchase will determine the level of detail (and therefore energy and cost) put into making the decision.

This paper offers a potential reason why this apparent lack of development in procurement theory may have occurred, whilst commenting on recent changes in terminology that suggests a need to re-orientation or thinking in order to find direction.

More than Semantics?

The term 'Procurement Systems' is relatively new, in fact it is not yet fully accepted at all levels of the industry (contractors think of procurement in terms of their need to procure resources, (Hindle 1995). Though there is evidence to show that `procurement of buildings' was a term used in the mid seventies in the public sector, it has only been in common use in British-influenced construction environments for little more than a decade, and one of the first to use the term was Franks (1984). Prior to this date, a number of terms were used, most often `contractual systems' or `Contractual Methods', (See for instance Waters 1982, and Ashworth 1983). A survey of the output of CIB W92 will reveal that most of the work has been produced by academics of British origin or from countries where the British model and influence is found. Only recently have academics in the USA begun to use the term, notably John B Miller (Miller 1998). However, it would seem that the term 'Project Delivery Systems' growing and more has become a more popular term in the USA, where a business approach to things is often the norm, (See for instance Lourie 1997, Kochnar & Sanvido 1999, Parsons 1999, Feniosky & Tamaki 2001).

But are they describing the same thing? According to Sanvido & Kochnar (1999), a building procurement system is the process by which an owner buys or acquires design and construction services for a project, whilst a project delivery system defines the relationships, roles and responsibilities of the parties and the sequence of activities required to provide a facility. The project delivery system organises the various participants into a team to deliver the intended facility, while the building procurement system is defined by the sequence of activities the owner uses to select the project team. Is this not a better way for an industry to approach its systems?

Market Orientation

Clearly the orientation of the term 'building procurement' is that of a customer or client who requires a facility and is concerned with the process that client faces in this event. It is likely that the term was coined by consultants who are engaged to help customers who were faced with the protracted and daunting task of construction. The term 'Procurement Systems' was adopted readily by academics and consultants, particularly quantity surveyors and architects. That the traditional professions accepted the term so readily was, perhaps, because it helped to reinforce their position in the hierarchic structure of the

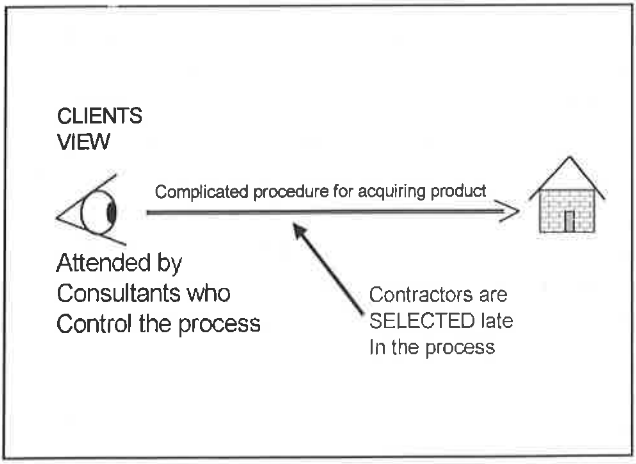

Figure 1. A Procurement Systems Approach to construction

construction industry in times of change (Hindle 1995). This can be seen in the way that most papers and books on the topic largely ignore the role of construction firms as leaders of the process, promoting the assumption that all procurement systems must be overseen by the built environment professions, (See for instance Franks 1990 and Turner 1990).

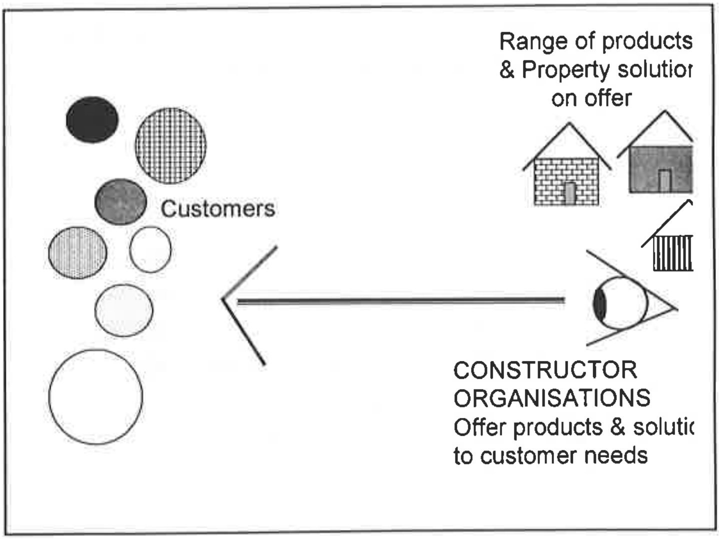

Figure 2. A Market Orientated Approach to Construction Markets

This term though, whilst it may have helped professions to maintain control of the process, changed the emphasis from one that described the construction process as seen by those involved in it, to one that considered the process from the customers vantage point. This development is contrary to sound business practice, which holds that product and service providers, after analysing the needs of their potential customers, market their products and services to them and in the process develop business process models. Such a concept requires its exponents to think in terms of systems of delivery, rather than how the customer engages in the market. In this way the term 'procurement systems' can be seen to demonstrate a lack market orientation by the entities involved in that industry. Figures 1 and 2 demonstrate the difference between these two 'vantage points'. When firms are able to adopt a market orientation they think in terms of service or product 'delivery systems' rather than 'procurement systems'.

The argument for the use of project delivery systems rather than building procurement systems is more than just a semantic one, therefore, and deals squarely with the perception role-players have of their role in the construction process.

Conclusions

In order for construction role-players to take control of their own destiny they need to adopt sound business practices. A complete rethink of business process is needed. This must start with the adoption of marketing and 'market orientation'. This type of change is hampered by the orientation of traditional consultants who have promoted their way of thinking by the use of the term 'building procurement systems'. Adoption of the term 'project or construction delivery systems' would be an important step towards self-development.

It is likely that this lack of market orientation will also explain why procurement systems development seems not to be advancing as fast as it could or should have.

References

Ball, M (1988) *Rebuilding Construction: economic change in the British Construction Industry*, Routledge.

Bowley, M (1966) *The British Building Industry: four studies in response and resistance to change*, Cambridge University Press.

Cox, A., and Thompson, I. (1998) *Contracting for Business*

Success, London: Thomas Telford.

DPW (1997) *Green Paper, Creating an Enabling Environment for Reconstruction*, Growth and Development in the Construction Industry, Co-ordinated by the Department of Public Works, SA Government Printer, November.

Egan, Sir J (1998) *Rethinking Construction*: The report of the Construction Task Force to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and efficiency of UK construction, Department of the Environment, Transport and the Regions, HMSO.

Pena-Mora, F & Tamaki, T (2001) Effect of Delivery Systems on Collaborative Negotiations for Large-Scale Infrastructure Projects, *Journal of Management in Engineering*, April, pp105-121.

Franks, J. (1990) *Building Procurement Systems*, 2nd Edition, Ascot: Chartered Institute of Building.

Green, SD (1999) Partnering: The Propaganda of Corporatism? In Ogunlana, S (Ed) (1999) Proceedings of the CIB W92: Procurement Systems and CIB TG 23: Culture in Construction, Ching Mai, Thailand.

Groak, S (1993) Building process and technological choice. *Habitat International* Vol 7 No5/6 pp 375-366

Hindle RD (1998a) What is Wrong With the Construction Industry? *The Civil Engineering & Building Contractor*, June, pp.10-12.

Hindle RD (1998b) The Professions: Following the Path of the Dinosaurs! A two part article in two issues, *Project Pro*, July, pp 200-21, and September, pp40-41.

Hindle, RD (1995) Construction marketing systems gain ground, *SAPOA News* South African Property Owners Association, March, pp. 15-17.

Konchar, MD & Sanvido, VE (1999) *A comparison of US and UK Project Delivery Systems*, In proceedings of CIB W55 & W 65 Joint Triennial Symposium, Cape Town, (CD Rom).

Lampl, Sir, F (1999) Securing the future for BOVIS, *Construction Manager*, May, pp 22-25, UK.

Latham, M (1994) *Constructing the Team*, Final report of the government/industry review of procurement and contractual arrangements in the UK construction industry, HMSO.

Lewis, J and Cheetham, DW (1993) The historical roots of current problems in building procurement, *proceedings of ARCOM 9th annual conference*, Exeter College, Oxford, September, pp. 50-61.

Lourie, DE (1997) Evaluating Project Delivery Systems, *The Building Economist*, December, pp 16-18.

Masterman, J. W. E. (1992) *An Introduction to Building Procurement Systems*, Cornwall: E. & F. N. Spon.

McDermott, P (1999) in Rowlinson, S and McDermott, P (Eds) (1999) *Procurement Systems: A Guide to Best Practice in Construction*, a CIB best practice book published by E & FN Spon

Miller, JB (1998) *Aligning Procurement Methods Towards Innovative Solutions to Environmental and Economic Needs*, Proceedings of CIB World Building Congress, Gavle, Sweden (CD Rom).

Ofori, G (1991) Programmes for improving the performance of contracting firms in developing companies: A review of approaches and appropriate options, *Construction Management & Economics*, E & FN Spon, Vol.9, pp. 19-38.

Parsons, J (1999) Decisions, Decisions Pick a Delivery System – Any Delivery System, *The Project Manager*, December, pp 3-7.

Porter, ME (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Macmillan, New York.

Sanvido, V and Konchar, M (1999) *Selecting Project Delivery Systems*, The Project Delivery Institute, USA

Tanah, KA (2001) Project Delivery Systems for Construction: An Overview, *Cost Engineering*, Vol. 43, No.1 January.

Towards Achieving More Effective Construction Procurement Through Information.

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Abstract

In recent years a number of reports and studies have been carried out, each recommending, in a variety of ways, more holistic, harmonious and cooperative approaches to construction procurement, in order to achieve greater benefits to construction clients, by providing the best quality for their required projects, whilst optimising the cost and time implications for the delivery of such projects.

As a result of pressures, led by public client bodies acting as best practice clients, there has been a move away from the traditional, financially driven competitive lump sum tendering strategies, in order to overcome the separation of design and construction, with all the various difficulties and problems such approaches bring. Today, many contracts are based on Design and Build approaches, with partnership agreements, either at project or strategic level, providing a more cooperative environment for all concerned and, equally importantly, an environment where more effective feedback is provided, thus facilitating action learning for the benefit of all. PFI type arrangements are also much in evidence, due to the need to pass the burden of funding the project from the client to the provider, allowing for much more consideration to be given to the long term use of the building, during its life.

Latest recommendations for government project procurement is the

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use of Prime Contracting which extends the use of Design and Build, where a single supplier is responsible for the design and construction of the facility, to one where the supplier is required to have a well-established relationship with a supply chain of reliable suppliers of quality products, with the aim of providing a facility which is fit for its purpose.

Whilst recognising that improvements have taken place and are continuing to take place, in construction procurement, this paper suggests that there still remains a fundamental hurdle to overcome, that being the need to remove mistrust and uncertainty, due to the lack of transparency in project information. A further disadvantage of such opacity is that it creates the need for unnecessary translations of project information to suit the needs of the various users involved in the supply chain, from design through to hand over of the project.

This paper sets out to analyse the nature of construction information and to consider what changes are necessary, including information organisation through classification, in order to provide the necessary information resources to facilitate effective communications between the various contributors to the procurement process. Without such improvements, the drive towards greater harmony and understanding will remain largely unachievable.

Keywords: Construction procurement, partnering, information management

Introduction

Unfortunately, there is no one perfect procurement strategy. Each individual approach will be more or less effective in a given circumstance. Researchers have developed a range of decision modelling techniques in order to attempt to select a procurement strategy, in which, in a given situation, the benefits outweigh the disadvantages.

It is perhaps worth reviewing, at this stage, precisely what is required of a procurement strategy. Put very simply it is an attempt to optimise the triangle of cost, time and quality for the benefit of the client. Unfortunately, these three expectations are usually competing with each other. For example, a very short construction time may well lead to higher costs. Low costs will usually lead to lower quality so, ultimately, a compromise must be sought which gives the best balance for a particular circumstance, as interpreted by the design team, acting on behalf of the client.

In identifying the most appropriate procurement strategy to achieve the optimal balance of time, cost and quality, the following criteria should be considered:

- The economic use of construction resources
- The need for the contractor to contribute to the design as well as the construction process.
- The incentive to make production cost savings and their subsequent control
- Continuity of work
- Risk and the assessment of who should bear it

Risk, and whether it should be retained, avoided or transferred, is very much at the centre of any procurement strategy. Risk is not only financial but also encompasses the achievement of the required quality and whether the project programme of activities is completed to schedule Current practice is to assess risk in terms of cost, which can be used as a common denominator to measure all risks.

Risk can be broadly classified as follows (Latham, 1994)

- Fundamental: War damage, nuclear pollution, supersonic bangs
- Pure : Fire damage, storm
- Particular: Collapse, subsidence, vibration, removal of support
- Speculative risks: Ground conditions, inflation, weather, shortages and taxes

All of these risks can be transferred by the client to the contractor. However the judgement to be made is whether the risk is better born by the client, as he/she may be better able to manage it, or perhaps commercially, it is likely that the carrying of the risk by the client will prove to be a lower cost than that included in the contractor's premium.

It is also worth stressing that, what might be seen as an appropriate strategy concerning risk in, for example, the United Kingdom, may be seen as entirely inappropriate in another country, due to cultural differences.

As a result of these misgivings, the use of the design and build method of contracting increased dramatically in the 1990's going from a 10% share during the 1980's up to a 30 % share of the construction procurement market in 1995 and a 41 % share in 1998, with traditional procurement going from 44 % share in 1995 down to a 28% share in 1998with management contracting declining to a 10% share, as evidenced by the latest survey carried out by Davis, Langdon and Everest (RICS 2000)

Future procurement strategies

Unfortunately, certainly within the United Kingdom, the construction industry still remains, in many cases, unable to perform, in terms of delivering projects of the right quality at the right price and at the right time. Stark evidence of such under performance has been highlighted in a recent report Benchmarking the Government Client Stage Two Study Document (December 1999) where, failure to deliver buildings on time and within budget, was found to occur in over 70 % of projects.

As a result of these failures a number of major reports have been commissioned at Government level addressing the problems facing the United Kingdom construction industry and what measures are required to bring about the necessary improvements. Construction procurement strategies make up the main focus of all these reports.

The first major report was produced by Sir Michael Latham (1994a) many of the recommendations of which have been largely ignored. It sought the views of contractors and key private and public sector clients and set out a clear action plan, which if implemented, would potentially make efficiency savings in the order of 30% in total construction costs over 5 years. An additional key recommendation was that the government itself should commit to becoming a best practice client.

Amongst the many recommendations the following were the most significant:

- Legislative procedures to simplify the resolution of disputes through mediation, reconciliation and adjudication as discussed earlier, together with ensuring prompt payment for work carried out. Much of this was implemented through the introduced in 1996, of the Construction Act.(1996)
- The establishment of a single organisation to bring together all sections of the industry and clients. This resulted in the establishment of the Construction Industry Board. It also led to the establishment of the Construction Clients Forum, a separate organisation, representing clients .
- The publication of a number of guides, checklists and codes of best practice concerning various aspects of the procurement, design and construction processes.

Following on from the Latham report was "Rethinking Construction" (Sir John Egan 1998). This report set out a number of key drivers and processes which need to be put in place to secure significant improvements in construction performance. These are listed below:

The five key drivers identified to achieve better construction were:

1. Committed leadership

2. Focus on the customer
3. Integration of the process and the team around the project
4. A quality driven agenda
5. Commitment to people

The four key processes needed to achieve change were:

1. Partnering the Supply Chain by establishing long term relationships based on continuous improvement with a supply chain.
2. A sustained programme of improvements for the production and delivery of components.
3. Integration and focus on the construction process and on meeting the needs of the end user.
4. Elimination of waste in the construction process.

Together with increases in:

- Predictability of projected cost and time estimates by 10%
- Productivity by 10%
- Turnover and profits by 10%

As a result of all these various initiatives and pressures, six essential requirements for all construction projects have been proposed for the effective procurement and management of construction (Modernising Construction 2001):

Contractor Selection

- Contractors should be selected on the basis of achieving long term sustainable value for money and not just lowest price.

Integrated Design and Construction

- Construction design should not be a separate process but be integrated with the whole construction process so that the design team can take more responsibility for the implications of their design, including cost, quality, buildability and the health and safety of those required to construct, renovate, refurbish, maintain and demolish buildings.

Better Planning
Sufficient time should be given to planning before commencing construction. This involves:

- Getting the construction sequence right.
- The assessment of risk and its management
- Carrying out value management

Project management
It is necessary to establish reliable project management. The characteristics of good management are:

- Comprehensive understanding
- Detailed knowledge of risks
- Regular monitoring
- Effective communication

Benchmarking
- The performance of construction projects should be measured to assess whether cost, time and quality requirements are being met. Additionally it is necessary to learn to disseminate these findings for future projects

Fair Price and Better Value
- Contractors should be remunerated in a way that encourages them to deliver good quality construction on time and to budget.

Information System
- A further essential requirement to bring about better construction performance is the development of a comprehensive information system, underpinned by information technology, which facilitates the accurate and rapid provision, manipulation and assembly of the specific information needs of all those concerned in the design, construction and operation of construction projects over their total life cycle, as a basis for their effective and efficient management.

Perhaps the main movement for change that comes out of all these reports and initiatives is the move towards greater harmony and spirit of cooperation between the various parties involved in the procurement process and the elimination of the adversarial culture with all the difficulties, tensions and conflicts, that so often prevail within the construction industry.

Partnering is, without doubt, seen as the way towards achieving many of the improvements reported above, if a modern, forward thinking, innovative construction industry is to be established.

Partnering, whether at project or strategic level, is based on encouraging better relationships between all the parties, and relies on the establishment of trust. It is a management tool, intended to promote more co-operative working between the various contracting parties involved in a construction project. The primary objective is to establish the shared goal of completing the work needed in a cost effective and timely manner to the mutual benefit of all concerned.

Protagonists of partnering have identified the following specific benefits from clients and contractors working together, which help in the achievement of better value:

- Reduction of the need for time consuming and expensive design changes
- Reduction of expensive disputes leading towards costly and lengthy litigation
- Integration of the supply chain
- Replication of good practice from earlier projects
- Encouraging the contractor to contribute towards developing more efficient and effective design and construction solutions
- Improvement of project performance during its lifetime.
- Development of more integrated and shared information systems, providing greater transparency and specificity for the various parties involved.

Whether or not partnering will prove to be the panacea that its various supporters claim, only time will tell. It is perhaps worth pointing out that such approaches are not new and similar arrangements and strategies have been deployed under various pretexts over many years (serial contracting, for instance) with limited success. Issues of probity in public tendering tend to work against any procurement strategy that wishes to develop a continuing relationship between client and contractor. Once the fragile bond of trust is breeched, the whole process can be undermined. Partnering may also inhibit competition and restrict the entry of new firms into the market. Ironically, some contractors may object to its universal adoption. Whilst a contractor may win a number of projects in a medium/long term partnering relationship, a greater number of unsuccessful contractors miss out on these projects, which are now withdrawn from the market place.

Partnering is, without doubt, an excellent principle to follow but, changing the culture of the construction industry's participants to facilitate its full support, may prove difficult to achieve, as the culture of a large number of clients and professional construction organisations is still to seek contracts with the lowest tenderer, irrespective of the ephemeral delights of harmonious relationships. Perhaps the prospect of paying less is just too tempting to many consumers – whether it is groceries or buildings!

On a more serious point, a recent report highlighted the fact that all involved in construction agree that they must abandon adversarial practices, with the exception of quantity surveyors. Cynically, this attitude by quantity surveyors could be because they need to perpetuate adversarial relationships in order to justify their existence.(Building 8th June 2001)

The *Modernising Construction* report (Modernising Construction 2001a) has recommended three procurement strategies for use with central government departments' construction projects, within the context of partnering arrangements aimed at bringing about the various improvements sought in construction performance, which are briefly referred to below:

1. Design and Build
2. Prime Contracting
3. Public-Private Partnerships

Design and Build

This approach is recommended, by the Office of Government Commerce, within a partnership arrangement, as one of the major ways of procuring construction projects. So, traditional forms of procurement are no longer the only method that government can use to procure projects.

Prime Contracting

This is seen by the Office of Government Commerce as an extension to design and build, in that the Prime Contractor is expected to have a well established relationship with a supply chain of reliable suppliers. The aim is to achieve increased quality and value for money through better consistency in the finished work and greater use of standardisation. Again partnering is a pivotal component of this approach.

Public-Private Partnerships

Here a supplier is contracted to build a public facility or infrastructure such as a hospital, bridge or tunnel, or a prison and also to be responsible for running the service the particular facility is providing, usually over a concession period of, for example, 30 years. In this way the risks associated with providing the service are transferred to those best able to manage them. Again the principle of partnering, both at project and strategic level, is an integral requirement if a successful outcome is to be achieved.

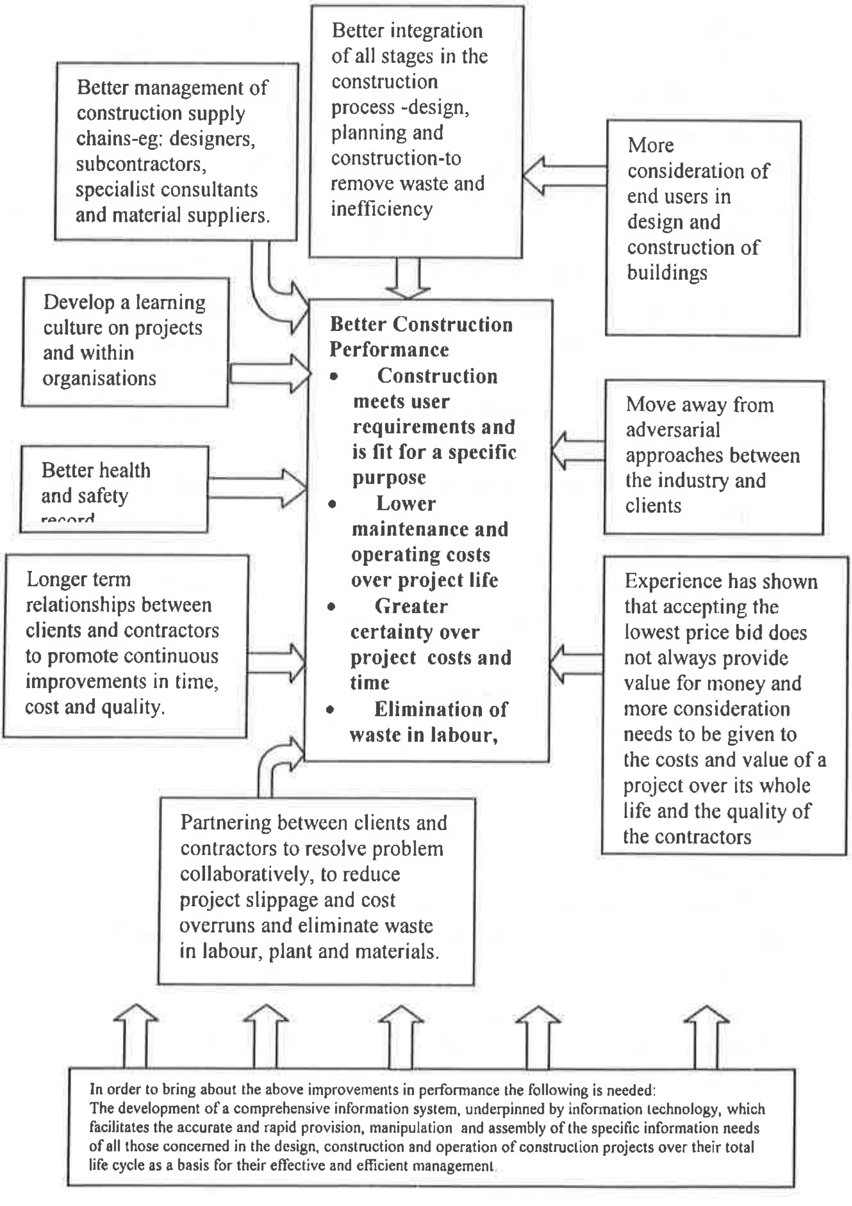
Further improvements

Despite all these admirable developments, which incidentally have been advocated under various guises since the 1940's (Simon 1944), (Emmerson 1962), (Banwell 1964) there is still, in the view of the authors, a fundamental problem remaining, which is the fact that project information reflects the product to be established namely the building, rather than the processes needed to achieve it. It is not capable of transposition from one manifestation to another and therefore specific information needs, at specific points in time, for specific purposes, remains largely unachievable. It is for this reason that so much mistrust prevails within the industry, which will not be eliminated unless there are fundamental changes in nature, form and content of the information used to describe construction. Such limitations have also been recognised by Rowlinson et al (2000) who suggests that, to underpin successful partnering, there is a need for improved communication and information flow. This view is further echoed by Lee et al (2000) who are developing a process protocol in order to provide " a common set of definitions, documentation and procedures, that provide the basis to allow a wide range of organisations, involved in a particular construction project, to work together, seamlessly". Kagioglou et al (1998).

Work by Edum-Fotwe et al (2000) has also shown that construction is essentially an information transaction process and that information should be treated as a resource, for use by the various parties involved in the procurement of construction projects.

Thus designers find it difficult to accurately model the resources needed in the construction process. As a result often

Fig 1: Steps necessary to bring about better construction performance (adapted from Modernising Construction)



sub-optimal solutions are produced, as the dynamics of the construction process are difficult to identify. Additionally, constructors, when developing their process model from product stated design solutions, have great difficulty in deriving accurate and realistic solutions, especially where competitive tendering is deployed and thus financial allocations are established before the establishment of the detailed process model.

However for this to happen, there have to be some parallel developments in information systems and their management in order to capture the opportunities of greater transparency offered by the developing of more open approaches to construction procurement. The present time is an ideal opportunity to develop information systems which are project related rather than developed primarily for use by each specific contributor in the design and construction process. In the past there have been a number of developments attempting to provide more effective information management, ranging from radical approaches, such as that proposed under the Operational Bill (Forbes W S and Scoyles E R 1963), the SfB classification system (CIB W74 Information Co-ordination for the Building Process 1986), the British Property Federation System (British Property Federation 1983) and civil engineering tendering documentation (Institution of Civil Engineers 1985) through to more cosmetic recommendations, such as developed by the DOE (PSA 1978), the CPI (Coordinated Project Information Committee 1987) and Uniclass (Construction Project Information Committee 1996). Most of these approaches, in the past, have tended to lead to fragmentation and thus poor portability and have tended, as a result, only to serve the needs of each particular interest. Through developments such as SfB, the CPI and, latterly, Uniclass, which allow us to organise our information through classification, there is now a real opportunity to utilise information technology so that a comprehensive information system can be developed. Such developments will facilitate the accurate and rapid provision, manipulation and assembly of the specific information needs of all those concerned in the design, construction and operation of construction projects, over their total life cycle, as a basis for effective and efficient management.

References

Banwell (1964), *Committee on the Placing and Management of Contracts for Building and Civil Engineering Work*, HMSO, London.

Benchmarking the Government Client *Stage Two Study Document* December (1999), HMSO, London.

British Property Federation (1983). *The BPF System for Building Design and Construction*, British Property Federation, London.

Building Friday 8th June 2001 p33, The Builder Group, London.

CIB W74 Information Co-ordination for the Building Process (1986). *A Practice Manual on the Use of SfB The Classification System for Project and General in the Building Industry*, CIB Publication 55. Council for Building Research, Studies and Documentation. Ireland.

CI/SfB *Construction Indexing Manual (1975)*. RIBA Publications, London.

Comptroller and Auditor General (2001). *Modernising Construction*. H C 87 Session 2000-2001. HMSO, London.

Construction Project Information Committee (1996), *Uniclass: Universal Classification for the Construction Industry*, Construction Project Information Committee, London.

Coordinated Project Information Committee (1987), *Common Arrangement of Work Sections for Building Works*, Coordinated Project Information Committee, London.

Housing Grants, *Construction and Regeneration Act* (1996), HMSO, London.

F T Edum-Fotwe, A Thorpe & R McCaffer (2000). Assessing Potential of On-Line Transaction for Information as a

Resource in the Construction Process. *Journal of Construction Procurement* pp 202-219. IPRG Limited.

J Egan (1998) *Rethinking Construction*. Report from the Construction Task Force. Department of the Environment, Transport and the Regions, London.

H Emmerson (1962), *Survey of Problems Before the Construction Industries*, HMSO, London

Forbes W S and Scoyles E R (1963). The Operational Bill, *Royal Institution of Chartered Surveyors Journal* February 1963, London.

Institution of Civil Engineers (1985), *Civil Engineering Standard Method of Measurement*, Thomas Telford Ltd, London.

M Kagioglou, R Cooper, G Aouad G Hinks, J Sexton & D Sheath (1998). *A Generic Guide to the Design and Construction Protocol*. The University of Salford. Salford

M Latham (1994). *Constructing the Team: Joint Review of Procurement and Contractual Arrangements in the UK Construction Industry*. Department of the Environment. HMSO, Lo0ndon.

A Lee, M Kagioglou, R Cooper, G Aouad (2000). Production Management: the Process Protocol Approach, *Journal of Construction Procurement* pp 164-183. IPRG Limited.

PSA (1978) *Construction Planning Units*, PSA Directorate of Architectural Services, London.

S Rowlinson, J Matthews, F Phua, P McDermott & T Chapman (2000). Emerging Issues in Procurement Systems, *Journal of Construction Procurement* pp 90-103. IPRG Limited.

Royal Institution of Chartered Surveyors (RICS) (2000) *Contracts in use: a survey of building contracts in use during 1998*, RICS London

E Simon (1944), Report of the Central Council for Building Works and Buildings, "*The Placing of Management of Building Contracts*", HMSO, London.

A Comparative Study of Safety in Culture the Construction Industry of Britain and the Caribbean

Summary of the Findings.

Steven J. Peckitt[1], A.I. Glendon[2] & R.T. Booth[3]

Abstract

This cross cultural study of safety culture[4i] examines occupational health and safety related attitudes and safety management practices in the construction industry in the Anglophone Caribbean[ii5] and Britain using both quantitative and qualitative techniques derived from the social sciences. Documentary and observational information is combined with the results derived from attitude scales and audits of site behaviours and management systems to produce a holistic and triangulated analysis of safety culture.

Bandura's (1977, 1986, 1991) *Social Cognitive* theory provides the conceptual framework for this study, highlighting the triadic and reciprocal relationships between cognition, behaviour and environment. This work explores cognitive issues such as risk perception, locus of control, accident causation beliefs and safety management responsibilities using safety climate tools. It examines specific behavioural factors through site safety auditing, safety management systems appraisal and interviews. It considers the impact of environmental or situational factors, such as occupational health and safety legislation, its enforcement and societal values, upon health

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[4] In this study the term safety culture relates to occupational safety and health risk management.

[5] This study collected data in the following English speaking Caribbean countries - Anguilla, Barbados, Guyana, Jamaica, St. Lucia, St. Vincent, Trinidad & Tobago

and safety performance.

Accident and ill-health data for the construction industry suggest that the comparatively highly developed societal safety management systems of legislation, inspection and consultation in GB have not resulted in lower rates of death and ill health compared with the Caribbean. This study highlights the importance of the influence of societal culture, the construction process and local environment upon safety culture in the construction industry. This research demonstrates that the safety culture paradigm is not just a catch all phrase or label for best practice, but is a holistic way of thinking about risk management which allows for identification of underlying causal factors behind safety performance in complex sociotechnical systems.

Keywords: cross-cultural study, safety, attitudes, safety management practices, Caribbean, UK.

Introduction

In most societies, the construction of structures is integral to human activity providing, *inter alia*, places for shelter, business, religious ceremonies and learning. The construction industry produces the built environment, creates employment and generates wealth. Small businesses specialist in one of numerous different construction related activities, dominate the industry resulting in a competitive, complex, dynamic and fragmented industry. The construction industry is commonly considered to be dangerous, difficult and dirty, and is one of the most hazardous land-based industrial activities, producing numerous serious accidents and cases of ill health to workers and members of the public.

The concept of safety culture is concerned with managing health and safety risks. The Advisory Committee on the Safety of Nuclear Installations (ACSNI) study group on human factors, provided one of the most quoted definitions of safety culture: *the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and proficiency of, an* *organisation's health and safety management* (HSC, 1993). Geller (1994) proposes the concept of *Total Safety Culture*, identifying *personal* (knowledge, skills, abilities, motivation, personality); *behavioural* (compliance, coaching, recognition, communication); and *environmental* (equipment, tools, machines, housekeeping, environment, engineering) factors as key aspects of safety culture. One of the most simple and general, but useful, definitions of safety culture is: *aspects of culture that affect safety* (Waring, 1992).

The aim of this research project[iii6] was to examine health and safety risk management in the construction industry in two different parts of the world in order to gain a better understanding of factors that significantly impact upon the safety culture of this industry. This paper briefly describes some key findings from this study, highlighting significant attitudes, behaviours and situations that were found to impact upon the safety culture of the construction industry in Britain and in seven Anglophone Caribbean countries in the last decade of the twentieth century. It examines the following specific issues:

1) standards of construction site health and safety;
2) construction worker attitudes to health and safety related issues;
3) construction companies health and safety management practices;
4) societal factors that impact upon the safety culture of the construction industry, including legislation and societal values.

Methodology

Cooper (1993), Geller (1994) and Cameron (1997) advocate the use of Bandura's (1977) *Social Learning* theory for the

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[6] This research was supported by Aston University and the Health and Safety Executive. The views expressed are those of the authors and do not necessary represent the views of the HSE.

analysis of safety culture. Bandura's theory can be used to model of safety culture, where safety culture is represented the dynamic reciprocal relationship between group members' perceptions and attitudes towards safety (cognition); their job related actions (behaviour); and the effectiveness of health and safety management systems (environment/situation) (Cooper and Phillips, 1995). The focus of this model can be extended from organisations to the industry level by viewing safety management practices as behaviours and the influence of external influences, including legislation, economics, history and climate as situational factors (Figure 1). This reciprocal model recognises that the strength of each element may be different in any given situation. Describing a safety culture as good/positive or poor/negative equates with the possession of characteristics identified as being effective or ineffective for controlling occupational risks to health and safety in their operating environment.

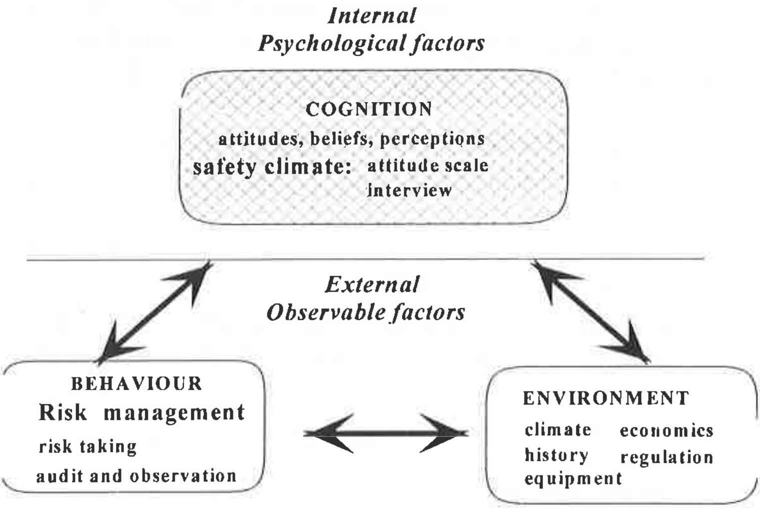


Figure 1 Reciprocally determined model of safety culture (after Bandura, 1977 and Cooper, 1993)

Combinations of psychological and ethnographic methods have been deemed to be the most appropriate tools for examining safety culture (Schein, 1990; Guest, *et al.* 1994). An organisation's safety management system, the prevailing safety climate and daily goal directed safety behaviour can be evaluated making it possible to assess safety culture in a meaningful way (Cameron, 1997). Attitudes can be measured using a safety climate tool, while work behaviours and situational factors can be assessed by a variety of techniques including audit, literature review, direct observation and questioning (see Appendix 1 for a summary the tools used for data collection). This triangulation of information sources provides a check against observer bias and provides verification of the emergent conclusions (Bryman, 1988).

Cognition

Safety climate scales developed by Leather (1987, 1988) and Phillips, *et al.* (1994) to examine workers' attitudes to safety-related issues in the British construction industry are incorporated into this study. In addition, an eleven-item interview schedule was developed by the first author to examine factors that Hinze (1981) found to influence accident rates on sites in the USA, including: size of working groups; inter-worker relations; and nature of deadlines.

Site Behaviours and Practices

A construction site safety audit tool, developed and validated by Cooper, *et al.* (1991), was used to measure aspects of construction site safety in the Caribbean. The results from the original British study are used as comparative data with the Caribbean audit scores (see Table 1). In addition to audit and general site observations, site safety management arrangements were explored during Caribbean head office and site interviews.

Situation

The characteristics of the industry, regulatory frameworks, and other relevant societal factors were examined through interview, literature review and observation.

In the Anglophone Caribbean, 59 sites were audited and interviews were conducted with 153 site workers, 61 managers and directors, and government inspectors and heads of representative bodies. In Britain, site safety standards and safety management auditing was undertaken on three major contracts of the Jubilee Line Extension Project (JLEP)[7] Ninety-four British construction workers employed on the JLEP, provided responses to the safety climate scales.

Results

1) Construction site safety

The results of site safety auditing highlight similarities and distinct cultural differences between the two construction industry cultures. The Caribbean Region scored an average site safety score of 57%, compared with an average score of 77% for British sites (Table 1).

Table 1

Mean Site Audit Results (% Safe) for British and Caribbean sites

Audit Category	British Sample* n = 27	Caribbean Sample n = 57
Housekeeping	77	78
Scaffolding	79	45
Access	81	71
Personal Protective Equipment (PPE)	71	33
Mean Score	77	57

*The combined pre-intervention baseline scores from the site audits conducted by UMIST researchers for HSE (Duff, *et al.* 1993; Robertson, *et al.* 1999) provide a comparable sample of British construction sites.

The two samples achieved almost identical average scores for

[7] Not reported in this paper

the Housekeeping category of the audit, while the Caribbean sites produced a marginally lower average score for the Access category and significantly lower scores than the British sample on the Scaffold and PPE categories. Housekeeping was good in both samples, but methods for gaining access to heights and the provision of PPE and scaffolding are areas of cultural difference.

Wooden scaffolding predominates in the Caribbean, while metal scaffolding is the norm in Britain. Edge protection and complete boarding to working platforms are rare in the Caribbean, but are recognised standards in the British construction industry. These results correspond with findings of Rowlinson and Linguard (1996), who, using the same measure in Hong Kong where bamboo scaffolding is common, found that the scaffolding category emerges as the most culturally influenced category on the UMIST site auditing tool and the hardest area in which to achieve behavioural change. Personal protective equipment provision was variable, but generally poor in the Caribbean. Workers readily wore protective equipment, i.e., hard hats, goggles, gloves, and facemasks, when the contractor provided them. Ladders are custom made out of wood on sites in the Caribbean, but factory manufactured from wood or metal in Britain. Compared with Britain, hazardous chemicals were not as common on Caribbean construction sites due primarily to climatic and economic imperatives that result in the use of different construction designs, materials, finishes, systems of work and techniques. The Caribbean was more labour intensive with relatively low levels of mechanisation when compared with Britain, and where used, plant was often poorly guarded and maintained.

2) Safety Climate

The results of the analysis of the attitudinal data provided by construction workers in Britain and the Caribbean indicates that there is broad correspondence on the key dimensions of each safety climate. Factor analysis of the data determined that the principal factor is the interaction between managers and workers. The other factors identified include workers' perceptions of risk, work experience, sense of rushing and safety communications, corresponding with the findings of Dedobbleer and Beland (1991).

In addition to the shared aspects of safety climate, the two samples demonstrate significant differences. Caribbean workers responded less positively to safety climate items relating to management behaviours in comparison with their British counterparts, but were more positive with respect to the items relating to the foreman's and their own actions with respect to safety, than was the British sample. Compared with the Caribbean sample, the British sample recorded higher scores on items relating to feeling rushed and that there was a significant chance of them having an accident. Caribbean workers scored higher than the British sample on the items relating to risk perception, sense of individual control over safety, communications and relations with their work-mates, and enjoyment of working on site. Less than a quarter of British workers stated that they discuss personal problems with their colleagues, less than a half stated that they enjoyed their work, while two-thirds responded that they experienced impossible deadlines and that they had to rush to finish off work.

3) Safety management practices

The majority of small construction companies that dominate the industry worldwide tend to have slim management structures, with little bureaucracy and no formal safety management systems. Risk assessments, safety policies, safety committees and documented safety management systems were virtually absent in the Caribbean. Directors and project managers were often unaware of their duties under health and safety legislation, including reporting accidents. Caribbean directors stated that they did not take occupational health and safety legislation or international standards into consideration when tendering for works, or price for safety items in their tender bids. There was a general absence of formal health and safety training specific to the construction industry in the Caribbean and there was no equivalent of the British Construction Industry Training Board (CITB).

In Britain the effectiveness of contractors' safety management systems varies both with size and activity (Birchall and Finlayson, 1996). Civil engineering contractors tend to have more sophisticated and effective safety management systems than do the commercial building and housing contractors. The medium and small construction contractors, who dominate the British construction industry, only rarely have effective safety management systems. In particular, the risk assessment process, communication of information and employee involvement is poor in many organisations. Health and safety training for managers, supervisors and workers is often lacking, despite the existence of national training organisations. Construction managers in Britain commonly view safety as a cost that conflicts with production and therefore take little direct interest in it and ignore safe systems of work when they feel strong programme and financial pressures (Leather, 1987).

Site managers with experience of working in both the Caribbean and Britain stated that they had to carry out a far greater degree of control of day-to-day site activities in the Caribbean due to the lack of engineers, skilled tradesmen and supervisors. Directors, managers and foremen stated that there were good relations on site between workers and site managers, stressing the importance of open communications and the need to consult with workers. Site relations tended to be more paternalistic on Caribbean sites, with less emphasis on efficiency and speed. Both foremen and managers across the Caribbean stated that you had to get the respect of the workers in order to get them to work hard and that workers do not like pressure and will walk off the job if shouted at or pressed to work faster or harder.

4) Industry characteristics

The stereotypical image of the British construction industry is that it is a dirty, noisy, dangerous, inconveniencing activity undertaken by hard living men, employed by unscrupulous contractors. There is little job security, little training and generally low academic entry requirements to the industry. The pressures of tight work schedules are compounded by bonus payment systems and "pay when paid" clauses. Sharp practices of many small builders, some of which border on fraud, perpetuate the image of the dishonest and incompetent cowboy builder frequently portrayed in British television dramas and documentaries.

Latham (1994) describes the British construction industry as litigious with conflict, adversarial attitudes, fragmented organisation and a lack of trust resulting in over 1000 writs being issued each year. Competitive tendering, programme pressures and the use of penalty clauses all set up pressures that conflict with safety management. Time and cost pressures result in risks being ignored and the law being broken with the consent of supervisors and managers. The requirement for high-speed project completion often results in poor planning, a cost premium and an increased risk of accidents and mistakes occurring. Competitive tendering limits the amount of influence that builders have on designs, the degree of innovation and investment in new technologies and prevents collaboration between architects, engineers and builders (Atkin, *et al.* 1995).

The fragmented relationships between clients, consultants, designers, contractors and subcontractors in the construction industry in both regions results in difficulties such as inadequate planning, disputes, nepotism, poor communications and time delays. Caribbean projects frequently experience delays due to client indecision, poor design briefs, design changes, materials supply problems and late payment (Atherley and Lewis, 1992). Adversarial relationships, attitudes of the work force, inefficient bureaucracies, lack of finance, low pay and motivation, low productivity, political interference, poor infrastructure, and skills and materials shortages are common problems facing the construction industry in the Caribbean (Lewis and Mugishagwe, 1993). However, compared with Britain there is not the same degree of adversity, 'cut-throat' competition, imposition of unreasonable deadlines, or litigation in the Caribbean. Only one of the Caribbean companies studied had been to court over a contractual dispute.

Project managers in the Caribbean who had experience of both cultures stressed the slower pace of work compared with British industry. In the Caribbean there was a lower level of pressure on the workers and a slower pace of working. Bonus schemes, tight time schedules, penalty clauses and litigation were all uncommon in the Caribbean. Construction managers with experience of both cultures stated that works of similar size would take approximately twice as long in the Caribbean generally, compared with Britain.

5) Societal factors

The nature of occupational health and safety regulation and the impact of societal culture were examined and compared. Occupational health and safety legislation applicable to construction in the Caribbean varies from country to country, is proscriptive and rarely enforced. Only Jamaica and Guyana had comprehensive construction specific regulations, while Trinidad and Tobago have a set of regulations relating specifically to earthworks. Inspectors are rarely provided with legal powers of prohibition and prosecution, or with adequate technical equipment, and means of transport. On the whole they are underpaid, handicapped by bureaucracy and excessive delays in judicial proceedings and the low level of legal penalties for violations.

The regulatory system for occupational health and safety in

Britain is extensive and complex. The Health and Safety Executive (HSE) is the organisation responsible for health and safety in the British construction industry. HSE inspectors have powers of immediate prohibition, improvement and prosecution. Regulations forming a comprehensive regulatory framework cover the whole construction process. In the mid-1990s an average of 100 inspectors was devoted to inspect the construction industry. HSE construction inspectors annually carried out around 30,000 inspections, representing approximately a quarter of all HSE inspections, issued around a half of all HSE prohibition notices and conducted a third of HSE prosecutions (HSC, 1996).

African-Caribbean people dominate the manual trades in the construction industry of the Caribbean region. When describing the important factors that impact upon construction site safety in the Caribbean, African-Caribbean workers stressed the values of freedom, love of life (*joie de vivre*), social aspects of work and the willingness to take time to do things. Caribbean workers scored items relating to interactions with fellow workers, communications on site and enjoyment of work higher than did British workers. A prevalent attitude expressed by Caribbean workers was that British people live to work whereas Caribbean people work to live. British culture, biased towards individualism and low power distance, places emphasis on the legal system, democratic power, technology and the work ethic (Hofstede, 1980). British workers scored higher the items related to rushing and risk-taking, highlighting differences in the perception of pressure and time. The common British cultural symbol of the fierce and determined Bulldog, contrasts with Anansi the clever spider which is a popular cultural figure amongst African-Caribbeans, derived from West African folk tales. Table 2 summarises key findings from this study.

Conclusion

Comparative profiles of the two safety cultures can be built up combining the significant factors identified in this study. The radar map (Figure 2) provides a conceptual depiction of the

Table 2)
Construction Industry Safety Culture - Summary of Key Findings

	CARIBBEAN	BRITAIN
	CONSTRUCTION WORKER ATTITUDES	
locus of control	relatively high	relatively low
risk perception	relatively high	relatively low
communications	relatively high	relatively low
sense of rushing	low	high
	CONSTRUCTION SITE BEHAVIOURS	
housekeeping	generally good	generally good
ladders	made on site - few accidents	manufactured - many accidents
scaffolds	made from timber, not used for storage of materials edge protection rare	made from metal often used for material storage edge protection generally good
PPE	poor	variable
techniques	simple methods, robust structures, limited use of technology	`often complex designs, common use of technology
	CONSTRUCTION ORGANISATIONS	
bonus schemes	rare	common
safety management systems	little proactive safety management, safety seen as site function for foreman and workers	variable - good in civil engineering, poor in smaller contractors, safety often seen as a site function
safety training	rare	national schemes increasing
pressures	financial and material supplies lack of specialist skills	fierce finance and time pressures skills shortages
dispute resolution	litigation rare	frequent litigation
project management	contingency approach	Taylorist approach

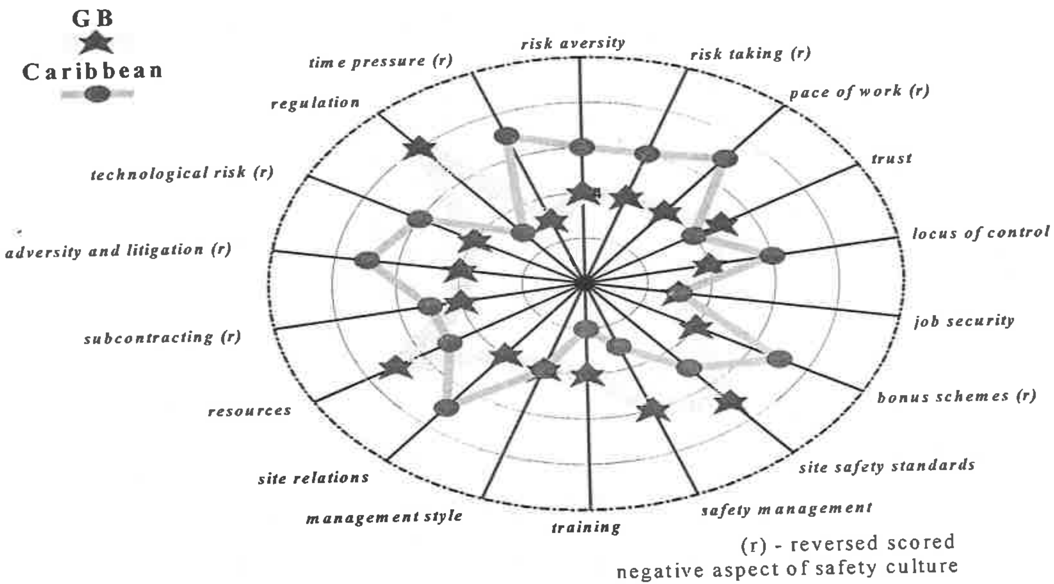
	CONSTRUCTION INDUSTRY	
adversity	little	common
legislation	little	comprehensive
inspectors	few	many
enforcement	rare	common
approach	negotiation	rule based
	SOCIETAL FACTORS	
regulation	little influence	large influence
climate	tropical	temperate
use of technology	restricted	extensive
life/work relationship	work to live	live to work
focus	spirituality	materialism
time	time synchronous	time sequential
risk	risk averse	risk taking
values	joie de vivre Anansi smartness	PWE Bulldog spirit

safety culture of the construction industry in the Caribbean and Britain. The data points are the key issues that emerge from this study. Personal factors such as risk taking and locus of control are positioned in the upper right hand third of the diagram. Construction industry factors such as site relations, training and safety management are located in the bottom third, while societal factors occupy the left hand third of the diagram.

The data points are placed on a five-point scale rising from zero at the centre of the map. The relative magnitude of each data point within each safety culture is derived from results of this study. The further the point away from the centre of the map, the greater is the influence of that factor.

Positive influences within the safety culture of the British construction industry include relatively high levels of regulation, resources and formal safety management systems. Negative influences include adversity, complex subcontracting relationships, risk taking and rushing. Positive influences in the safety culture of the Caribbean construction industry include a strong personal locus of control for safety, high risk

Figure 2 Radar map of the construction safety cultures of the Caribbean and Britain



perception and relatively slow work pace. Both industries suffer from a lack of job security and training, effective quality management and trust .

Accident and ill-health data for the construction industry are inherently unreliable due to the endemic failure to report non-fatal accidents, both in Britain and the Caribbean, and must therefore be treated with caution. From available data the accident rates for the Caribbean construction industry are substantially less than those in the British construction industry (Appendix 2). Between 1987 and 1991 the average fatal accident incidence rate for employees in the British construction industry was 9.7 (HSC, 1992). Averaging the often-sketchy employment and accident data for Caribbean states gives a regional fatal accident incidence rate of 1.7 for the construction industry in 1990. The all accident incidence rates for the Caribbean construction industry were generally half the British figures.

Despite significant regulatory and site management efforts to provide fall protection, falls account for half of all British construction fatalities. In the Caribbean edge protection is commonly lacking, fall arrest equipment is rare and working platforms are not fully boarded. In the Caribbean the relatively slow pace of work, sense of locus of control over safety and risk are cultural factors that help to explain the relative lack of falling accidents compared with Britain. Despite the common occurrence of unprotected drops, mediating cultural factors reduce the potential for falls, corresponding with Hinze's (1996) *Distractions Theory* and Leather's (1987) *PAS Model*. The absence of formal safety management systems was balanced to a degree by the strong locus of control for their safety exhibited by Caribbean workers who were agile, avoided rushing work and also tended to be risk averse.

The Caribbean construction industry faces less technological risk due to the comparatively limited use of chemicals, complex construction techniques, plant and machinery. The Caribbean construction industry is less adversarial, less pressurised and less regulated than the British construction industry. Time is less of a pressure, production related bonus schemes are generally absent and work pace is relatively slow. British concepts of time and risk ensure that construction clients and contractors frequently focus too much on costs and progress at the expense of quality and safety, resulting in frequent accidents, disputes, litigation, poor quality and rushed work.

Societal cultural biases have a significant impact upon safety culture of the construction industry. Conceptions of time, human relations and risk taking emerge as important societal factors that impact on safety culture. The key to improving risk management in the construction industry is the recognition of the negative impact of specific cultural biases and implementing effective measures to counter them.

References

Atherley, B. A. and Lewis, T. M. (1992). Analysis of Construction Delays, *Proc. 8th International Symposium, CIB W-65*, Scotland, Sept. 1996

Atkin, B. Flanagan, R. Marsh, L., & Agapiou, A. (1995). *Improving value for money in construction guidance for chartered surveyors and their clients.* London: Royal Institution of Chartered Surveyors.

Bandura, A. (1977). *Social Learning Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1986). *Social foundations of thought and action. A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1991). Social Cognitive Theory of Self Regulation. *Organisation, Behaviour, and Human Decision Process, 50*, 248-287.

Birchall, S. J., & Finlayson, H. (1996). The Application of

European Directive Safety Management Regulations to the British Construction Industry. In L. M. Alvez Dias, & R. J. Coble (eds), *Implementation of Safety and Health on Construction Sites.* CIB W99 1996 Lisbon. Balkema, Rotterdam, pp. 41-52.

Bryman, A. (1988), *Quantity and Quality in Social Research,* London: Unwin Hyman.

Cameron, I. (1997). A social learning approach to the practice of safety management. *The Health and Safety Practitioner,* March, pp.26-32.

Dedobbeleer, N., & Beland, F. (1991). Safety Climate Measure for Construction Sites. *Journal of Safety Research, 22*, 97-103.

Duff, A.R., Robertson, I.T., Cooper, M.D., & Phillips R.A. (1993). Improving Safety on Construction Sites by Changing Personnel Behaviour. Health and Safety Executive Contract Research Report No. 51/1993, HSE Books.

Cooper, M. D. (1993). *Reciprocal model for measuring safety culture*, Applied Behavioural Sciences, Hull.

Cooper, M. D., & Phillips, R. A. (1995). Killing Two Birds With one stone: achieving quality via total safety management. *Leadership and Organizational Development Journal, 16*, 3-9.

Cooper, M. D., Phillips, R. A., Robertson, I. T., & Duff, A. R. (1991). Improving safety on construction sites by the utilization of psychologically based techniques: Alternative approaches to the measurement of safety behaviour. Paper given at the Vth European Congress of the Psychology of Work and Organization, Rouen, France.

Geller, S. E. (1994). Ten principles for achieving a total safety culture. *Professional Safety*, September, 18-24.

Guest, D. E., Peccei, R., & Thomas, R. (1994). Safety culture and safety performance: British Rail in the Aftermath of Clapham Junction Disaster. Paper presented at the Bolton Business School Conference on Changing Perceptions of Risk, Bolton, February 23 - March 1.

Health and Safety Commission (1992). *Annual Report 1994/95* HSE Books.

Health and Safety Commission (1993). *ACSNI Human Factors Study Group Third Report: Organising for Safety,* London: HMSO.

Hinze, J. W. (1981). Human Aspects of Construction Safety. *Journal of Construction Division,* ASCE Vol 107 No CO1 Proc. Paper 14848 Sept pp. 253-262.

Hinze, J. W. (1996). The Distractions Theory of Accident Causation. In L. M. Alvez Dias, & R. J. Coble (eds), *Implementation of Safety and Health on Construction Sites,* CIB W99 1996 Lisbon. Balkema, Rotterdam. pp. 375-373.

Hofstede, G. (1980). *Cultures' Consequences*. International Differences in Work-related Values. Volume 5, Cross-cultural Research and Methodology Series: Sage.

Latham, M. (1994). *Constructing the Team,* London: HMSO.

Leather, P. J. (1987). Safety and Accidents in the Construction Industry: A Work Design Perspective. *Work & Stress, 1*, 167-174.

Leather, P. J. (1988). Attitudes Towards Safety Performance on Construction Work: an investigation of public and private sector differences. *Work & Stress, 2*, 155-167.

Lewis, T. M., & Mugishagwe, D.D. (1993). Operational Problems Facing a Sample of Construction Firms in Trinidad & Tobago, *Proc. 8th International Symposium, CIB W-65*, Scotland, Sept. 1996

Phillips, R. A., Cooper, M. D., Sutherland, V. J., & Makin, P. J. (1994). A Question of Safety Climate – Measuring Perceptions of the Working Environment. *Proceedings of the BPS 1994 Conference,* Birmingham.

Robertson, I. T., Duff, A. R., Phillips R. A., Weyman, A. K., & Cooper, M. D.(1999). Improving Safety on Construction Sites by Changing Personnel Behaviour Phase II. Contract Research Report No. 229, HSE Books.

Rowlinson, S., & Linguard, H. (1996). Behavioural Safety Management in Hong Kong's Construction Industry;

Success and Limitations. In L. M. Alvez Dias, & R. J. Coble (eds). *Implementation of Safety and Health on Construction Sites,* CIB W99 Lisbon. Balkema, Rotterdam pp. 281-289.

Schein, E. H. (1990). Organizational Culture. *American Psychologist*, *45*, 109-119.

Waring, A. E. (1992). Organisational culture, management and safety, *Paper presented at the British Academy of Management 6th Annual Conference,* 14-16 September, Bradford University.

Appendix 1

Summary of Measures Used in this Study

Measure	**Originator**	**Number of Items**		**Focus**	**Comments**
		Original	Actual		
Attitude Scales					
UMIST Safety Climate Scale	Cooper *et al.* (1991)	36	26	Caribbean and British Manual Workers	Ten non-applicable items removed
Leather's Attitude Scale	Leather (1987)	12	10	Caribbean and British Manual Workers	Two non-applicable items removed
Interview Schedules					
Government	Peckitt	22		Caribbean Government Officials	
Company	Peckitt	19		Caribbean Construction Company Directors	
T U / Employers Schedule	Peckitt	16		Caribbean TU / Employers Organisation	Includes TU and Emp, ILO, UNECLAC
Site Safety Schedule	Peckitt after Hinze	11		Caribbean and British Manual Workers	Developed in Barbados
Physical Site Safety Audit					
Site Safety Audit	Cooper *et al.* (1991)	24		Sites audited in the Caribbean	Some items not applicable

Appendix 2

Accident Data

The construction industry is globally renowned for its informal employment practices and operations. In the 1990s the Labour Force Survey of Britain estimated that 60% of nonfatal reportable accidents in the construction industry go unreported to the HSE (HSC, 1995). The dubious accuracy of particularly nonfatal accident data, limits the extent to which meaningful comparisons can be made. However, available data suggest that there is significant underreporting of industrial accidents and cases of ill-health under the relevant industrial health and safety legislation in both Britain and the Caribbean.

Britain

On the basis of reported accident data, the British construction industry is more dangerous than any other land-based industrial activity except for mining. Between 1986/7 and 1991/2, 851 fatalities occurred in the construction industry. On average five workers were killed every fortnight and a member of the public was killed every month (HSE, 1994). The rate of fatalities in the construction industry was six times greater than that in the manufacturing sector and nearly 16 times the rate in the service sector. In the mid-1990s the annual accident toll from the construction industry included around 85 fatalities, 3000 major injuries and 11,000 over three-day accidents every year (HSC, 1995). With an estimated 60% under-reporting of non-fatal construction accidents, the actual number of major and over three-day injuries is likely to be 6000 and 22,000 per year respectively for all construction workers. British figures exclude road traffic accidents, which are a significant cause of fatal accidents to construction workers and are included in the statistics of many countries – e.g., USA, France, Denmark.

Falls from height account for around half of all fatal construction industry injuries to workers in Britain, the majority of which result from treading on fragile roof lights. Other common causes of fatalities include trapping, collapsing or overturning accidents (14%), being struck by a moving vehicle (14%) and being struck by a moving or falling object (9%). Roofing, ground works and demolition are the activities that produce the most fatal accidents. Inadequate training or instruction, and inadequate supervision each contributed to around 100 deaths between 1986/87 and 1991/92 (HSE, 1994). Compared with other workers, British construction workers' experience increased mortality rates from malignant diseases particularly lung cancer and stomach cancer, as well as from work-related accidents. These result from exposures to hazardous substances and physical agents of harm at work, and poor diet, excessive alcohol consumption, smoking, and stress induced by living away from home (Dong, *et al.* 1995). The number of cases of ill health caused by the industry is difficult to gauge accurately. HSE (1994) estimates that annually:

up to 48,000 suffer from musco-skeletal problems;

up to 23,000 suffer respiratory diseases;

up to 10,000 suffer from dermatitis; and

almost 6000 workers suffer occupational deafness.

In the 1990s, asbestos-related diseases are estimated to kill between 3000 and 3500 people every year in Britain. This figure is likely to go on rising, probably for the next 25 years, when the death rate could be between 5000 and 10,000 each year (HSE, 1994). The long latency of asbestos-related diseases (those for cancers and mesotheleoma are anything from 15 to 60 years) means that these deaths are occurring from exposures that have already taken place. Construction workers such as carpenters, electricians, plumbers, gas fitters and cabling installers form the largest high-risk group. This is because of the common use of asbestos materials in buildings in Britain for insulation and fire protection from the start of the 20th century.

The Caribbean

In the Caribbean there is no standard method of collecting and recording occupational accident and ill-health data. In most of the countries studied limited industrial accident and ill-health data were available from both Labour Departments and the National Insurance Scheme (NIS). However, Anguilla did not collect any occupational accident data, and in Saint Lucia data were only available from the NIS. There were often large differences between the two sets of data available from labour departments and the NIS, due to differing reporting requirements, the wider scope of coverage of the NIS and the beneficial aspects of reporting to the NIS.

The definition of what constitutes a reportable work accident differs between countries within the Caribbean Region. In Guyana, employers are legally required to report all one-day absences from work both to the NIS and by occupational health and safety legislation. In Jamaica the Factories Act 1943 requires submission of reports of all incidents resulting in over 48-hour absences from work. Barbados, Saint Vincent and the Grenadines, and Trinidad and Tobago require reports of greater than three-day absences from work caused by occupational accidents. Little information was available concerning occupational diseases throughout the Region. Table 3 shows available relevant Caribbean occupational accident data.

Accident incidence rates

In 1990/91 the fatal accident incidence rate for employees in the British construction industry was 9.3, (HSE, 1993). Averaging the Caribbean employment and fatal accident data gives a regional incidence rate of 1.7 for the construction industry in 1990, (estimated working population of the construction industry in the Caribbean countries studied is 125,000). The variation in rates caused by one fatality in small population size samples is demonstrated in the examples of the construction industry fatal accident rate for Barbados (12) and Saint Vincent (30), in 1991. Two fatal accidents were recorded in the Caribbean construction industry in 1991, giving a fatal accident incidence rate of 1.6. This may be compared with the British fatal accident incidence rate of 9.3 for the construction industry in the same year.

The all accident incidence rates for the Caribbean construction industry were generally less than 50% of the British figure. From the available data, construction accidents occur more frequently in Britain compared with the Caribbean. Electrical, 'struck by' and machinery accidents appear to be more common causes of fatal accidents than falls, in contrast to Britain

Table 3 Accident Numbers and Incidence Rates by Country

Country	**Date**	**Fatal Accidents**		**Non-Fatal Accidents**		**Notes**
		Number	Rate per 100,000	Number	Incidence rate	
Anguilla	1989 1990 1991	- - -	- - -	- - -	- - -	No industrial accident data available.
Barbados	1989 1990 1991	1 0 1	10.75 0 11.76	70 22 27	642 230 318	Figures from Labour Dept. (>3 day). Employment figures Labour Market Information Report 1990
Guyana	1989 1990 1991	0 1 0	0 1.6 0	15 11 13	165 121 143	Assumes 9,000 construction workers. Reports for greater than one day absences. NIS figures. Total workforce 270,000
Jamaica	1989 1990 1991	0 0 0	0 0 0	68 40 126	224 152 405	Greater than two day absences. Figures from NIS assumed 30,000

						construction workers
St. Lucia	1989 1990 1991	0 0 0	0 0 0	- - 36	- - 1663	From National Insurance Figures, not recorded by industry group. (> 3 day)
St. Vincent	1989 1990 1991	0 0 1	0 0 30	23 19 15	675 557 440	Labour Mkt Bulletin Vol 3 1990, (>3 day) Total employees = 37,782 Construction workers = 3,380
Trinidad and Tobago	1989 1990 1991	0 0 0	0 0 0	2 1 0	5.2 2.5 0	CSO Reports Trinidad Labour Dept.Figures. (> three day absences.)
Britain	1988/89 1989/90 1990/91	109 108 110	9.9 9.4 9.3	18763 20339 19377	1842.9 1971.4 1876.5	HSE Annual Reports. Employees only RIDDOR Reports

Reducing the Incidence of Claims and Disputes in Construction Contracts

David Yates[1]

Abstract

The topic of this paper is claims and disputes in construction, mainly from the perspective of the client in the context of the client / contractor relationship.

The causes of claims and disputes are examined from the perspective of transaction cost economics (TCE) theory due to its focus on contracting problems and in particular its suitability for complex, long-term and dynamic relationships which are found in construction contracts.

Consideration of TCE theory in the context of construction suggest that the root causes of claims and disputes are:

- Contractual incompleteness; and consequent "post-contract" adjustments
- Opportunistic behaviour, in particular on the part of the contractor.

A brief case study drawn from Hong Kong's Airport Core Programme is used to illustrate the presence of contractual incompleteness and opportunism. Measures for preventing / reducing the incidence of claims and disputes are proposed.

Conclusions are drawn that the actual incidence of claims and disputes is largely governed by the client in determining the balance of his priorities for the project and his consequent selection of procurement system, and design and construction teams.

Keywords: Claims. Disputes. Transaction Cost Economics.

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Introduction

From the perspective of transaction cost economics (TCE) theory the root causes of claims and disputes, in the context of the client/contractor relationship, are *contractual incompleteness* and *opportunism* (Doree 1994, Alsagoff 1996, McDermott and Alsagoff 1996 and Yates 1998).

Contractual Incompleteness

Many contracts which take place over an extended period of time can be described as incomplete in the sense that, at contract formation *(ex ante)*, the obligations of the parties cannot be fully and unambiguously specified to take account of all future "states of the world" which may be encountered during contract execution *(ex post)*. In theory, a construction project tendered on the basis of a fully completed design (or, in the case of design/build procurement, a full and precise statement of the Employer's Requirements), having no errors or omissions in tender documentation and requiring no changes or variations during the construction phase, could be described as a "complete".

In reality, however, in view of the complexity of the construction process and time necessary for overall delivery, all but the smallest of projects are inevitably incomplete. In "traditionally" procured projects contractual incompleteness is usually manifest in one or more of three categories:

1. At contract formation stage in the form of Prime Cost Sums, Provisional Sums, Provisional Quantities, and the like, all of which are "adjusted" during the construction phase depending on the client/design team's actual requirements.
2. A contractual mechanism – namely, the right to instruct variations – which allows the client/design team optimum flexibility in decision-making (either by leaving decisions as late as possible and/or changing

decisions previously made).

3. Ambiguities, errors or omissions in the *ex ante* contract documentation, which come to light *ex post*, necessitating clarification of the client/design team's requirements and leading to *ex post* "adjustments". (Usually classified as variations).

Opportunism

Contractual incompleteness *ex ante* sets the stage for potential problems *ex post*. When events/circumstances arise that are not fully and unambiguously covered by the contract provisions, one or both parties may have incentives to behave "opportunistically" by taking actions that will increase the costs or reduce the revenues of the other party.

Opportunistic behavior involves making "false or empty, that is, self-disbelieved, threats and promises in the expectation that individual advantage will thereby be realized." (Goffman 1969). It involves subtle forms of deceit and also includes stronger, more blatant forms of behaviour such as lying, stealing and cheating. The notion that, in certain circumstances, "contractual" man will behave opportunistically is entirely consistent with one of the basic concepts of neoclassical economic theory, namely "the motivating force in the economic system is self interest." (Galbraith and Salinger 1981).

More generally opportunism refers to the incomplete or distorted disclosure of information, especially to calculated efforts to mislead.

The assumption that contractual man is opportunistic "elicits a variety of reactions, ranging from abhorrence through easy acceptance to an insistence that this is yet another case where there is nothing new under the sun." (Williamson 1985).

TCE theory does not insist that individuals (and/or firms) are opportunistic continuously, or even largely given to opportunism. Williamson (1985) merely assumes that "some individuals are opportunistic some of the time".

There appears to be a spectrum or scale of opportunism, with nil or insignificant opportunistic behaviour at the low end of the scale and extreme behaviour, possibly involving criminal activity, at the top.

It may well be that a "reputable" contractor, in normal circumstances on a contract that promised a reasonable margin of profit, would be placed on the lower reaches of the opportunism scale. However, faced with the prospect of a significant loss - due, for example, to the occurrence of an event which is at its sole risk - the contractor, at a stroke, could jump several notches up the scale to such an extent that it would be prepared to spend significant additional sums of money on legal advice and even "take its chances" with a full arbitration.

It is theoretically possible that a claim genuinely made by one party could genuinely be disputed by the other involving no opportunistic behaviour by either party. In practice, however, contractors' claims are often opportunistically inflated, exaggerated or even spurious and clients (and their staff/consultants) frequently respond with reciprocal opportunism, by rejecting contractors' claims out of hand.

Case Study - Hong Kong's Airport Core Programme (APC)

In 1989 the Hong Kong Government announced the intention to construct Hong Kong's new international airport on the northern coast of Lantau Island at Chek Lap Kok, together with related infrastructure, all of which was to be completed in 1997.

The Airport Core Programme (ACP) was an unusually large scale and complex undertaking, the primary objective of which was the procurement of the new airport. The ACP also included extensive supporting infrastructure comprising reclamation, new expressways, tunnels, bridges and a completely new railway system connecting the new airport with Hong Kong's central business district.

Due to the delays in obtaining agreement between the British and Chinese Governments completion dates were modified such that the opening and full operation of Chek Lap Kok and the airport railway took place in July 1998. The remaining seven ACP projects together with the Western Harbour crossing, were completed on programme in 1997.

The following article, which appeared in the *Hong Kong Sunday Morning Post* on 8th June 1997, illustrates both contractual incompletedness in the form of "design changes, schedule variations and delays" and opportunism by the contractor in "demanding millions to finish their contracts on time". Reference is also made to an earlier "$1.9 billion payout" which was evidently "paid despite little supporting paperwork," suggesting a negotiated settlement of earlier claims and illustrating the significant "hold up" potential on the part of the Contractor.

Chek Lap Kok Builders want $1.6b for extras

Building contractors on the $12 billion passenger terminal at Chek Lap Kok are claiming an extra $1.6 billion from the Airport Authority – just nine months after a $1.9 billion payout for other added costs.

The Sunday Morning Post understands the claims, as a supplemental agreement to the initial contract, have just been lodged with the authority by BCJ, the Britain-China-Japan joint venture responsible for construction of the terminal.

They cover design changes, schedule variations and delays which have arisen since a previous supplemental payment was agreed last September.

"The group got the building weather-tight just about on schedule while getting other elements ahead of schedule. It is doing a good job, but there is a cost to that," an on-site source said.

BCJ consists of Amec and Balfour Beatty from Britain, Kumagai Gumi (HK), China State Construction Engineering and Maeda of Japan.

In September, BCJ and AEH – the building services installer – were paid $1.9 billion to settle outstanding construction wrangles on the project.

The payments angered legislators who demanded that senior authority executives give a full explanation for them.

The wrangle recently resurfaced after suggestions the claims were paid despite little supporting paperwork setting out a precise cost schedule for the delays and other problems suffered by BCJ and AEH.

There also have been allegations the authority is being "held to ransom" by contractors demanding millions to finish their contracts on time.

The authority's corporate development director, Clinton Leeks, said the initial supplemental agreements were made at an extremely high level in both the authority and the contractors.

A second newspaper article from the *South China Morning Post* of 12th March 1998 gives overall ACP data on numbers of claims submitted and resolved to date; the values actually agreed as compared with the much higher values originally claimed; further illustrating the scale of contractors' opportunistic behaviour on the ACP.

Large contract claims 'usual'

Hefty claims are a natural part of large-scale construction contracts, a senior official said.

In a written reply to Eric Li Ka-cheung, acting Secretary for Works Lee Shing-see said 20,923 claims against 152 airport contracts had been received.

According to the Quarterly Report on the Airport Core Programme Projects submitted to the Finance Committee, the Airport Authority and the Mass Transit Railway Corporation had resolved 6,047 claims at a cost of $2.87 billion against an original claim amount of $10.8 billion by the end of December, leaving 14,876 claims unresolved.

"Given the scale, complexity, multiple contractual interfaces and tight programme [of airport core projects], the number and amount of claims submitted are not unusual," said Mr. Lee.

Delays in the possession of sites, variations in design and limitations on certified construction methods contributed to legitimate claims.

This second newspaper article illustrates not only the nature of the contractors' opportunistic claims strategy – whereby initial grossly inflated/exaggerated claims are submitted which are subsequently reduced significantly as part of claims evaluation and negotiation – but that this opportunistic behaviour is considered by a senior government official, the acting Secretary for Works, as "not unusual".

Measures for reducing the incidence of claims and disputes

Contractual incompleteness and opportunism are identified as the root causes of claims and disputes in construction.

It follows therefore that a client who perceives claims and disputes as a problem and wishes to lessen their incidence should proactively endeavor to:

1. limit or reduce contractual incompleteness, and/or
2. attenuate the opportunistic inclinations of the contractor.

Limit/Reduce Contractual Incompleteness

- The singular most effective way of reducing contractual incompleteness is for the client and his staff/consultants to comply with accepted construction industry "good practice" conventions. The Latham Report (Latham 1994) contains the most comprehensive "good practice" recommendations made in recent years. Whilst the report is directed at the UK construction industry, many of its findings are applicable to the construction industries of other countries.
- Issues that are of particular relevance are:
- Adequacy of client organization and briefing process;
- Choice of the most appropriate procurement system (not necessarily the traditional approach, particularly if time is short),
- Selection of experienced, reputable and capable design consultants (particular attention should be paid to the design and coordination of building services);
- Contractor selection based on quality (including reputation and experience) as well as price.

Attenuation of Opportunism

Reputational factors

Some contractors value their "claims averse" reputations. Other considerations (that is, quality, price, and so on) being equal, such contractors are to be preferred. The term "claims averse" is used to describe contractors who value their reputations for restraint in the submission of opportunistic (that is, spurious or exaggerated) claims. In TCE terms, such contractors perceive their "claims averse" reputation to be of greater (long-term) value than the potential gain to be made from (short-term) opportunistic claims. However, as discussed earlier, a contractor who in normal circumstances may be claims averse can, at a stroke, move several notches up the opportunism scale when suddenly faced with the prospect of a substantial loss on a particular project.

Relational Factors

There has been an abundance of literature in recent years on the subject of "partnering" (for example, NEDC Construction Industry Sector Group 1991, Uher 1994, Bennet and Jayes 1995, Godfrey 1996). Closely related topics are "relational contracting" (Alsagoff and McDermott 1994); and informal "clan relationships" which exist between consultants and contractors who frequently work together on the same projects, albeit that there is no contractual tie between them (Reve and Levitt, 1984).

Such "relational" factors and "partnering" arrangements, wherein the prospect of future work for a contractor is almost guaranteed (in other words, the current project is part of an ongoing series of projects - what Bennett and Jays refer to as "strategic" partnering), have the effect of attenuating opportunism. In TCE terms, the prospect of the future contracts is perceived by the contractor to have greater value than the potential gain of making an opportunistic claim on the current project. (Consequently, from a TCE perspective, the suggestion that similar benefits might accrue from a partnering arrangement for a single, one-off, project - that is "project" partnering - is illogical).

It could no doubt be argued, from a sociological point of view, that any procedure which brings the parties together in the early stages of the project (for example, partnering and value engineering workshops) can have a positive influence on working relations and teamwork, which also may have the effect of attenuating opportunism.

Institutional factors

Williamson's (1985) analysis of commercial trust, which includes trust in the context of institutional environments (such as societal culture, trading networks, the professions and corporate culture), as a "check" on opportunism, has significant relevance in the construction field. As an illustration of societal culture Williamson refers to trading trust in Japan which "is said to be much higher than in Great Britain." This particular cultural characteristic may begin to explain not only why the incidence of claims and disputes is comparatively low in the Japanese construction industry, but also why Japanese contractors working overseas are known to have "claims averse" reputations.

Alsagoff and McDermott (1994) in a study of relational contracting refer to the Japanese concept of "amae", meaning "cooperation and dependency", wherein clients, contractors and subcontractors maintain an ongoing relationship throughout a long series of projects. Any disputes, for example, over vaguely worded contracts or the execution of additional work, are resolved by negotiation between the parties. An illustration is given, furthermore, of contractors taking the initiative to accelerate the project in the clients' interests, but at the contractors' expense, in the knowledge that the award of future contracts will reward this cooperation. "The overall result will be in a manner such that the short term losses incurred are compensated in the end".

An efficient and "well-informed" Client

According to TCE theory information impactedness or the deliberate withholding of information, to create a situation of differential knowledge/intelligence, is a form of opportunistic behaviour. It is advantageous for an opportunistic contractor to have superior knowledge than the client of the true facts.

Conversely, a client who is efficient and well informed has the effect of curbing an otherwise opportunistic contractor. A contractor will only spend time and money on the submission and pursuit of opportunistic claims and disputes if the contractor is of the view that his "chances of getting away with it" are good. A knowledgeable and well-informed client has the effect of reducing the contractor's "chances".

Alternative Dispute Resolution

The use of certain alternative dispute resolution (ADR) procedures, in particular those involving the appointment of an adjudicator (or similar) at the outset of a contract - in addition to their value in resolving disputes - can also have the effect of attenuating opportunistic behaviour by the parties. The presence within the project team of an experienced and well-informed, neutral third-party, whose sole objective is the successful outcome of the project (with minimal conflict/disputes) often has the effect of discouraging both parties from engaging in "one-upmanship" and spurious conduct.

The concept of ADR techniques assumes that the parties genuinely want their disputes resolved by alternative methods to arbitration. However, this assumption is not necessarily always valid. Sometimes an opportunistic contractor may decide there is little to be gained in resolving matters economically and efficiently. "In such circumstances realism might dictate the full majesty of the adversarial (arbitration) process in the hope of the return that a well briefed legal representative might deliver". (Clegg 1992).

Economic factors

The prevailing macro-economic climate has a direct influence on contractors' profit margins, and hence their inclinations to behave opportunistically.

"Virtually all who are engaged in the construction industry are profit-oriented. Invariably, this orientation stems not so much from inherent avariciousness but from the basic need for survival. Each firm must make a profit to survive, and all the individuals involved in the quest for profit are eager to prove their particular self-worth." (Hohns 1979).

A questionnaire-based investigation of UK contractors' tendering strategies during the construction industry recession in the mid-1990's demonstrated that the profit margins of five out of six leading contractors were less than one percent. (Pasquire and Collins 1996). The study also found that 65 percent of contractors would consider tendering at tight or even negative margins, during such difficult times.

In such circumstances it is hardly surprising that contractors are opportunistic. Indeed, Latham (1994) warns "when contracts are won on a price which can only produce loss for the main contractor, the likelihood of a contract dominated by claims is extremely high".

Conclusions

Given the "incomplete" nature of most construction projects, this paper suggests that claims and disputes, to some extent, are inevitable.

The actual extent of claims and disputes, on a particular project, is largely governed by the client in determining the balance of his priorities - especially regarding time and cost - and through his selection of procurement system, client/consultant advisers and contracting team.

References

Alsagoff, A., (1996), Construction Transaction Cost Conflicts: Analysis of Dispute Triggers in Construction Contracts. In Heath, B.C. (ed.) *Proceedings of CIB Task Group 15 Research Papers: The Origin, Incidence and Resolution of Conflict in Construction, CIB Publication No. 196.* Wrexham, North Wales: North East Wales Institute of Higher Education (NEWI).

Alsagoff, A. and P. McDermott, (1994), Relational Contracting: A Prognosis for the UK Construction Industry. In Rowlinson, S.M. (ed.) *Proceedings of CIB W92 Symposium: East Meets West: Procurement Systems.* CIB Publication No. 175, Hong Kong: Department of Surveying, The University of Hong Kong.

Bennett, J. and S. Jayes, (1995), *Trusting the Team: The Best Practise Guide to Partnering in Construction.* Reading, England: The Centre for Strategic Studies in Construction, The University of Reading.

Clegg, S. R., (1992), Contracts Cause Conflicts. In Fenn, P. and R. Gameson (eds.), (1992), *Construction Conflict: Management and Resolution.* London: E & F N Spon.

Doree, A.G., (1994), Conflict as Element of Construction Trade. In Fenn, P. (ed.) *Proceedings of CIB TG15 Meeting: Construction Conflict: Management and Resolution*, CIB Publication No. 171, Lexington Kentucky. London: E & F N Spon.

Galbraith, J.K. and N. Salinger, (1981), *Almost Everyone's Guide to Economics.* London: Pelican Books.

Goffman, E., (1969), *Strategic Interaction.* Philadelphia: University of Pennsylvania Press.

Hohns, H.M., (1979), *Preventing and Solving Construction*

Contract Disputes. New York: Van Nustrand Reinhold Co.

Latham, M., (1994), *Constructing the Team*. London : HMSO.

McDermott, P. and A. Alsagoff, (1996), Organizational Governance and Transaction Costs - Case Study Evidence of Trust, Solidarity and Conflict Resolution in the UK Construction Industry. In Heath, B.C. (ed.) *Proceedings of CIB Task Group 15 Research Papers: The Origin, Incidence and Resolution of Conflict in Construction, CIB Publication No. 196*. Wrexham, North Wales: North East Wales Institute of Higher Education (NEWI).

National Economic Development Council (NEDC), (1991), *Partnering: Contracting Without Conflict*. London: National Economic Development Office (NEDO).

Pasquire, C. and S. Collins, (1996), Competitive Tendering and Value Within the UK Construction Industry. In Taylor, R.G. (ed.) *Proceedings of CIB W92 Symposium: North Meets South: Developing Ideas*, University of Natal, South Africa.

Reve, T. and R.E. Levitt, (1984), Organisation and Governance in Construction. *International Journal of Project Management*, **2**, 17-25.

Uher, T.E., (1994), *Partnering In Construction*. Sydney: University of New South Wales.

Williamson, O.E., (1985), *The Economic Institutions of Capitalism*. New York: Free Press.

Yates, D. J., (1998), *Conflict and Disputes in the Hong Kong Construction Industry: A Transaction Cost Economics Perspective*. Unpublished M.Phil. Thesis: University of Hong Kong.

A Scenario-Based Approach to Research into Construction Claims

Steve Scott[1] & Richard Harris[1]

Abstract

Our knowledge to date of construction claims has tended to fall into one of a few categories. There is the anecdotal/experience-based approach, in which the author offers his insight into claims based on his experience and own personal knowledge. Another approach is to offer methodologies, and there are recent examples of papers describing systems for resolving delay claims on construction contracts that effectively recommend a step-by-step means of generating what is hopefully a convincing solution. Some researchers analyse claims on completed contracts to gain an insight into current practice and to identify the main causes of claims and delays. Such work often attempts to gain an appreciation of the extent of claims in the industry and will typically make recommendations for improvement. Although not strictly research, there are, of course, those who chronicle and summarise the current state of the law with regard to construction issues and such publications clearly help professionals to keep up to date with recent developments

In this paper, a new approach is adopted that attempts to understand how contractors try to justify claims and how supervisors are likely to assess them. This is done by encapsulating particular claims types into scenarios and asking not only contractors and supervisors, but also claims consultants, to give their views. In this way, a new insight into the attitudes of construction professionals to claims is obtained and common areas of agreement and disagreement can be identified.
Keywords: scenario-based, claims, claims consultants

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Background

Despite a number of recent innovations in the way in which contracts are procured and administered, it is clear that the circumstances that cause claims on most contracts will continue to occur. The advent of partnering will hopefully make negotiations more amicable regarding these issues, but the issues will still need to be addressed. This is evident from the Egan report (1998) which describes partnering as '...two or more organisations working together..., devising a way for resolving disputes...' This less confrontational environment should, however, provide a more supportive setting for new, innovative approaches to dealing with the issues.

Even on work procured using the Engineering and Construction Contract (1995), where compensation events effectively replace claims, the Project Manager will still have to assess the contractor's quotations. Of course, if no quotation is offered, if quotations are unacceptable, or if there is disagreement about whether a compensation event has actually occurred on such contracts, the situation reverts to a 'normal' claims-type scenario. Only on design and build contracts, if the client requires the contractor to shoulder all risks, will the need to deal with claims be substantially reduced and even then, changes by the client will still force a reassessment of cost and time to be undertaken. The Latham report (1994) was supportive of both partnering and the Engineering and Construction Contract as means of improving adversarial relationships on site and the way in which contracts are managed, but still recognised that the issue of disputes would not simply disappear. Latham said: 'Nevertheless disputes may arise, despite everyone's best efforts to avoid them' and then proceeded to recommend that an adjudication process be built in to all standard forms of contract. Thus, the circumstances that lead to claims will still have to be dealt with on the majority of contracts, but new measures to enhance their speedy resolution should be more willingly accepted in today's hopefully more enlightened construction industry

Research to date dealing specifically with construction claims may be seen as falling into a few main categories. There is the anecdotal/experience-based approach typified by Zack (1992,1993) who offers his insight into claims based on his experience and own personal knowledge. Another approach is to offer methodologies, and Knoke and Jentzen (1994) and Bordoli and Baldwin (1998) are recent examples of papers describing systems for resolving delay claims on construction contracts that both rely on full as-built records of the progress of the work. Some researchers analyse claims on completed contracts to gain an insight into current practice and to identify the main causes of claims and delays (O'Connor et al (1993), Yogeswaran et al (1998) and Kumaraswamy (1998)). Such work often attempts to gain an appreciation of the extent of claims in the industry and will typically make recommendations for improvement. The aim of the research reported in this paper was fundamentally different to previous work in that it attempted to understand how the protagonists viewed some of the generic issues surrounding claims. Most contract forms identify the right to make a claim when certain circumstances arise, but much is still left to the judgement of the parties involved. Legal precedent, if available, might help to clarify acceptable approaches, but possibly as a result of the private methods of resolution of claims that have been in use for some time, little helpful legal support was found. In effect, the results of the present research are an attempt to recognise an industry-accepted precedent in the absence of legal precedent.

The Survey

The results reported here come from interview surveys based on fully developed questionnaires, completed by 46 professionals working in the construction industry. The interviewees comprised 20 employees of contracting organisations, 20 employees of consulting engineers (supervisors of construction) and 6 claims consultants. This mix of personnel was chosen primarily to get the views of the two main protagonists in on-site claims negotiations (contractors and consultants), but also to get a third party view (claims consultants).

The initial questions in the questionnaire were posed to assess the interviewees' experience of construction and particularly of claims formulation and assessment. From the results it could be seen that all but one had more than 15 years experience of construction, principally in the civil engineering sector, and that 40 out of the 46 had been dealing with claims for more than 10 years. They were thus ideally suited to comment on the issues addressed in the survey.

The complete questionnaire addressed several areas typically confronted when dealing with the whole cross-section of claims types. In this paper, however, it will only be possible to consider a small selection of the areas investigated.

Three Areas of Interest

To demonstrate the approach used, three specific areas that have generated debate on the issue of construction claims, and that were dealt with in the study, will be reported. They are:

- i) effects of exceptionally adverse weather;
- ii) the problem of early completion schedules;
- iii) the issue of prolongation costs.

i) Effects of exceptionally adverse weather

In most contract conditions, the contractor is expected to make allowances for the extent of adverse weather that can be expected at the project location and for the time of year during which the works take place. That is, any days lost as a result of normally expected adverse weather conditions are at the contractor's risk. However, when the weather is exceptionally adverse, the risk is usually shared. This means that an extension of time will likely be available, but without any recovery of overheads. The main problem with assessing any extension of time here, is how to judge when the weather is exceptionally adverse as opposed to simply adverse. Figure 1 was used to test two alternative methods of calculating exceptional adverse weather with the following scenario:

> *Works for the theoretical contract are carried out in January and the following weather delays occurred during the following operations.*

(a) Temperature at -4°C during concreting of the pier foundations – 3 days delay
(b) High winds of up to 60Km/hr during erection of the structural steelwork with a crane – 1 day delay
(c) Rain of 2mm/hr during painting of the steelwork – 1 day delay

The two methods of assessment were defined as:

1) Make a comparison with the average number of days lost to work in the last 10 years – past records show an average of 3 days are lost in January and thus a 2 day extension of time could be justified.
2) Make a comparison with the weather parameters in the last 10 years – past records show that a temperature of –4 C and rain of 2mm/hr is not exceptional in January, but a wind speed of 60km/hr is. Thus an extension of time of 1 day could be justified.

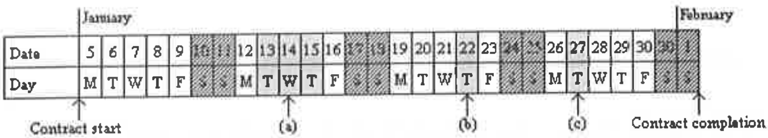

Figure 1: Diagram depicting exceptionally adverse weather

Despite the fact that the first method in this instance gave the greater extension of time, contractors, supervisors and claims consultants preferred the second method by more than 3 to 1. This is a convincing consensus on an issue which is fundamental to processing 'weather' claims.

ii) The problem of early completion schedules

Most construction contracts will specify a 'time for completion' in which the works must be complete, otherwise the client may be able to recover liquidated damages from the contractor. The problem addressed here, and depicted in figure 2, arises when the contractor provides a programme showing he will complete earlier than the completion date, is then delayed by the employer (type E delay in the figure) and makes a claim for the cost of his overheads for his prolonged period on site.

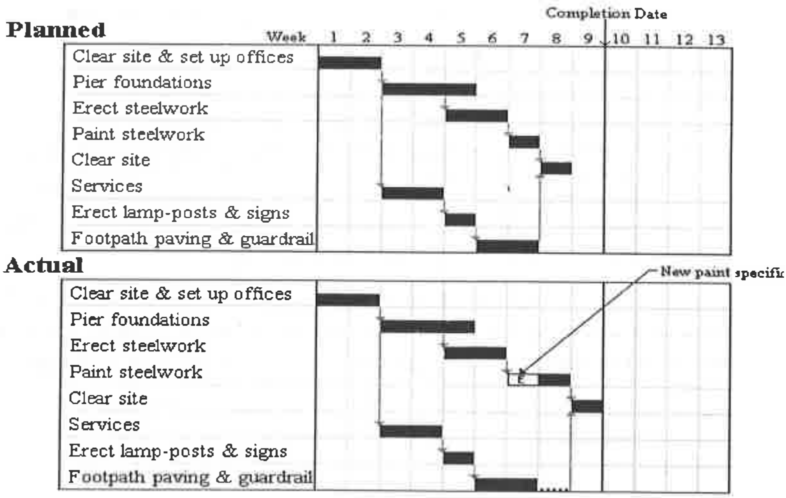

Figure 2: Scenario showing early completion schedule

For this scenario, the respondents were asked to say: should there be an extension of time (T), and if so for how long; should there be overheads paid (C) and if so for how long; should there be liquidated damages deducted (D) and if so for how long? The results are shown in figure 3 and, not surprisingly, 90% of the contractors believed that costs should be paid for 1 week. This view was affirmed by 60% of the supervisors, 20% of whom also wanted to give an extension of time, despite the fact that none was needed, as the work was completed by the completion date. There were, however, 40% of the supervisors and 33% of the claims consultants who felt that no overhead costs should be paid. Clearly the majority view was that overhead costs should be paid, but there was a sizeable majority who disagreed about what must surely be a fairly common occurrence on construction contracts. Although the agreement here between contractors and supervisors is not so well defined, the evidence still shows a majority of supervisors agreeing with the decision to award 1 week costs. Individuals having to make these decisions may well find such information helpful in making their own judgements.

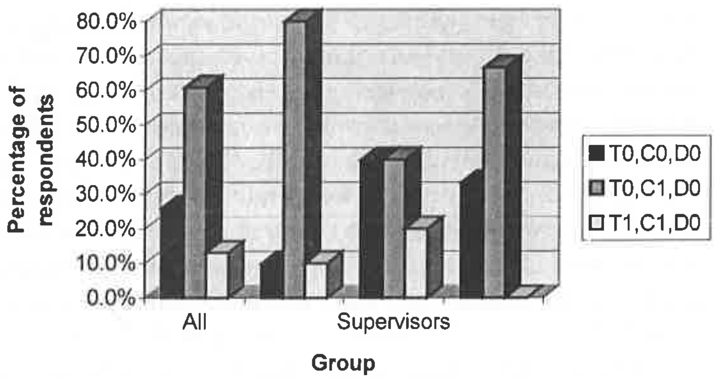

Figure 3: Results of early completion schedule scenario

iii) The issue of prolongation costs

When a delay for which the employer is responsible gives the contractor the right to costs for a prolonged period on site, there has always been some controversy about the level of overhead costs that should be reimbursed. Figure 4 helps to describe this situation and clearly suggests that the level of weekly overheads towards the end of the contract, when the work is coming to an end, is likely to be lower than that during the period when work is in full flow. The argument thus concerns whether it is the level of overheads during the extended period on site (at the end) that should be paid or whether it should be the level of overheads being incurred by the contractor at the time of the delaying event. Respondents were asked to choose from:

1) Prolongation costs at the actual time of the delay should be payable
2) Prolongation costs at the end of the contract should be payable
3) Prolongation costs at the end of the contract should be payable and the contractor should prove any other additional costs over and above these
4) Other (please specify)

Almost all the contractors (95%), all the claims consultants and 50% of the supervisors chose 1, with most of the rest of the supervisors (35%) choosing 3 – the other 15% chose 2. Amongst the supervisors there was thus an even split between those who would pay overheads at the 'higher' rate and those who would either pay at the 'lower rate' or expect additional justification to convince them to pay at anything more than the 'lower' rate. If it is accepted that claims consultants have a greater appreciation of the ways in which claims are eventually settled, their unanimous choice of paying at the 'higher' rate might be seen to be meaningful. Another way of looking at this result for the contractor would be that he should ensure that his overhead costs are recorded and, if possible, agreed with the supervisor in the expectation that he will be asked to prove his claim for overheads at a level higher than those applying at the end of the contract.

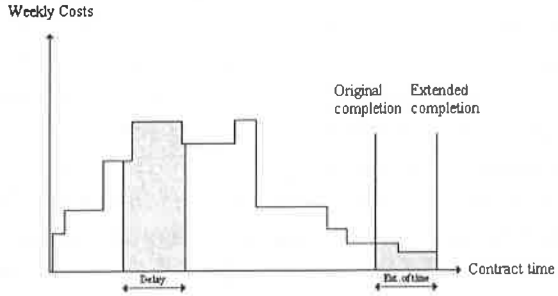

Figure 4: Contractor's overhead costs

Conclusions

The approach adopted in this research set out to understand the views of those who deal with claims about some of the generic issues that must be decided when dealing with these issues. The initial hope was that a consensus could be recognised that would enable professionals who must deal with these matters to have an understanding of the 'industry' view. Although none of the areas studied produced unequivocal or unanimous agreement, the appreciation gained still provides much more support to contractors and supervisors than currently exists and should as one of the respondents said,'…help me to see if I'm singing from the same hymn sheet.'

References

Bordoli, D.W. and Baldwin, A.N. (1998), 'A methodology for assessing construction project delays', *Construction Management and Economics* vol 16, No 3: 315-325.

Egan, J., (1998), *'Rethinking Construction'*, Report of the Construction Task Force to the Deputy Prime Minister, DETR.

Institution of Civil Engineers, (1995), *'The engineering and construction contract : an NEC document'*, 2nd ed., Thomas Telford.

Knoke, J. R. and G. H. Jentzen (1994), *'Facilitate delay claim* *analysis with As-built schedule database'*, Proceedings of the 1st Congress on Computing in Civil Engineering, Washington, DC, USA, ASCE, New York, NY, USA.

Kumaraswamy, M.M. (1998), 'Consequences of Construction Conflict: A Hong Kong Perspective', *Journal of Management in Engineering*, Vol. 14, No. 3: 66-74

Latham, Sir Michael, (1994), *'Constructing the Team'*, Final report of the government/industry review of procurement and contractual arrangements in the UK construction industry, HMSO.

O'Connor, J. T., Chmaytelli, A. and Hugo, F. (1993). 'Analysis of highway project construction claims', *Journal of Performance of Constructed Facilities* 7(3): 170-180.

Yogeswaran, K. Kumaraswamy, M.M. and Miller D.R.A. (1998), 'Claims for extensions of time in civil engineering projects', *Construction Management and Economics* vol 16, No 3: 283-293.

Zack Jr., G. (1992). 'Schedule Games' People Play, and Some Suggested Remedies', *Journal of Management in Engineering* 8(2): 138-152.

Zack Jr., G. (1993). 'Claimsmanship: current perspective', *Journal of Construction Engineering and Management* 119(3): 480-497.

Supply Chain Management
A Contextual Analysis of Aerospace and Construction

Stuart D. Green[1], Robert Newcombe[1], Marylin Williams[2], Scott Fernie[1] & Stephanie Weller[1]

Abstract

Research is reported that investigates the extent to which supply chain management practices can be shared between different industrial contexts. Current recipes for learning from other industries tend to be over-simplistic and often fail to recognise the embedded and contextual nature of management practice. The existing literature reveals a widespread absence of contextual awareness amongst those who advocate supply chain management for the construction industry. The industrial context of UK construction is compared to that of the aerospace. The construction industry is highly fragmented and localised. In contrast, the UK aerospace sector has experienced significant consolidation as a result of global pressures. These differences have fundamental implications for the way that supply chain management is implemented in the two sectors. Semi-structured interviews with practitioners from both sectors support the contention that supply chain management is significantly more established in aerospace than construction. The introduction of prime contracting in the construction sector potentially provides a much more supportive climate for supply chain management than has traditionally prevailed.

Keywords: supply chain management, contextual embeddedness, industry structure, consolidation, prime contracting

Introduction

Supply chain management (SCM) is currently attracting significant attention amongst construction researchers. The

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literature relating to SCM in the construction industry tends to see SCM as a 'technique' for improving project performance. The overriding assumption is that techniques developed in other sectors can be transferred to construction. What seems to be absent is any critical appraisal of the extent to which the successful application of SCM is dependent upon the wider industrial context. This tendency is by no means unusual within the 'management improvement' literature. Concepts such as SCM are invariably presented as best practice tools that can be introduced at the project level irrespective of a broader contextual understanding. The models of SCM presented in the construction best practice literature tend to conform to this stereotype. The outputs from *Building Down Barriers* provide a prime example (Holti et al., 2000; Nicolini et al., 2001). A review of a recent construction sector special issue of the *European Journal of Purchasing and Supply Management* lends further support to this assertion (Vrijhoef and Koskela, 2000; Akintoye et al., 2000; Hall et al., 2000). Such sources reveal a widespread absence of contextual awareness amongst those who advocate SCM for the construction industry. This paper reports ongoing research that investigates the extent to which SCM practices can be shared between the aerospace and construction sectors. The research is shaped by the recognition that knowledge relating to managerial practices is frequently tacit in nature and embedded in context (Nonaka and Takeuchi, 1995). The achievement of a comparative contextual understanding is therefore an essential part of learning across business sectors. The comparison begins with an appraisal of the structural characteristics of the two sectors.

Structural differences

The UK construction sector is significantly larger than the UK aerospace sector. On the basis of the latest available figures, the construction industry has an annual output of £69.261bn. (DTI, 2001a) The equivalent DTI figure for the aerospace sector is £16.138bn. On the basis of a different boundary definition, the Society of British Aerospace Companies (SBAC, 2001) quote an aerospace turnover figure of £18.24bn. Figures for the number of employees in the two sectors also differ in accordance with the way in which the sector boundaries are defined. The latest DTI (2001b) figures are 1,400,000 for the construction industry and 121,000 for the aerospace sector. The corresponding SBAC (2001) figure for the aerospace sector is 150,650. Of 1,400,000 employees in the construction industry, 500,000 are self-employed (DTI, 2001a).

Although the construction sector is larger than aerospace, it is considerably more fragmented with a much greater concentration of small firms. According to the DTI (2001b) the UK construction sector comprises 123,445 SMEs (excluding sole traders). Collectively, these firms account for a remarkable 84.5% of private sector turnover. In comparison, the DTI (2001b) list only 420 private sector SMEs within the aerospace sector (Standard Industrial Classification D353). In sharp contrast to the construction sector, these 420 firms account for only 10% of aerospace employees. The remaining 90% are employed by 50 large firms. The figures from SBAC are different, but nevertheless tell the same story. SBAC (2001) estimates that there are between 1,000-1,200 SMEs in the UK aerospace sector and that these account for a turnover of £1.90bn and 21,357 employees. The relative extent of consolidation/fragmentation in the two sectors is further illustrated by the fact that in the UK aerospace sector, BAE SYSTEMS (formerly British Aerospace) accounts for 60% of supplier output (A. T. Kearney, 1998). In the construction industry, the top 30 contracting firms routinely account for only 17% of output. The structure of the construction sector is that of a broad-based pyramid dominated by small firms. In contrast, the aerospace sector is dominated by large firms. Suppliers in aerospace are also more specialised than those in construction, with much higher levels of technological expertise. Furthermore, technological expertise is much more widely spread throughout the supply chain than tends to be the case in construction. Within the construction sector, suppliers tend to compete on cost efficiency rather than technical expertise. The knowledge-intensive nature of the aerospace sector is illustrated by an estimated annual research expenditure of £1.73bn (SBAC, 2001). The comparative figure for construction is a relatively modest £270M (NAO, 2001). The high technology content of the aerospace sector combines with a complex network of inter-dependency to present significant barriers to new entrants. In contrast, the construction industry has traditionally been characterised by low barriers to entry. This is especially true of the SMEs that comprise the industry's pool of sub-contractors. Of further significance is the diversity of the construction industry's client base. Every domestic and commercial property owner in the UK is an occasional client of the construction industry. In this respect, the contrast with the clients of the aerospace sector could hardly be greater. Firms within aerospace tend to possess longstanding collaborative relationships with very few highly sophisticated clients. The fragmentation of the construction sector can be seen to reflect directly the fragmentation of its client base. It is contended that this sharp distinction in industry structure has fundamental implications for the way that SCM is implemented in the two sectors.

Relationship with government

The structure of firms and relationships in the aerospace sector is a product of its unique history. It is widely recognised that the aerospace and defence sector has traditionally enjoyed a privileged relationship with government due to its strategic importance (A. T. Kearney, 1998; Hartley, 1974; Hayward, 1989). Government has in the past attempted to shelter the aerospace industry from fluctuations in the civil aircraft market through defence expenditure (Hayward, 1989; Todd, 1988). In contrast, it has long been contended that the UK government has traditionally used the construction industry as an economic regulator (Ball, 1988; Hillebrandt, 1985; NEDO, 1978; Wood

Report (1975). When wishing to expand the economy the government has injected money into construction. When wishing to deflate, the economy the government has throttled back on construction investment. The housing sector is especially sensitive to changes in the interest rate. Both the aerospace and construction sectors remain subject to economic cycles. In the case of aerospace, government has historically acted to alleviate such cycles. In the case of construction, various British governments since the Second World War have acted to exacerbate the economic cycle through successive 'Stop-go' policies. Hillebrandt (1985) cites the public expenditure cuts of 1973 as a prime example. Ball (1998) refers to the sharp deflation induced by the Conservative governments of the 1980s as a further demonstration of the influence of periodic state expenditure cuts on the demand for construction work.

The fragmented structure of the UK construction industry is primarily a direct result of the prevailing low barriers to entry and the dominance of localised markets. Whilst its use as an economic regulator by government may not have caused fragmentation, it certainly has not helped. The positive side of fragmentation is flexibility. One of the most significant strengths of the UK construction industry has been its ability to expand and contract in response to severe fluctuations in demand. The Egan Report (DETR, 1998) cites the flexibility of the industry as a key strength. The benefits of a flexible construction industry are evidenced by numerous recent delegations from Japan seeking to learn how to cope with fluctuations in demand. It should be noted that the much heralded Japanese practices of SCM were predicated on the continuously expanding market that prevailed within Japan from the 1950s through to the early 1990s. Many Japanese firms have found it difficult to adapt to the financial crises and associated economic stagnation that have prevailed within Japan for the last decade. It is ironic that firms in the UK construction industry are seeking to adopt Japanese models of

SCM at the same time as Japanese firms are seeking to learn the benefits of flexibility from the UK construction sector.

Recent changes

Notwithstanding the comments above, government policy towards the aerospace sector has more recently tended to give primacy to value for money rather than strategic support (A. T. Kearney, 1998). MoD agencies are increasingly willing to procure 'off-the-shelf' systems from overseas suppliers. The UK government has recently encouraged international collaboration in defence procurement to spread development costs. This weakening of the government's traditional strategic relationship with the aerospace sector has introduced fresh competitive imperatives. The aerospace sector's reliance on domestic government contracts has declined significantly over the last 10 years and currently stands at only 14% of turnover (SBAC, 2001). The decline in UK government contracts highlights the current importance of export contracts in sustaining the UK's aerospace expertise. The new climate of international competitiveness is further evidenced by several best practice initiatives. Examples include the *Lean Aerospace Initiative* (LAI) and the Society of British Aerospace Companies' (SBAC) *Competitiveness Challenge*.

It must also be conceded that there is little recent evidence to support the thesis that government continues to use the construction industry as an economic regulator. The prevailing economic stability has undoubtedly alleviated the need for crude interventions of this type. The result is that the construction industry's collective memory of the prolonged post-war 'stop-go' cycle has eased. It is therefore the current relatively stable trading environment that provides the context for the construction industry's recent interest in integrated SCM. The prolonged steady expansion of construction output since 1993 provides the context for the current desire of main contractors to form long-term relationships with their supply chains. The advent of the next recession could see a rapid return to overtly competitive behaviour and less emphasis on collaborative SCM practices.

Global trends in aerospace

Changes in the UK government's industrial policy towards aerospace must be understood alongside significant trends of consolidation and collaboration in international aerospace. Any understanding of the current structure of UK aerospace should be predicated on a broader knowledge of the intense rivalry between the European and US aerospace industries. Since its launch in 1970 *Airbus Industrie* has been phenomenally successful in challenging US post-war domination of the aerospace markets. In 1970 European manufacturers produced only 10% of commercial aircraft. They now claim a market share of 50% for recent new aircraft orders. In order to meet the huge costs of aircraft development the members of the Airbus consortium were provided with launch aid by their respective governments. These loans later became highly contentious elements in a conflict between the EU and US over allegations of unfair competition. In response, EU representatives have pointed to hidden US subsidies provided by defence procurement and publicly funded R&D (Lawrence, 1999). Extensive competition between the US and EU has been sharpened by the global reduction in defence spending following the end of the Cold War. The European industry remains disadvantaged by the need to serve the diverse defence requirements of different national governments.

The period from 1970 saw significant restructuring in the US aerospace industry, culminating in the merger of Boeing and McDonnell Douglas. In 2001 three giant companies dominate the US aerospace and defence industry: Raytheon, Lockheed Martin and Boeing. In the face of extensive US consolidation, the European aerospace industry had little choice but to develop collaborative working practices. Despite significant political difficulties amongst national governments, the European aerospace industry has in part followed the US trend towards consolidation. The Airbus consortium finally became a corporate entity in 2000. A further stream of mergers resulted in the European Aerospace, Defence and Space Company (EADS).

Consolidation in the UK aerospace sector culminated in the merger of British Aerospace with Marconi Systems. This resulted in the emergence of BAE SYSTEMS as the sole UK national aerospace champion. The current interests of BAE SYSTEMS reflect the UK's longstanding policy of facing simultaneously across the Channel and the Atlantic (Lawrence, 1999). BAE SYSTEMS combines a 20% stake in Airbus with extensive manufacturing facilities in North America. The company is also engaged in a number of collaborative ventures with US aerospace companies. Of further significance is the way that prime contractors within the aerospace sector have positioned themselves as 'systems integrators'. This reflects the increasing use of 'off-the-shelf' systems in aerospace projects. The prime source of competitive advantage to some extent now lies in their skills of integration and SCM.

The end result of a prolonged period of extensive global consolidation in the aerospace industry is a realisation amongst UK suppliers that they have to collaborate in order to survive. In a highly competitive global market, BAE SYSTEMS and their suppliers are locked into a relationship of mutual dependency. This web of mutual dependency extends into a network of complex global relationships. The unique history of the UK aerospace industry combines with global mega-trends of consolidation and collaboration to provide a unique context for the enactment of SCM. Whilst the construction industry has experienced an increasing degree of globalisation and mergers (Carrillo, 1998), these remain minuscule in comparison to the restructuring of the aerospace sector. With few exceptions, firms within the construction industry remain locked in a mindset of mutual competition.

Best practice initiatives

The current best practice agendas for the two sectors are remarkably similar. Both are heavily influenced by the collaborative managerial practices that have emerged from the automotive sector. The Society of British Aerospace Companies (SBAC)'s *Competitiveness Challenge* embraces five key areas: Supply Chain Relationships in Aerospace (SCRIA), Lean Aerospace Initiative (LAI), People Management, Winning Business and Knowledge Management. The best practice agenda for the construction industry reflects identical themes to those found in *Competitiveness Challenge* (with the possible exception of 'Winning Business'). Neither of the best practice agendas show any sensitivity to the importance of context. The overriding assumption seems to be that the principles of best practice are universally applicable.

The major clients of the construction industry have provided a significant impetus to the best practice programme in construction. Clients have long been dissatisfied with the poor customer orientation of the construction industry, caused in part by its continued fragmentation. Clients are tired of dealing with a fragmented and adversarial industry. Advocated 'best practice' solutions for the construction industry invariably play heavily on the concept of integration. Examples include: integrated design and construction, integrated team working and integrated supply chain management.

Prime Contracting in construction.

Procurement initiatives such as *Prime Contracting* and *Procure 21* are designed to overcome the problems of fragmentation in providing clients with an integrated service. They offer construction companies the opportunity to work collaboratively both with their clients and supply chains. Under these arrangements, contractors are commonly evaluated on the extent to which their supply chains are 'in place' and on their experience of collaborative working. Although new to construction, prime contracting has a long history of application in the aerospace and defence sectors. The MoD has been influential in promoting the concept of prime contracting for the construction industry. The underlying principles reflect the MoD's SMART procurement initiative to realise better value for money in defence procurement. Procurement routes such as prime contracting extend the contractor's obligations to include design, construction and operation of the built facility. They therefore replace the traditionally fragmented process with the opportunity for an integrated approach. Within such frameworks, facilities management expertise and life-cycle costing become central to commercial success.

Prime contracting has the potential to overcome the problems of fragmentation in construction project delivery. However, there has been some resistance within the construction industry to the MoD's perceived policy of transferring unreasonable risks onto the private sector. The entry requirements to prime contracting are significant in terms of the additional expertise required from construction companies. Raising the barriers to entry would seem to satisfy the need of the construction industry's large clients to deal with fewer, more sophisticated construction firms.

The construction sector has seen significant jockeying for position in recent years as firms attempt to integrate themselves into stable supply chains to take advantage of the emerging prime contracting market. Many firms have made a significant investment in training in order to develop the necessary skills of collaborative working. The rewards for success are potentially high. The likely outcome is a polarisation in the market place between those players who meet the criteria for prime contracting and those who do not. The latter group is likely to form a significant rump that will continue to operate in traditional ways. It is debatable whether or not these trends will serve the interests of small occasional clients.

In many respects, the firms best placed to capitalise on the prime contracting market are those that have been successful in securing PFI work. Carrillo (1998) refers to the emergence of a 'super-league' of contracting groups formed through quasi-mergers to compete for PFI projects. In contrast to the SME sector, the PFI market is characterised by significant barriers to entry (Ezulike et al., 1997). Indeed, the number of firms that compete for PFI projects is strictly limited. There is already a significant degree of overlap between the firms that are competing within the embryonic prime contracting market and those that compete for PFI work. Whilst the construction sector as a whole has seen little consolidation, this is not true therefore for the PFI and prime contracting markets. Providing that a regular workflow can be achieved, prime contractors in construction may be able to maintain integrated supply chains on a quasi-permanent basis. If these conditions occur then SCM within prime contracting in construction may begin to approximate towards the established practices within aerospace. Such an outcome is highly dependent upon the ability of clients such as the Ministry of Defence (MoD) to provide continuity of work. It is further notable that the advent of prime contracting in construction is likely to see more offloading of risk and responsibility onto suppliers, thereby reflecting established trends within the aerospace sector.

Themes from the interviews

Twenty semi-structured interviews were conducted with supply chain specialists from the aerospace and construction sectors. Each sector had equal representation. The research team also conducted a review of various sets of in-house documentation relating to SCM policies. The identified themes were then corroborated within the context of a one-day workshop involving 11 industrial participants. Further interviews are ongoing.

Interviewees from the aerospace sector supported the contention that the origins of collaborative SCM lie in the imperatives of global competition. Within BAE SYSTEMS, several interviewees referred to the way in which the share crisis of the 1980s provided the platform for a revised way of working. Collaborative working in the aerospace sector was born from a shared sense of mutual dependency in the face of global competition. The construction sector has yet to experience a comparative crisis and therefore feels little imperative to change its long established way of working. Whilst many interviewees cited client pressure, the need to change was considered less than compelling. No construction interviewees cited globalisation to be a significant issue for the UK construction industry. Within the aerospace sector, there was found to be a strong reliance on providing advice and support to first tier suppliers. This reflects the established ethos of mutual dependency. The Supply Excellence Programme (SEP) would appear to be widely applied to both internal and external supply chains with BAE SYSTEMS. Whilst the SEP provides the dominant view of SCM, aerospace interviewees are also focused on the issue of core competencies. Several cited the need for continual re-alignment in accordance with changes in the market place.

Construction interviewees were heavily influenced by the *Building Down Barriers* model of SCM. However, in sharp contrast with the aerospace sector, they tended to describe the model they were working towards, rather than a model they had actually implemented. Phrases such as *'we recognise the need for a more integrated approach'* were commonplace - even amongst alleged SCM experts. Aerospace interviewees tended to describe SCM on the corporate level as being central to the way in which the *business* operates. In contrast, construction interviewees tended to describe SCM as an approach that could be used on specific *projects*. Several of the firms interviewed had to reconcile the fact that whilst on some projects they would be required to demonstrate SCM, on others they would operate in the traditional mode of contract management. Many referred to colleagues within the same company that continued to insist on competitive tendering for sub-contractors.

Many construction companies are organised into quasi-independent regional business units. Such a structure has advantages in terms of flexibility, but seriously impedes information sharing and the implementation of SCM on a corporate basis. Some significant national contractors do not possess a centralised database of sub-contractors. The more traditional firms within construction tend to see SCM to be synonymous with the purchasing function. The scope of the purchasing function is often limited to sourcing materials and services at minimum cost. This tends to be done as an independent exercise for each project. Construction interviewees directly involved in prime contracting saw SCM as an essential means of ensuring their competitive position in the marketplace. Others were openly sceptical of what they saw to be the latest 'fad', preferring to emphasise the need to 'talk the talk' in accordance with the current improvement agenda. There was widespread concern that the Ministry of Defence (MoD) has yet to finalise the contractual basis of prime contracting.

Conclusions

Firms within the UK aerospace sector share a much more common view of SCM than that which prevails in the construction industry. The *Supply Chain Relationships in Aerospace* (SCRIA) initiative has been influential in establishing a common SCM framework across a highly integrated industrial sector. The prevailing ethos within aerospace is that of mutual dependency. As a result of their dominant position as national aerospace champion, the Supply Excellence Programme (SEP) implemented by BAE SYSTEMS would appear to be especially significant. SCM undoubtedly serves the needs of sector efficiency by imposing a normative framework on supply chain interactions. Such frameworks provide a basis for the implementation of standard integrated systems across the aerospace supply chain. BAE SYSTEMS fully recognise their dependency upon first tier suppliers and hence offer them a significant amount of advice and support. The barriers to entry within the UK aerospace are such that sustainable supply chain relationships are of central importance in the face of intensive global competition.

The practice of SCM in construction has been found to be much less well established than in aerospace with a significant diversity of views. Progress towards the implementation of any normative framework of SCM within construction seems very limited. Many respondents tend to describe the frameworks they would like to introduce rather than systems that are already in place. Construction practitioners also tend to see SCM as a means of improving project performance, rather a fundamental shift in the way that they do business. This same view is also evidence within the literature that advocates SCM for the construction industry. However, it would be a mistake to conclude that the relative lack of development of SCM in construction is indicative of backwardness. The different levels of implementation must be explained in terms of the different industrial contexts. These structural differences reflect not only the higher technological content of the aerospace sector, but also different historical relationships with government. The imperatives of international competition have obliged the UK aerospace industry to operate in a highly collaborative manner. It is the shared ethos of mutual dependency that provides the platform for effective SCM. This is the only way in which European firms can compete with the US giants. Whilst the

UK construction industry has also experienced some degree of consolidation amongst large firms, the industry as a whole remains highly fragmented and localised. The construction industry's much maligned culture of adversarial relationships is a product of its fragmented structure.

The emergence of prime contracting in the construction sector potentially provides a much more supportive climate for SCM than has traditionally prevailed. Providing that a regular workflow can be achieved, prime contractors may well be able to form collaborative relationships with key suppliers that approximate towards established practice within aerospace. Such trends are already observable within the PFI market. Major clients will undoubtedly benefit in the short-term through a more integrated service. However, it must also be recognised that there is a point at which supply chain consolidation may become anti-competitive if new entrants are not encouraged. In either case, the influence of SCM practices on the construction industry at large is likely to remain small.

References

A. T. Kearney (1998) *The Impact of Global Aerospace Consolidation on UK Suppliers*, Society of British Aerospace Companies/A. T. Kearney Ltd.

Akintoye, A., McIntosh, G. and Fitzgerald, E. (2000) A survey of supply chain collaboration and management in the UK construction industry, *European Journal of Purchasing and Supply Management*, **6**, 159-168.

Ball, M. (1988) *Rebuilding Construction: Economic Change in the British Construction Industry*, Routledge, London.

Carrillo, P. M. (1998) Mergers and acquisitions: the impact on information systems and information technology, *Engineering, Construction and Architectural Management*, **5**(3) 276-284.

DETR (1998) *Rethinking Construction*, Report of the Construction Task Force, Department of Environment

Transport and the Regions, London.
DTI (2001a) *Construction Statistics Annual*, Department of Trade and Industry, London.
DTI (2001b) *Small and Medium-sized Enterprise (SME) Statistics for the UK*, Department of Trade and Industry, London.
Ezulike, E. I., Perry, J. G. and Hawwash, K. (1997) The barriers to entry into the PFI market, *Engineering, Construction and Architectural Management*, **5**(3) 276-284.
Hall, M., Holt, R. and Graves, A. (2000) Private finance, public roads: configuring the supply chain in PFI highway construction, *European Journal of Purchasing and Supply Management*, **6**, 227-235.
Hartley, K. (1974) *A Market for Aircraft*, Hobart Paper 57, Institute of Economic Affairs, London.
Hayward, K. (1989) *The British Aircraft Industry*, Manchester University Press.
Hillebrandt, P. M. (1985) *Economic Theory and the Construction Industry*, Macmillan, London.
Holti, R., Nicolini, D. and Smalley, M. (2000) *The Handbook of Supply Chain Management: The Essentials*, CIRIA, London.
Lawrence, P. (1999) Europe vs America: strategic trade in civil aeronautics, in *Strategic Issues in European Aerospace* (Eds. P. K. Lawrence and D. L. Braddon), Ashgate, Aldershot.
NAO (2001) *Modernising Construction*, Report by the Comptroller and Auditor General of the National Audit Office, The Stationery Office, London.
NEDO (1978) *How Flexible is Construction?*, NEDO Books, London.
Nicolini, D., Holti, R. and Smalley, M. (2001) Integrating project activities: the theory and practice of managing the supply chains through clusters, *Construction Management and Economics*, **19**, 37-47.
Nonaka, I. and Takeuchi, H. (1995) *The Knowledge-Creating*

Company, Oxford University Press, Oxford.
SBAC (2001) *UK Aerospace Facts and Figures 2000*, Society of British Aerospace Companies, London.
Todd, D. (1988) *Defence Industries: A Global Perspective*, Routledge, London.
Vrijhoef, R. and Koskela, L. (2000) The four roles of supply chain management in construction, *European Journal of Purchasing and Supply Management*, **6**, 169-178.
Wood Report (1975) *The Public Client and the Construction Industries*, HMSO, London.

Constructability in Higher Education Buildings in Portugal,

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Abstract

Recent improvement of higher education buildings in Portugal has been conducted in the frame of European Community programmes. This implies for each project the strict accomplishment of pre-established cost and time objectives but this has not been achieved in a number of projects. According to our research, problems mostly arise during the construction phase, although following several design deficiencies in more then 70% of the case studies. Main problems are the lack of clarity, cohesion, co-ordination and integration of design outputs in the conditions of construction contracts. Because of the dissociation of design and construction contracts, although aiming at the common objective of client satisfaction, management efforts are required to optimise project performance making use of the knowledge of all project participants. This paper reports the results of our research in this problem, so far. A sequence of procedures on the constructability analysis of the project life cycle of higher education buildings is suggested through a set of workshops involving a co-ordinator and the design team. This may help project managers to avoid the lack of accomplishment of project objectives.

Keywords: constructability, higher education buildings, workshops

Introduction.

In the last few years, the construction of higher education buildings in Portugal has been co- financed by several specific European Union programmes in the scope of the European Fund of Regional Development (FEDER). These programmes

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aim at the promotion and development of higher education in Portugal (PRODEP I, II, III) by:

- Increasing the number of students;
- Improving teaching quality;
- Bettering student social support;
- Encouraging sports among students.

PRODEP programmes are essentially focused on the extension of higher education infrastructures by building new facilities, enlarging and refurbishing existing ones. Eligible facilities include administrative areas, lecturing rooms, laboratories, residence halls, restaurants, sport areas, etc.. Candidate facilities must obviously comply with programme objectives as specified by the programme manager. Selection criteria are usually specified in the programme regulations and typically include the adequacy to strategic objectives of the programme, the contribution for the correction of regional asymmetries and unbalances among economic sectors, technical and financial quality of the project, etc.. The contract usually specifies the project objectives, the financial support related to the project development, the project schedule and other obligations of the contracting organisations. The lack of accomplishment of contract obligations may lead the PRODEP manager to cancel the contract with the contracting institution. Therefore, efficient cost and time management is essential to keep the project financial support which is presently a basic condition for the development of Portuguese institutions of higher education.

However, the author's experience of the last 10 years or so has evidenced that several projects have failed to accomplish contract conditions, therefore leading to financial difficulties during project execution. Main reasons for this are as follows:

- Design errors only detected during the construction phase;
- Lack of clarity, cohesion, co-ordination and integration of design outputs;

- Inadequate evaluation of site conditions and ground investigation prior to foundation design;
- Use of new design solutions with no practical background of construction technology required to put them into practice.

In order to overcome these problems, designers require excessive project changes, contractors claim to use much more resources than previously scheduled, project managers get too much stress, all these leading to cost overruns and delays and a terrible headache for the client. Actually, a PRODEP contract implies the strict accomplishment of pre-established cost and time objectives otherwise it may be cancelled and this brings severe financial consequences to the promoting institution. Furthermore, facilities are often planned for the start of the scholar year (say, September) in order to allocate new students, laboratories or lectures which are forecasted well in advance and cannot be cancelled close to the opening due date. Moreover, no project can just be postponed for a year without severe losses for the promoter, higher education institutions being no exception. This calls for a significant management effort although not enough has been placed so far in a number of recent projects of this type.

Preliminary conclusions coming from the authors experience revealed that problems mostly arise during the construction phase of the projects, although following several design deficiencies. A survey has been conducted to a set of projects recently undertaken by Universidade do Minho in order to typify main construction problems and to make use of past experience in order to prevent future problems. Information has been gathered through the analysis of contractors' claims which invariably have encompassed extra costs for the University and time delays for project conclusion.

Case studies.

Five projects have been surveyed, namely, two buildings for technological departments, one building for a science department, one building for an art department and one building for sports. These projects have been selected from a larger set undertaken by the University in the last ten years and are the most recent and probably cover the most representative of their type. Moreover, the records of claims are well organised which was very helpful while conducting the survey. Main characteristics of the projects are depicted in Table 1.

Table 1.

Projects	Building Type	Building Area (m^2)	Scheduled Duration (months)	Actual Duration (months)	Final Cost (10^6 Euros)
A	Technology Department	9000	10	18	6.00
B	Technology Department	780	5	Contract rescinded	0.30
C	Science Department	8,300	16	17	4.40
D	Art Department	6,700	15	Under Construction	4.25
E	Sports Building	3,500	10	16	1.60

It can be concluded that in some projects, construction delays reached over 50% of the initially scheduled project duration. Moreover, contract cost deviations have been up to 30% in the most severe cases. In each project, contractor claims have been analysed reaching as much as 300 records for project A. Claims have been perceived as follows:

Lack of design-site co-ordination due to poor knowledge of site conditions during the design phase of the project. In most cases, site surveying and investigation, ground investigation and geotechnical surveying have not been satisfactory performed during the design phase of the project, originating design solutions not compatible with site reality.

Lack of design-construction co-ordination resulting from inadequacy of design, namely, design management operations, design solutions, design specifications, design detailing and design team co-ordination.

Lack of construction efficiency on site mainly because of poor planning, deficient co-ordination of construction phases and inefficacy of construction operations undertaken by contractors .

Lack of design-utilisation co-ordination with consequences an possible poor performance of some part or equipment of the building detected during the construction phase.

The distribution of the above construction problems in the projects surveyed are shown below in Table 2:

Table 2.

Project	Lack of Design-site coordination	Lack of Design-Construction coordination	Lack of Construction Efficiency	Lack of Design-Utilisation Coordination	Total
A	20	220	50	10	300
B	1	1	-	-	2
C	3	42	5	-	50
D	-	15	5	-	20
E	6	43	4	7	60
Total	30	321	64	17	432

Table 2 shows that most of the records have been classified as problems resulting from the lack of design-construction co-ordination (74% of the cases), following lack of construction efficiency (15% of the cases), design-site co-ordination (7% of the cases) and lack of design-utilisation co-ordination (4% of the cases). In view of the above, it may be concluded that design has not bean configured to enable efficient construction in a significant number of cases. This is evident as new design solutions have been attempted without enough knowledge of construction technology, standardisation has not been adopted whenever possible, lack of co-ordination of the design team has prevented construction planning efficacy, design detailing and design specifications have failed to promote construction efficiency, etc.. In order to keep project cost and time on track, this set of problems clearly called for deeper constructability analysis of the project team. This could be achieved by introducing constructability programmes in design documents usually contracted by Universidade do Minho but the way to make it work deserved further research.

Constructability Programme.

In order to develop a constructability programme for Portuguese higher education buildings, further information should be collected from other promoting institutions. This has been achieved by means of an inquiry to a set of selected higher education institutions, construction contractors and design teams. The inquiry aims at identifying the main constructability problems in recent construction experiences of this type of buildings. Information will be used to establish critical checking points of the programme. In this phase of the research, the results of the inquiry are not yet fully available.

Meanwhile, the basic, procedure supporting the constructability programme to be followed by design teams contracted by Universidade do Minho is as follows:

- Constructability concepts and objectives of the constructability programme;
- Early appointment of the constructability coordinator for the design phase of project development responsible for the development of the constructability programme;
- Assessment of likely construction efficiency hazards in view of design options of the design team;
- Search for alternative design solutions in order to

overcome possible inefficient construction;
- Register design team action for construction efficiency;
- Register possible constructability residual problems.

Obviously, actions aiming at constructability should be put into practice as early as possible in the project life-cycle, because the chance to improve design for this purpose decreases as the project evolves. The function of the constructability coordinator is to ensure that the construction experience of the design team is put into practice from the early stages of project development. The constructability coordinator may be someone from the design team assuming this function, or someone from outside.

It is expected that the constructability coordinator will act through a set of workshops with the design team so that the above actions can be put into practice. These are sometimes called Constructability Revisions and it has been suggested to plan them for a set of instants during the design phase. For example, workshops would take place after completion of 30%, 60% and 90% of the design(*Hanlon and Sanvido*). However, it has been decided to adopt a more flexible approach, planning workshops for the end of design sub-phases, as defined in design contract documents.

Accordingly, four constructability workshops are foreseen for typical buildings contracted by Universidade do Minho:
- At the beginning of the preliminary phase.
- At the end of the preliminary design phase.
- At the end of detailed design phase, before the release of execution drawings.
- At the pre-construction phase.

The first workshop marks the beginning of the design process, and it will be organised into two parts:
1. The first part is a brief introduction to constructability

concepts and the aim of the constructability programme,

2. The second part is a thorough analysis of likely construction efficiency hazards resulting from site conditions (near by obstacles, public services, topography, etc.) and ground conditions. Relevant site investigation may be decided (for example, further geotechnical testing). Constructability problems resulting from preliminary design solutions, products and materials to be used are also reviewed.

The **second workshop** takes place at the end of the preliminary design phase. The conclusions of the previous workshop are first recalled and the results of further site investigation are analysed. An assessment is made of likely construction efficiency hazards in view of design options of the design team. Specifically works involving some possible constructability problems are studied. Some examples are as follows:

> Do we have practical background or do we fully understand the construction technology required to put into practice this nice design solution? Can we standardise this set of design objects in order to facilitate manufacture without sacrificing this brilliant idea? Are we using standard series for these design components or will we need to produce them just for this project? Can we avoid these small differences between our design components or do they make sense only with these millimetre differences? Are we ensuring co-ordination of the design team or are we expecting things just to fit when time comes?

After the above discussion the team is encouraged to search for alternative design solutions in order to overcome possible inefficient construction due to problems detected. Design team action for constructability is registered according to the requirements of the design contract with Universidade do Minho.

The **third workshop** is scheduled for the end of the detailed design phase. This aims at verifying design in a sense closer to the traditional Constructability Revisions. Records from previous constructability action of the design team are first recalled and then a revision and final design solutions is made, possibly with the help of checklists. Some examples of this action are as follows:

> Are we sure that our project can easily be put into practice? Can it be done safely and in respect for environment? Have we had enough geotechnical information to get to the solution for foundations? Are drawings compatible among design specialties? Are design detailing and design specifications meaningful and complete? Can we expect efficient construction planning with design information released for tendering? Have we looked for environmental and safely issues of construction by allowing enough space for site erection and operation?

A report is expected after the above discussion and possible constructability residual problems are registered for further action.

The **fourth workshop** is a pre-construction meeting involving the constructability coordinator and the contractor team as is devoted to the analysis of possible construction efficiency problems. This aims at discussing constructability problems prior to the start of the construction phase, bringing together the views of both designers and builders.

Records

A formal record system easy to use and to monitor throughout the design phase is intended driving to more consistent approach to constructability issues during the phase. Besides, information transfer to the construction phase is easier to achieve.

Accordingly, the design team is required to register constructability action, namely problems detected and alternative design solutions adopted to overcome those problems. Checklists used in the scope of the third workshop and results of the inquiry should also be registered, then, a final report on constructability should be produced.

These documents are organised in a file delivered to the project management team from Universidade do Minho that will make use of it in tender documents.

Records of claims during the construction phase are also helpful information to improve constructability initiative in future projects.

Conclusions.

This paper reports our research on a constructability approach for higher education buildings and is based on the our experience on this subject at Universidade do Minho. It was decided to collect further information from other promoting organisations, which will be helpful to establish critical checking points of the programme, as those used at the third workshop mentioned above. An approach to the constructability programme to be followed by design teams contracted by Universidade do Minho is presented. This process is to be conducted by a constructability co-ordinator who will be appointed by design teams at the contract stages.

Under this approach, it is expected that the constructability process may become team work from the project start. Moreover, it is expected that the implementation of a constructability programme will lead to quality improvement and cost reduction of our projects as well as a dramatic reduction in animosity among project participants.

The implementation of the constructability programme has not yet been achieved in a new project, because we are still testing the suggested procedure with the results of the inquiry to other promoting organisations. However we expect to put it into practice in our new building for sciences of the health, schedule to start in the year 2002.

References

Martin Fisher, C.B. Tamtum, - Characteristics of Design – Relevant Constructability Knowledge; *J. Const. Eng. and Mang.* – Sept/1997

James O'Connor, Richard Tucker, - Industrial Project Constructability Improvement, *J. Const. Eng. and Mang.* – March /1986

Eric J. Hanlon, Victor Sanvido, - Constructability Information Classification Scheme, *J. Construction Eng. and Mang.* , December/1995

G. E. Gibson Jr., C. I. McGinnis, - Constructability in Public Sector, *J. Const. Eng. and Mang*. Sept/1996

John A. Gambatese and James Mcmanus, - The Constructability Review Process: A constructor's Perspective, *J. Management in Engineering*, Jan/Feb, 1999

Jeffrey S. Russell, and John G. Gugel, - *Comparison of two Corporate Constructability Programs*, J. Const. Eng. and Mang. , Dec.,1993

Jeffrey S. Russell, and John G. Gugel, - Comparative Analysis of three Constructability Approaches, *J. Const. Eng. and Mang*. March, 1994

Sadi Assaf, Abdul–Mohsen Al–Hammad, and Mansoor Al–Shihah, - Effects of Faulty Design and Construction on Building Maintenance, *J. of Performance of Constructed Facilities* , Nov., 1996

Harvey, A. Kagan, - How Designers can Avoid Construction Claims , *J. of Professional Issues in Engineering*, July, 1985

Michael W. Radtke and Jeffrey S. Russell - Project-Level Model Process for Implementing Constructability, *J. of*

process:

1. Low price wins the award.
2. Construction not on-time, on-budget, and does not meet quality expectations.
3. Construction requires excessive management and inspection.
4. Environment of conflict, a win-lose relationship.
5. Change orders implemented after the job is awarded, allowing poor performing contractors to compete with contractors who put in a price to meet the intent of the project.
6. Allows a contractor who missed requirements to get the project.
7. Allow general contractors to mistreat subcontractors.
8. Has lead to poor quality work.

A careful analysis of the low bid process reveals the following process. A designer identifies the minimum allowable quality that is defined by minimum standards. Minimum standards are usually the description of the lowest performing construction materials and systems. Due to the different levels of quality products, management and craftsperson skill, the contractors are at different levels of performance.

The highest performers usually have higher prices due to their long time craftsperson skill, better performing construction materials, management, and higher overhead (Figure 1). The designer then uses a subjective minimum acceptable level. This minimum level is subjective and must be interpreted. Due to the imperfections in communication, and the complexity in construction, the definition of the minimum level is based on perception (Figure 2).

As soon as the contractors with different levels of performance see the specification, the movement is to try to provide the owner with the lowest possible level of performance without being identified as not meeting the performance level (minimum specifications of materials and systems).

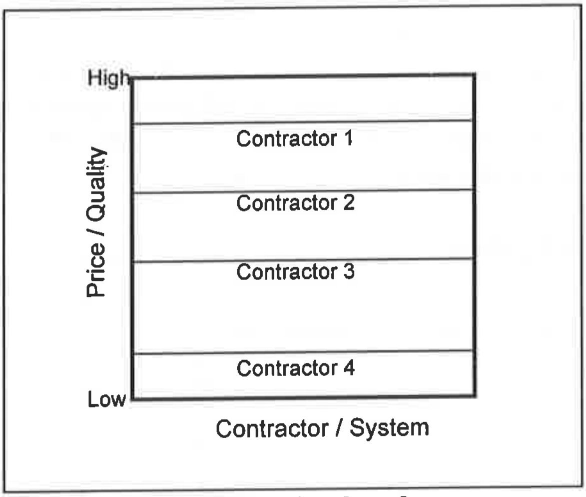


Figure 1. Different levels of Performance

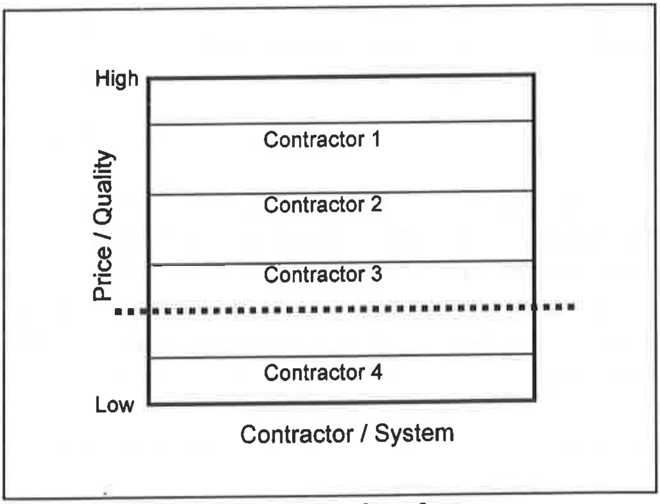
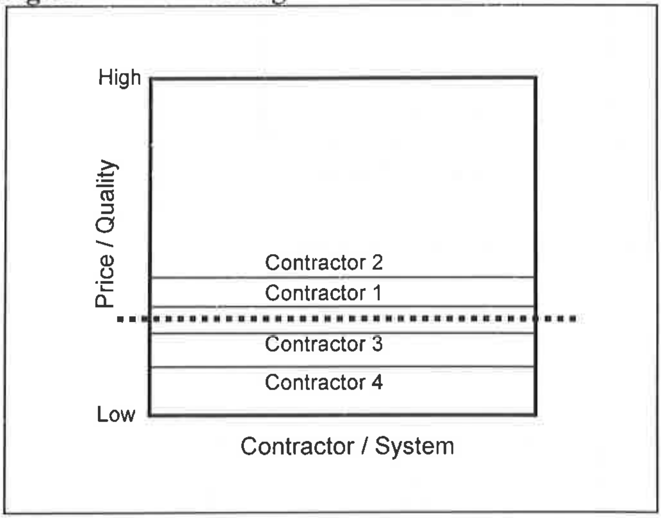


Figure 2. Different levels of Performance

Figure 3 shows that most contractors reduce their quality to get the lowest possible price. However, not all the contractors will bid this type of construction. Many contractors either negotiate their work, or wait until the low-bid work goes bad, and comes in to fix the facility at their own price. The problem with minimum material or process standards is that the numbers relate to technical properties and do not relate to performance or longevity of performance level in terms of minimization of maintenance.

Figure 3: Low Bidding



The owners and designers are directing the contractors to provide the "cheapest" possible construction. To get the projects, a contractor must have the lowest price. The contractors are forced to take risks. If anything happens, they are forced to submit change orders to maintain a profit. As the low price becomes more and more important, the following occurs:

1. Manufacturers redo their systems to reduce price and remain competitive.
2. Contractors are forced to do more and more work for less money (leverage volume for price).
3. Because the emphasis is on minimum quality, the value of training goes down. Training is expensive, and higher

quality is not a requirement.

4. Contractors are forced to do the minimum for what they are paid. Therefore, they take less time, and force the owners to do more complete inspections.
5. Management of construction becomes a very critical job. As construction is awarded on-price, contractors move toward providing less and less, management requires more and more expertise. Management is not a value added function. The more resources go into management, the less resources will go into the actual construction.
6. Very detailed specifications including means and methods allow craftspeople with very little skill to do the job. They take longer, need more supervision and do not have the high level of quality. They seem to be cheaper, however the lowering of quality and the effort to maintain a minimum level of quality is an endless spiral.

The evidence of the above is:

1. Movement away from low-bid.
2. Low profit margins of contractors.
3. Owners are forcing contractors to leverage volume for price.
4. Construction research generated because of poor quality construction.
5. Movement towards construction management @ risk.
6. Number of projects that are not on-time, on-budget, or meeting quality expectations. In the four states that Performance Information Procurement System (PIPS) has been implemented, the projects have not come in on-time, on-budget, and meeting quality expectation. This is the construction norm under the low-bid system.

Performance Specifications

The movement away from low-bid affects the major player in construction procurement: the designer. The designer has always been the overall manager of construction delivery and the approval authority in construction. However, as there is a movement toward design-build, the contractor becomes an equal if not the major player. For the designer, there is a sense of losing control of the process and working for the contractor. The designer and engineer have always been the professional. The designer negotiates their fees after being selected on performance. The contractor has been treated as an uneducated commodity (award is based on price). Designers, in trying to keep their professional status, have moved to performance specifications to be used in best value awards. This process retains the design-bid-build delivery system, but awards can be made to the best value.

However, there is an irony in the term performance specifications. If it is a specification, it will contain a minimum acceptable value or standard. If the award will be made to the best value (performance and price), there is no need for a minimum performance value, because an unacceptable performance will never get the award. The issue also results in other questions:

1. How does a designer describe the minimum level of performance that involves multiple criteria?
2. How does minimum performance that is made of multiple criteria ensure that the minimum level of performance is available?
3. How does the designer make a decision on what performance is in terms of longevity, minimization of maintenance, minimization of breakdowns, and the impact of different levels of contractor performance?
4. What is the value of performance?
5. How is performance verified? How many references are required? How does a designer take the performance of other jobs and relate it to the performance on the next job?
6. What level of craftspeople is the contractor required to put on the project?
7. What if the contractor's systems do not perform soon

after construction is complete and the contractor has been paid?
8. How does the designer identify if nonperformance is the contractor's fault or the manufacturer's fault or the designer's fault?

If a performance specification is used, the award should be made to the lowest bidder. The minimum performance should be quantifiable and supported with documented performance. Performance specifications will not work over time for the following reasons:

1. Specified performance levels are subjective and require interpretation.
2. Performance of a constructed system is complex and there are too many factors for someone to quantify.
3. Performance specifications direct someone on how to do work and do not have any corrélation with performance.
4. Construction performance data is nonexistent and it is too difficult to identify what the minimum data sample should be and how to collect it.
5. The price pressure will force the contractor to provide the minimal allowable performance, which will lead to a conflict (minimum vs. performance expectation).

No one has clearly defined a performance specification. Does it include means and methods? Does it include minimum material and system standards? If it does, then is it the assumption that these systems will perform? Performance specifications require subjective interpretation, analysis and decision making. Anything that requires subjection interpretation and decision making will tend to highlight the decision maker. Performance than becomes a subjective term that is constrained by the knowledge of the decision maker. Because no decision maker has all information, when problems occur, they will be difficult to solve. In this environment, liability is still diluted. When decisions are made, liability must be assumed. However, if this were true, the contractor would never be liable for nonperformance if there was a specification, and the designer used an inspector to ensure that the contractor followed the specification. Due to the industry being "function focused" and not "business focused," the movement of specification and low-bid award to performance specification and best value award will not minimize the problems of the low-bid delivery system.

Performance is a Business Issue

Deming states the performance is always dictated by the owner. Performance is defined by the author as being on-time, on-budget, and meeting quality expectations. This is a business issue and not an engineering technical issue. A layperson can identify if the contractor finished on-time, on-budget, and whether the owner's expectations were met. The owner's problems can be solved if the owner can know if the contractors can:

1. Identify the risk to the owner with the constraints of budget, time, and expectations.
2. Know how to minimize the risk using construction and engineering skill.
3. Accurately identify the costs.
4. Have skilled managers and craftspeople that will perform the construction.
5. Identify the construction schedule.

The owner can do this by doing the following:

1. Have the contractors submit their best references to identify past performance.
2. Have the contractors identify what performance criteria make contractors different.
3. Have the contractors identify the risk, how to minimize the risk, and prepare detailed schedules and cost breakouts.
4. Have the general contractors hire their subcontractors based on performance.

5. Consider both relative performance and price to pick the best value.

There are several issues if the owner is to implement the above. Because it is a business process issue and not a technical issue, minimum standards cannot be used. Requirements are already set by the industry. They include licensing, bonding, and insurance. Therefore, a method must be created to do the following:

1. Measure items on a relative basis.
2. Compare both objective data and subjective data without translation. For example, if there are no minimums, a contractor might have only two references, which give high marks, while another contractor might have 40 references with almost the same marks. Which contractor is better?
3. Minimize decision making on what is performance, but be able to input on what level of performance is acceptable.
4. Even though the designer represents the owner, the process should make the contractor liable for understanding the owner's expectations and performing the construction.

The identification that is a business issue and not a technical issue is unsettling for many designers. The new process will require information workers and not designers or engineers. The owner's requirement will still be quantified in technical terms, but the increased performance will be obtained by using business information (past performance). Designers and engineers can change their function to become information workers with design capability.

Performance Information Procurement System (PIPS)

PIPS is an information based procurement system with the following steps:

1. Identification of past performance. This gate forces contractors to identify their own level of performance.

Poor performers will only pass this gate if they change their method of operation and personnel, and do it at a more economical price.

2. Request for proposal (RFP). The owner uses a complete design and specifications, partial design, or requirements only to convey the requirement to the contractors. The RFP includes the relative importance of past and future performance.
3. Bid submittal. The contractors submit a management plan (MP). The MP includes the identification of risk to the user, how the risk will be minimized, construction schedule, and detailed cost breakout.
4. Analysis of MP. The MP will be rated in relative fashion.
5. Interview of key personnel. The key personnel are interviewed. The interview thrust is a test to see if the key personnel, site manager and project manager, can visualize the risks of the projects before it is constructed, and how they will react based on planning.
6. Prioritization of alternatives. The relative data from their past performance (general, subcontractors, key personnel, MP ratings (future capability on specific job), and key personnel interview ratings, is reviewed by an artificial intelligent decision maker that measures the relative differences and prioritizes the alternatives to meet a unique user's requirement. The relative performances are then compared with prices based on preset weighting to identify the "best value."
7. Preaward meeting. The "best performing" contractor then is asked to recoordinate the specifications and drawings with all the critical subcontractors, identify any points that need clarification, get the answers from the designer and owner, and then present how they will construct the facility. They sign a contract that includes the RFP, their management plan, interview comments, and the discussions with the owner and designer before the preaward meeting. The only change orders will be for scope changes and unforeseen events as identified by the

owner. An important fact is that if the contractor is good, and the owner wants the contractor back, he will not act in an unfair manner. Another safeguard is that the contractor can always pull out of the job if the contractor identifies the owner as an "unfair" owner. If an owner runs PIPS, the PIPS will also identify if the owner is unfair.

8. Rating on construction. The contractor and all the subcontractors are rated after the job is completed, and their rating becomes 25% of their future performance rating.

The AI system is based on a modified Displaced Ideal Model (MDIM) developed by Zeleny. It measures relative differences of criteria with minimum translation. It is easy to use and understand. The MDIM prioritizes differently every time. It does not take into account previous runs. Every implementation uses the same "processing."

If performance is more of a business issue than a technical issue, PIPS will increase performance. The following are results of PIPS implementations:

1. Implemented 290 times.
2. Used on $150M of construction procurement.
3. Largest project was $53M.
4. 99% of projects on-time, on-budget, and met quality expectations.
5. 100% customer satisfaction.
6. State of Hawaii has run 100 tests. Management requirements have been minimized to 10%. One engineer can do the work of 10 engineers under the low bid system.
7. Designers and inspectors work and risk is reduced by 50%.
8. Performance has exceeded the expectations of facility managers, owners, and manufacturers.

The above results show that construction performance is a business issue. If the owner hires contractors who understand construction, the majority of performance issues disappear. Good business practices include the following results:

1. Minimized decision making.
2. Using past performance information.
3. Paying a fair profit.
4. Differentiation of performance.
5. Totally open competition.
6. Entry and exit barriers.

The key to having the last three characteristics is to use the performance information to become the entry and exit barrier. Performers will not leave and non-performers cannot enter.

Conclusion

Performance in construction is a business issue. Trying to solve a business issue with technical specifications will not lead to performance. Performance specifications should therefore include the owner's requirements, and the method of identifying the best performance. Performance specifications should not include minimum performance standards. Performance specifications can only be used when considering performance and price. The using of performance specifications will not be welcomed by designers and large contractors due to the following factors:

1. Change in process.
2. Change in functions.
3. Increased liability for performance.

However, due to the information environment, the requirement to minimize risk, and the price pressure, the construction industry will move to a performance orientation.

References:

Deming, W. Edwards, (1986) *Out of the Crisis,* Massachusetts

Institute of Technology, Cambridge, MA.
Zeleny, Milan, (1982) *Multiple Criteria Decision Making*, McGraw-Hill Book Company, New York, NY.
Kashiwagi, Dean T., (1984) *The Economic Feasibility of the Polyurethane Foam Roof System,* Master's Thesis, Arizona State University, Tempe, AZ.
Buckingham, Marcus and Coffman, Curt (1999) *First, Break All The Rules,* Simon & Schuster, New York, NY.

Performance Contracting for Accelerated Innovation and Efficiency

Hans Westling[1]

Abstract

Formulation of challenging performance criteria has in many areas contributed to innovative solutions. New collaborative work is ongoing within the Demand-Side Management Agreement of the International Energy Agency (IEA). The objective is to facilitate the use of performance contracts and other energy service company (ESCO) contracts. Performance contracting is a well-established mechanism for promoting the installation of energy efficient building equipment and systems. Facility owners and energy service contractors use this method to retrofit equipment to save money on building operations. The savings in energy bills - often 20-40% - are shared between the facility owner and the ESCO under the terms of the agreement. The ESCO is taking the project's performance risk by guaranteeing a specified level of energy savings. Eight countries participate in this new project, which includes studies into processes, rules for contracts and demonstration projects.

Keywords: performance contracts, energy efficiency, ESCO

Introduction

Energy service contracting, or performance contracting, is an established mechanism for promoting the installation of energy efficient building equipment and systems. Facility owners and energy service contractors, or ESCOs, enter into agreements to perform retrofit installations of equipment that can save money on building operations. The savings in energy bills due to the more efficient equipment are shared between the facility owner and the ESCO under terms of the agreement. Most importantly,

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the ESCO takes on the project's performance risk by guaranteeing a specified level of energy savings. The ESCO's compensation is directly tied to achieving these savings. The financing can either be by the ESCO, by the suppliers of the system or components or by an outside third-party company – or in different combinations. Leasing arrangements can also be considered. Different problems and hindrances have reduced the introduction and wider spreading of this method. Within the Demand-Side Management (DSM) Agreement of the International Energy Agency (IEA) the collaborative work Task X "Performance Contracting" has started with eight countries participating - Finland, France, Italy, Japan, the Netherlands, Norway, Sweden and the United States. Different motives, scope and objectives, methodology, preliminary findings (including barriers and possibilities) and the future work is further discussed in this paper

Motives

There might be different motives for choosing a performance contract or other ESCO financial arrangements:

- For some property owners and users the main reason can be lack of investment capital.
- For some it is simply a very economical business strategy. We only pay when we see value-added functions, as reduced energy bills.
- For the ESCOs, it is a good business argument and a way to connect with customers and start new business relations.
- For some companies and government organisations it can be a very efficient way to inspire innovations and to facilitate the introduction of more efficient solutions.
- Spreading of the use of performance contracting to more markets.
- A joint multinational IEA project contributes to an expanding international market for performance

contracting.

Scope and Objectives

This project is a business-to-business project limited to efforts involving the performance contracting agreements and other ESCO related financial options and services between client, businesses and all types of companies offering these services.

The overall objective is to facilitate the greater use of performance contracts and other ESCO financial options and services (PC/ESCO) in the participating countries.

The IEA DSM Performance Contracting project will:

- Provide all the participants with a better understanding of how performance contracts and other ESCO financial options and services can be used.
- Promote an understanding of the benefits of performance contracting and other ESCO financial options and services and the potential contribution of these financial options and services to promoting energy efficiency and mitigating global climate change.
- Promote an understanding of the necessary regulatory and legal context under which the performance contracting industry may function.
- Identify the market potential in countries for which no mature performance contracting industry currently exists.
- Identify and share information concerning potential barriers and problems associated with implementing performance contracting and other ESCO financial options and services.
- Identify and share information concerning solutions to problems and success stories involving performance contracting and other ESCO financial options and services.

- Contribute to increased awareness of the excellent opportunities that the performance contracting models can offer, and as a result, establish larger market opportunities in more countries.
- Formulate definitions of different types of performance contracting.
- Identify how to involve energy agencies, consultants and other intermediates in the preparation process.
- Identify solutions and schemes how to find suitable ESCOs and how to improve the tendering process.

Methodology

The project is organised with a group of National Experts, who work together under the co-ordination of an Operating Agent or project manager. Each of the eight participating countries has a National Co-ordinator and has organised groups representing different stakeholders, such as for instance facility owners, different ESCO companies, energy suppliers, consultants, financiers, and government officials. The work is divided into steps, or subtasks.

During the Initial Workshop - Subtask A, the Experts completed work already started during earlier phases and discussed the contents in coming Country Reports and the way of presenting different case studies.

In the Country Reports – Subtask B, the countries have started the work on contributing reports on the situation in their country from their perspectives regarding establishment and utilisation of the performance contracting industry. Countries with mature performance contracting industries can provide information in their reports about already existing model contracts, problems/hindrances, case studies, and market size.

This subtask will be followed by an interactive workshop comparing the Country Reports and the ideas – Subtask C. This is a forum for the participating countries to share the results of their research into the performance contracting industry and to draw conclusions from the comparison of the different Country Reports and to have discussions with other interested parties.

The countries will then develop individual Country Plans - Subtask D - to increase the viability of performance contracting in their countries. These plans will be followed up by identified cases and demonstration projects, which will be analysed to form a background for formulation of lessons learned, and of a draft for a final Management Report.

Different stakeholders, financiers, legal specialists, and people specialised in benchmarking, measurement and verification matters will be invited to some of the meetings and workshops.

Preliminary Findings And Issues For Future Work

Some preliminary findings after the presentation and studying of the first drafts of the Country Reports are summarised below.

- Valuable contents for future comparisons have been formulated by the eight participating countries.
- Barriers for the early acceptance of performance contracting have been identified such as lack of information and understanding of the opportunities, lack of public recognition and future-oriented buyers taking the lead, unclear public procurement rules and no generally accepted contract principles, lack of financing on attractive conditions and the separate responsibilities within buyer organisations for investment and operation.
- The countries have identified a number of cases for future study:
  projects like hospitals, schools, industries, and

commercial buildings.

- Some models used for contract arrangements have also been pointed out. They include different proposals for sharing the savings and the risks and also different arrangements for the investment capital. Benchmarking will facilitate better comparisons and stimulate development of better solutions.
- Typical energy savings according to analysis of many projects in different countries are in the area of 20-40%.
- Target markets and customers have been identified in some of the countries.
- Definitions about performance contracting have been discussed. Further analyses have to be made, for instance whether it is possible to include also other services, apart from energy, for which there is a market. This could for instance be cooling, combined with district heating in some countries, but it could also be various IT services, cable arrangements, etc.
- Some key areas, which should always be included in the performance contracting arrangements, have been identified by some of the countries, and there is openness among the participants also to include other areas and detailed arrangements.

The main issues for the further work include:

- Contract arrangements about:
  Standard/Model processes and contracts
  General Conditions
  Ownership of installed equipment
- Principles for sharing positive and negative results
- Guarantees and enforcement
- Financing with different alternatives
- Measurement and verification

Performance contracting can be a good partnering activity, and an important tool for the use of resources and the wider use of more efficient solutions resulting in reducing CO_2 emissions and climate risks. Accepted principles for process and main contract conditions can accelerate the internationalisation.

A very important element is to inspire large public organisations to take an active role and as clients initiate more performance contracting arrangements.

References

BRECSU (2000): "Energy services at Warwickshire schools", Good Practice Case Study 385. Brochure. Watford, United Kingdom.

CIB (2001): CIB Special Project: "PeBBU Proposal – conditionally – accepted by EU!" Article by General Secretariat. *In* CIB Information Nr. 1/01.

IDAE (1995): "Third Party Financing for Energy Saving Projects". Edited by Juan Antonio Alonso Gonzalez by order of the European Commission Directorate-General for Energy (DG XVII). Madrid.

International Energy Agency (2000): "Task X. Performance Contracting". *In* Annual Report 2000 from the International Energy Agency DSM Implementing Agreement.

International Energy Agency DSM Agreement Task X 'Performance Contracting' homepage: http://iea.dsm.org/research/project10/project10.htm

International Energy Agency DSM Agreement Task X 'Performance Contracting' (2001): Country Reports. Drafts from Finland, France, Japan, Norway, Sweden and United States.

Kogan Lockhart, N & Singer T.E. (2000): "Accelerating International Energy Efficiency Project Development: Identifying Practical Approaches and Replicable Models". NAESCO, Washington D.C.

Kogan Lockhart, N (2001): "Financing ESCO Projects in the United States", copies of transparencies from presentation at the ESCO Seminar in Helsinki, Finland, 18 June 2001.

WEEA, World Energy Efficiency Association (1999): "Briefing Paper on Energy Services Companies with Directory of Active Companies" (Revised Edition).

Westling, H. (1996): "Co-operative Procurement. Market Acceptance for Innovative Energy-Efficient Technologies". B1996:3. NUTEK/IEA. Stockholm.

Westling, H. (2000): "IEA DSM Annex III Co-operative Procurement of Innovative Technologies for Demand-Side Management - Final Management Report". Swedish National Energy Administration, EI 6:2000. Stockholm.

Westling, H (2001): "Agreed Performance Criteria Facilitates More Efficient Housing Solutions". Paper for the CIB World Building Congress, Wellington, New Zealand, April 2001.

Westling, H (2001): Task X 'Performance Contracting' Task Status Report, September 2001.

Public-Private Partnership Projects in the UK
Treatment of Associated Risks by Local Authorities

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Abstract

The cyclical pattern of the overall expansion of local government services -and particular services in the post-war years has created and inheritance of a social infrastructure requiring substantial investment in modernisation and replacement works. Public-private partnerships of the type spearheaded in the UK by the Private Finance Initiative (PFI) have offered a solution to the problem of securing the necessary investment at a time of severe public expenditure restraint. In the UK, central government has offered positive encouragement to local authorities for the development of this alternative procurement. For PFI, a major challenge is to achieve a distribution of risk acceptable to all parties, including the public sector client, private suppliers and contractors together with their financing institutions. The current study shows that most respondents are conversant with the principle of risk management advanced in government policy i.e. that risk should be allocated to the party that is best able to manage it. All respondents agree that the DBFO risks should be completely transferred to the private sector. The risk factors that authorities prefer to share with the private sector are those related to demand and regulation/legislation.

Keywords: public-private partnership, risk allocation, public sector, DBFO,

Introduction

Public-private partnerships (PPP) in construction facilities development can involve the private bodies in the design,

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financing, construction, ownership and operation of a public sector utility or service. Partnership between the public and private sector is now a widely known and acceptable alternative to the traditional fully state provided public facilities. Arguably, it allows the public sector client and the private sector supplier to achieve an outcome which neither party could alone achieve, thanks to a blend of special skills and experience which are incorporated in the joint approach. Within the UK this takes the form of the Private Finance Initiative (PFI).

Interest in the PFI, while to date, has mainly been associated with projects promoted by UK central government Departments, It is increasingly targeted upon UK local authority (LA) services, spurred by changes to regulations governing LA capital expenditure and borrowing, the launching of the Public Private Partnership (PPP), and the reaffirmation by Government of tight controls upon levels of publicly funded capital expenditure. Local authorities offer a variety of calls upon such capital resources; typically: social service premises, schools, energy initiatives etc. In the case of school projects, a number of LA schools are due for development and refurbishment. In other reaches of local authority provision, domestic energy systems, combined heat and power or waste-to-energy projects are being actively pursued using the PFI.

The two fundamental requirements for a PFI scheme are that the public must secure value for money (VFM) and the private sector must genuinely assume responsibility for the risks associated with the scheme. In essence, the public sector, including local government, must be seen to have achieved an optimum allocation of the risks associated with a PFI scheme.

This paper reviews PPP and documents the UK experience of public-private partnership, the adoption of the Private Finance Initiative by the local authorities and the experience of the local authorities in dealing with the risk allocation associated with the initiative, based on a questionnaire survey involving fifty-five PFI schemes.

Public Private Partnership

From tentative beginnings of rhetoric rather than action, the private-public partnership has established itself worldwide as a significant means of delivering public infrastructure development. The World Bank records the number of new private investments of this nature in Asia during the period from 1984 to 1995 amounted to some 160 projects, representing 28% of a worldwide 574. In addition, out of the ten largest private investment projects world-wide initiated during this period, seven were of Asian origin (Tong-Kyu, 1998). Haarmeyer and Mody (1998) conclude from their study of such initiatives, that the shift to private participation for infrastructure provision can create substantial benefit. However, they reckon that effective private involvement required governments to provide a new facilitating and regulatory role in order to create a credible and low-risk contracting and operating environment for its private partners.

Initiatives designed to involve the private sector in public service delivery can take four forms: (i) outright privatisation of previously state-owned utilities; (ii) contracting-out of services such as refuse collection or cleaning to private firms; (iv) the use of private finance in the provision of social infrastructure; and (iv) public-private arrangements involve a variety of techniques and activities to promote more involvement of the private sector in providing traditional government or public services (EPA, 1999)

The benefits of public-private partnerships have been listed by the Environmental Protection Agency (EPA 1998), itself a derivative of local authority service provision. The Agency attributes this to the specialist skills available in the private sector which a private supplier can offer; the general improvement in efficiency of resources use, techniques for achieving a quality service for the public and a variety of financial savings and a general ability to adapt and respond to change which is less evident in the public sector. The EPA also confirms a gain from private sector procurement methods and shorter implementation times but does however, echo the traditional concern of the client in any 'out-sourcing' i.e. the feared actual or potential loss of control over key variables influencing control over the quantity and quality of service delivery.

Celeste (1996) concludes that public-private partnerships invent new relationships, stimulate growth, have a positive effect on job creation and provide an effective response to global competition; partnerships provide relationships which are challenging and productive for both parties.

The World Bank reports that in a number of projects it has studied, the involvement of private enterprise in public service provision has been associated with "substantial benefits to consumers in terms of expanded coverage and quality of service as well as significant improvements in productive efficiency" (Rivera, 1996). At the strategic level, a public-private partnership allows a government to implement change without losing sight of the true business of government i.e. to develop social policy, maintain and communicate a vision for the future and manage the delivery of service. In effect, local authority activity concentrates upon administering a strategic, facilitating and monitoring role, rather than direct service provision. For the private sector, it represents an opportunity to offer new products and skills to new markets and to develop strong, long-term relationships with clients in the public sector.

Public-Private Partnerships – The UK Experience

The whole concept of Public Private Partnership is a government policy to tackle financial problems in facility provision, and an integrated private management skill to increase efficiency, effectiveness and quality (HM, 2000). The level of private sector involvement might range from a purely service provision, without recourse to public facilities, through service provision based on public facilities usage, up to "public facilities" ownership.

The UK government has identified eight types of PPPs as follows:

- Asset Sales which relates to the sales of surplus public sector assets.
- Wider Market which deals with introducing the skills and finance of the private sector to help with better use of the asset in the public sector.
- Sales of Business, which deals with the sales of shares in state owned business by flotation or trade sale.
- Partnership Companies, which is about introducing private sector ownership into state owned business, while still preserving public interest through legislation, regulations, etc.
- Private Finance Initiative
- Joint Ventures in which public and private sector partners pool their assets together under joint management.
- Partnership Investments in which the public sector contributes to the funding of investment by private sector parties, to ensure that the public sector shares in the return generated.
- Policy Partnerships in which the private sector individuals, or parties, are involved in the development, or implementation, of public sector policy.

Contractual arrangements between the parties, and the nature and scale of service provision, provide the means of classifying partnerships. In PPP, the degree of direct interest and involvement of the private sector in the public sector projects provide a useful dimension. In a Korean study (Tong-Kyu, 1998) this approach is used to distinguish between two types of private infrastructure provision; termed: primary and secondary. Primary-facilities are those projects which were judged to be more sensitive to public interest, required more investment than secondary facilities and were developed based on a build-transfer-operate mechanism (BTO). The ownership of the facilities reverts to the centre or local government upon their completion, but for a predetermined franchise period, the franchiser is granted the right to operate the facilities and assign user fees to the beneficiaries. The primary facilities include such infrastructure facilities as road, railway, harbour, airport, sewage and telecommunications.

Secondary facility projects were developed through a build-own-operate mechanism and examples of these are power plants, distribution complexes, bus terminals and parking lots. With the secondary facility projects the franchisers have permanent ownership of the completed facilities and are allowed to make a reasonable profit.
Specifically in relation to the UK Private Finance Initiative projects, Hall (1998) identifies three types of public-private partnership projects namely:

- financially free-standing projects in which the capital outlay can be recouped through user charges;
- joint ventures in which the public sector provides the PFI contractor with a subsidy to reflect the social benefits of a project not reflected in cash flow, such as the Docklands Light Railway extension to Lewisham, the Manchester Metrolink and the Channel Tunnel Rail Link; and
- services sold to the public sector such as those provided by Bridgend Prison, DBFO road schemes and new

rolling stock for London Underground's Northern Line.

The UK's Private Finance Initiative (PFI) began with the declared objective of finding ways of mobilising the private sector to meet the needs which are traditionally been met by the public sector. The initiative was first announced in under the Conservative Government in 1992. The Labour Government has continued with this initiative by putting PFI into the framework of its "public-private partnerships"(PPP).

The most popular type of PFI contract in the UK is Design, Build, Finance and Operate (DBFO) or Design Construct, Manage and Finance (DCMF). Currently, most PFI schemes are operating under a DBFO contract arrangement in which the public sector makes monthly, quarterly or annual payments for the use of privately owned facilities over the lifetime of the concession. Although PFI is currently being used for a variety of public sector projects, Mountain (1998) has presented an argument that the only projects clearly open to the PFI/PPP treatments are infrastructure projects such as roads and highways, water transport, metropolitan transport systems etc.

As part of the Labour Government efforts to re-invigorate PFI, the Bates Commission was established to review the initiative. The Commission published 29 recommendations (see Cunliffe, 1997) which according to Sandison (1998) focussed mainly on: *"enhancing the professionalism of existing department procurement units through training; sharing of best practice across the public sector and drawing on private sector experience through inward secondment; standardising the terminology, procedures and contract documentation used by different departments; making better use of external advisers by introducing an accreditation scheme and requiring them to contribute their written work to a dedicated procurement library for use as precedents in subsequent projects."*

The UK government has identified four inter-related principles at the heart of the PFI:

- Risks should be allocated, between the public and private sector parties, to that party best able to manage them to ensure optimum value for money (genuine risk transfer).
- Contracts should specify the service output required by the public sector client from the private sector (output specification).
- PFI contracts should normally require the contractor to take responsibility and assume risk for the performance of the asset over the long-term, at least for a significant part of its useful life, so that efficiencies arising from long-term asset management can be realised (whole life asset performance); and
- Payments to the contractor under a PFI contract are characterised as a regular "unitary" fee for services which must be subject to performance appraisal in relation to specific and quantified criteria in the contract (performance-related reward).

Hall (1998) listed three fundamental criteria for a project which should be apply in the evaluation of the PFI as a means of providing public services namely: that the project should realise additional investment in social infrastructure; provide good value for money (VFM) for taxpayers, and not limit the pursuit of the public sector's ability to pursue its public service objectives, now or in future. Hall's assessment indicates that, to date, PFI has been used as a substitute for rather than a complement to publicly financed investment. Assessments of value for money suggests that the out-turns have been variable but some PFI contracts have delivered good value and the effect of the PFI on the public sector's flexibility to pursue its social objectives have yet to be established. Hall concluded: "the gain realised through the PFI may increase as public sector managers gain experience in how risks and responsibilities can be optimally shared between the public and private sectors in a cost-effective manner."

Local Authorities Involvement In PFI

PFI was originally conceived as a means of attracting private capital into capital-intensive areas of public service provision, particularly transport. Today, it has extended its reach to include health, prisons, defence, education etc. (Gray, 1997). In successive phases of development the instrument has been underpinned by administrative and other arrangements which leave local authorities equipped to meet a significant volume of their needs using the new approach to service provision. Sanders (1998) provides a substantial list of statutory responsibilities for which PFI can now be regarded as a potentially attractive local authority procurement route, particularly in relation to residential and nursing care for the elderly, and school projects.

The Department of the Environment Transport and the Region's (DETR, 1998) publication titled: 'Local Government and the Private Finance Initiative' identifies the benefits of PFI and other public private partnerships for local government as being to :

- promote private investment in the capital assets required to deliver public services efficiently by bringing in private sector finance and operational management on a risk-taking basis;
- improve value for money by allocating risks to those best able to manage them in the public or private sectors;
- encourage the upgrading and rationalisation of local authority property, including that needed for service delivery and office accommodation.;
- allow the transfer to the private sector of trading assets, which would benefit from better utilisation, and of surplus operational land and buildings;
- facilitate joint ventures to give authorities new scope to participate in companies led by the private sector - and to score only the council's contribution to such joint

ventures as public expenditure, not the activities of the company as a whole; and
- remove unnecessary obstacles to partnerships in the areas of economic development and regeneration.

The latest changes in the rules governing capital expenditure in projects involving the private sector and associated revenue support mechanisms are designed to encourage local authorities to make maximum use of the opportunities outlined by the DETR. The Local Government (Contracts) Act 1997), in order to assure the private sector that a Local authority can enter into a PFI deal acting within its powers, has clarified the powers of local authorities to enter into contracts; introduced certification procedures (enables LA to certify the major long-term contracts that have caused concern); and introduced the concept of relevant discharge terms, which ensures that the contractor would be compensated if the contract were set aside. Also the general framework and the associated regime relating to revenue expenditure have been amended to facilitate development of PFI projects by the local authorities in England and Wales (Local Authorities (Capital Finance) (Amendment) Regulations 1998 [SI 371]). According to the DETR (1998) *"Within this framework the general aim is to give authorities discretion to make their own choices on expenditure priorities. The PFI in local government works within this framework but a series of regulatory changes has introduced various relaxations, giving authorities a wider choice of procurement method and new ways to achieve value for money and to deliver higher quality services to the public."*

Risk And Privately Financed Infrastructure

The risk associated with private provision of public sector infrastructure differs according to the nature of the service for which the facility is provided. In the report of The Private Finance Panel (1995), entitled: 'Private Opportunity, Public Benefit', six generic risks relevant to PFI: design and construction (to cost and time); commission and operating (including maintenance); demand for volume/usage, residual value, technology/ obsolescence; and regulation and legislation were identified. These risks were further commented upon in the Panel's publication (1996), 'Risk and Reward in PFI Contracts'.

The risks of private sector toll road operating within a public sector road network, are identified by Arndt (1998); these he categorised as:

- Design and Construction Risks – design suitability; obtaining necessary permit and approvals; the time and cost of construction compared with the budget, site characteristics, including environmental, archaeological, and heritage issues; and project completion and commissioning.
- Operating Risks: production risks, including adequate tolling system operation, ability to penalise non-paying motorists, input costs, rates and charges. Other risks include those associated with maintenance, service standards, meeting environmental standards, and maintaining required insurance.
- Market Risk – traffic volume, growth of transport substitutes, availability of other revenue sources such as advertising, and the setting of toll levels subject to agreed caps.
- Sponsor Risk – availability and structuring of finance, commercial risks such as required rate of return, tendering cost, and project viability, consortium risks including adequacy of documentation and make-up of the project vehicle, and condition of transfer. Other sponsor risks include: credit worthiness and suitability of the project vehicle and its individual parties.
- Sovereign or Legislation Risks – changes in legislation and government policies affecting the project. It may be essential for this risk of general changes in the law or small regulatory changes to be borne by the private

sector with the contract containing provision for re-negotiation and possible price adjustment in the event of changes with a major impact.

- Network risk including access to the existing government road network and the feasibility of connecting to the existing infrastructure. This also includes the risk of the use of alternative routes available by toll-averse drivers.
- Technology Risk – this includes the use of new technology in the operation of a road that had never been used on a real life project. An example is the use of a fully automated tolling system in case of the Melbourne City Link (MCL) BOOT project in Australia. Technological risk, associated with the obsolescence of both the services and the function of the assets themselves is most relevant to IT-based projects; it is recommended that this risk should be dealt with explicitly in the contractual agreement.
- External Risks – these include *force majeure* events, interest rates, exchange rates, and inflation.

In addition to the foregoing, other risks associated with the private provision of public sector infrastructure include: demand risk and residual value risk. Demand risk is the willingness of the private sector to take on the risks associated with demand, and will depend on its ability to control and manage this risk. In cases where the public sector itself is not the only user of the services provided, consideration must be given to the possibility of transferring demand risk. Residual value risk has two main determinants: (i) the condition of the asset at the end of the contract and (ii) demand for it. The specialist nature of some assets and lack of alternative uses may limit the scope for transfer of this class of risk. Since these affect the value of asset, the transfer of residual value risk for each PFI scheme must be given case consideration.

Chapman and Ward (1994) have identified three types of clients' behaviour when making an independent choice between alternative ways to achieve completion of a project. Firstly, clients are prepared to take risk, but they are not prepared to take an additional amount of risk without a decrease in expected cost. Secondly, they will always seek the lowest expected cost for any given level or risk, or the lowest level of risk for any given expected cost. Thirdly, they will seek an optimal trade-off between risk and expected cost. Chapman and Ward argue that reciprocal assumptions apply to contractors in terms of their profit. However, they are of the view that both client and contractor should be prepared to negotiate a level of risk sharing which puts both parties in an improved risk/return trade-off position. Obviously, the risk associated with PFI should be efficiently and optimally allocated. Initially, the Government sought for an opportunity to transfer, through the Private Finance Initiative, most of the risks associated with the public sector servicé and asset provision to the private sector. The position has changed and it is now recognised that risk should be allocated to the party that is best able to manage it.

Local Authorities PFI Schemes Risk Allocation

The objective, that a high proportion of risk should be allocated to the private sector, lies at the heart of the PFI /PPP exercise. It is of particular importance in relation to the argument advanced by the Accounting Standards Board that the capital costs of all PFI projects should appear in official records as part of the PSBR. The Treasury response argues (from a standpoint keen to limit PSBR) that because PFI is a scheme which enables the public sector to buy services rather than an asset, capital costs should not rank against the PSBR. Given the possibility that the settlement of this debate is likely to hinge upon the degree of risk transfer, the pressure to maximise such transfer remains considerable.

In the present studies, current involvement of the UK local authorities in PFI and the associated task of risk assessment and management were investigated through a mailed questionnaire survey. Overall, the mailed questionnaire achieved 55 positive responses from the project managers involved with PFI projects, a response rate representing 30% of the entire UK local authorities involved in one or more PFI projects. This paper refer only to the risk allocation element of the investigation.

The local authorities were asked to indicate the criteria used to allocate risks associated with their PFI projects (whether to retain, transfer or share). Forty-five respondents (82%) completed this part of the questionnaire. Table 1 indicates the criteria and the number of times these were mentioned.

Table 1 Criteria used by local authorities for PFI risk allocation.

Criteria for risk allocation	No of Respondents (n=45)	%
Assessment of the party best able to mange risk	20	44.4
Guideline from government, govt department and Treasury Taskforce	10	22.2
Value for money (including cost/benefit)	8	17.7
Bargaining power/negotiation (incl. Commercial reality and bankability)	6	13.3
Based on advise of external advisers	6	13.3
Management judgement and previous experience	3	6.6
Current/common practice and reasoned assessment	3	6.6
Affordability	2	4.4
Project and risk off balance sheet	2	4.4
Sufficient risk transfer to private sector	2	4.4

The criteria are intrinsically linked; the need to assess and allocate risk to the party best able to manage it, apart from being a good risk allocation practice, is one of the guidelines or principles of PFI produced by the UK government to ensure that the best value for money is achieved. It is explicitly referred to in the explanatory note on PFI and Public/Private Partnerships in local government, "Local Government and the Private Finance Initiative". As part of the government guidelines for risk allocation of PFI within the local authorities, Regulation 40 of the Local Authorities (Capital Finance) Regulations 1997, Contract Structure Test, specifies that a minimum of 20% of the payments due to a local government PFI contract are must be tied to performance related criteria.

A further criterion mentioned is bargaining power and negotiation, subject to the commercial reality (what the market can accept). Current or common practices operating within the PFI sector (e.g. schools PFI projects) may be considered by the local authorities in arriving at the decision on risk allocation. Some local authorities depend on external advisers to assist with the risk allocation but such advisers should abide by government guidelines in formulating risk allocation decisions.

Local Authorities Treatment Of PFI Risk Allocation

The government publication (Private Finance Panel, 1996) identifies seven principal PFI types of risk arising from designing, building, financing and operating an asset, which should be genuinely considered, and transferred where necessary, between the public and private sector to the party best able to manage the risk and ensure best value for money. In addition, the DETR's publication (DETR, 1998): 'Local Government and the Private Finance Initiative' outlines indicators of risk, based on Treasury guidelines, which show whether or not the operator is bearing real commercial risks, namely: demand risk, availability and performance risk; pricing risk, residual value risk, operating cost risk and design risk.

Based on the seven principal risk factors for PFI, the respondents in this study were asked to indicate how risks are allocated; with the options of any risk being retained by the public sector, transferred to private sector, shared between public and private sectors or where unknown to indicate 'unknown at present'. Table 2 shows how the authorities treat the seven risk factors. Forty-three of the 55 respondents (78%) completed this part of the questionnaire. Six respondents did not indicate how demand risk should be treated and of these, four believed that this is applicable to their projects (projects concerned were a school, magistrate court, transport and IT scheme). Two respondents involved with transport and school schemes indicated that technology/obsolescence risk is not applicable to their schemes.

The Table shows that the seven principal risk factors could be grouped into three classes: (i) risk factors that the local authorities should transfer completely to private sector; (ii) risk factors to be shared between the local authority and the private sector, (iii) risk factors where respondents are divided on their treatment.

The principal risk factors that the local authorities respondents reckoned should be completely transferred to private sector and in which they were unanimous are design and construction (95.2%); commissioning and operating (95.3%); financing (83.7%); and technology/obsolescence (66%) risks. Only 11.6% and 32% of the respondents indicated that financing and technology/obsolescence risk factors, respectively, should be shared between the local authority and the private sector. With the exception of commissioning and operating risk factor, in which one respondent indicated that this should be retained by the local authority, none of the respondents indicated that local authorities should retain the risk factors falling into this group.

Regulation risks fall under the second group of risk factors to be shared between the local authority and the private sector. The majority of the respondents (64.3%) agree that these should be shared with 24% indicating that this should be transferred to private sector and 10% that this should be retained by the local authority.

Residual value and demand risks fall under the third group i.e. those for which the respondents are divided on the treatment of the principal risk factors. Thirty percent of the respondents indicated that demand risk should be retained by the authority, 35% favoured risk sharing and 35% believed it should be transferred to the private sector. In case of residual value, 25% of respondents favoured it being be retained, 17.7% favoured sharing and 40% favoured transfer to the private sector; 17.5% are, at present, not sure how to treat the risk.

Table 2: Treatment of Risk

Principal PFI Risks		**Risk Allocation**							
		Retained by LA		Shared		Transferred to private sector		Unknown at Present	
	Nr	Nr	%	Nr	%	Nr	%	Nr	%
Design & Construction	42	-	-	2	4.8	40	95.2	-	-
Commissioning & Operating	43	1	2.3	1	2.3	41	95.3	-	-
Demand	37	11	29.7	13	35	13	35	-	-
Residual Value	40	10	25	7	17.5	40	29.0	7	17.5
Technology/ Obsolescence	41	-	-	13	31.7	27	66.0	1	2.4
Regulation	42	4	9.5	27	64.3	10	23.8	1	2.4
Financing	43	-	-	5	11.6	36	83.7	2	4.7

Further analysis was carried on these two principal risk factors to discover if differential treatment of demand and residual value risks is applied according to project type; no evidence of this practice could be found.

Conclusions

The public-private partnership principle embodied in PFI is now established worldwide as a significant means of developing public sector infrastructure. Such initiatives, designed to involve the private sector in public service delivery, can take the form of: (a) outright privatisation of previously state-owned utilities; (b) the contracting-out of services such as refuse collection or cleaning to private firms; (c) the use of private finance in the provision of social infrastructure; and (d) a number of other public-private arrangements which promote greater involvement of private enterprise in public service delivery. It is commonly emphasised that the benefits of any such arrangements should accrue to both sectors, public and private. From such initiatives can flow an overall improvement in the efficiency of resource use, techniques for achieving greater quality in service provision, a variety of financial savings and a general ability to adapt and respond to change which has been hereto lacking in public sector provision.

The Private Finance Initiative has now achieved a central position in the delivery of UK public sector services following upon its initial official adoption by central government in 1992. The pressure of local government spending limits has encouraged local authorities to explore the use of the initiative in meeting demands for new and replacement premises and services. In addition the drive to adopt private sector business methods and management to define and pursue organisational goals has led to a developing interest in the full range of resources and initiative which the private sector might contribute to modern public service provision.

For the particular case of public-private partnerships involving local authorities, a set of key risk factors which should be considered for transfer to the appropriate party are design and construction risk; commissioning and operating risk; demand (or volume/usage) risk; residual value risk; technology and obsolescence risk; regulation risk; and project financing risk. Most UK local authorities are conversant with the principle of risk management advanced in government policy i.e. that risk should be allocated to the party that is best able to manage it. All respondents agree that the design, build, finance and operating risks (DBFO) should be completely transferred to the private sector. The risk factors that authorities prefer to share with the private sector are those related to demand and regulation/legislation.

References

Arndt R H (1998) Risk allocation in the Melbourne City Link project. *Journal of Project Finance*, Vol. 4, No. 3, pp. 11-24

Celeste R F (1996) Strategic alliances for innovation: Emerging models of technology-based twenty-first century economic development. *Economic Development Review*, Vol. 14, No.1, pp. 4-12.

Cunliffe P (1997) The Bates Review. *Private Finance Initiative Journal*, Vol. 2, Issue 3, pp. 24-27.

Chapman C B and Ward S C (1994) The efficient allocation of risk in contracts. *Omega, International Journal of Management Science,* Vol.22, No. 6, pp 537-552.

DETR (1998) *Local Government and the Private Finance Initiative*. An explanatory note on PFI and Public/Private Partnerships in Local Government. HMSO

EPA (1998) *Public-private partnership.* http://www.epa.govt/docs/AltFinanceRep

Gray, A (1997) Editorial: Private Finance Initiative. *Public Money & Management*, Vol. 17, No.3, pp. 3-4.

Haarmeyer D and Mody A (1998) Tapping the private sector: Approaches to managing risk in water and sanitation. *Journal of Project Finance*, Vol. 4, No. 2, pp. 7-23.

Hall, J. (1998) Private opportunity, public benefit. *Fiscal Studies*, Vol. 19, No. 2 pp. 121-140.

HM, Treasury (2000). *Public Private Partnerships – The Government's Approach*, the Stationery Office, London. http://www.hm-treasury.gov.uk/docs/2000/ppp.html.

Mountain P (1998) Building for the Future. *Private Finance Initiative Journal*, Vol. 3, Issue 4, September, pp. 30-34.

Private Finance Panel (1995) *Private opportunity and public benefit*. HMSO, London. November

Private Finance Panel (1996) *Risk and Reward in PFI Contracts*. HMSO, London. May.

Rivera, D (1996) *Private sector participation in water supply and wastewater sector*. Directions in Development Series, Washington D.C., World Bank, pp. 71.

Sander S (1998) Risk-taking without tears. *Public Finance*, November 20-26, pp. 24-28.

Sandison, H. (1998) Why better government must include better government procedure. *Private Finance Initiative Journal*, Vol. 3, Issue 3, July/August, pp. 46-48.

Tong-Kyu P (1998) Private infrastructure development in Asia. *Journal of Project Finance*, Vol. 4, No. 3, pp. 25-33.

Strategic Risks and their Communication in Project Management

Conceptual Framework

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Abstract

Strategic risks need to be communicated to the project participants for their appropriate management. This paper develops a conceptual framework of risk communication process between project participants for the successful execution of a project. The framework is based on the research conducted in Sydney with a sample of contractor, client and consultant representatives on construction projects at the Sydney Olympics site. The risk communication framework will help in the project design, project tender, contractor selection and the management of the project process. Open communication of the strategic risks will lead to reduced uncertainty and improved relationships between the client and the project team. This approach will lead to better coordinated documentation for the project and a successful project.

Keywords: strategic risks, communication, conceptual framework, project management

Introduction

Building construction process is one of the most complex activities undertaken in the commercial sector. The majority of projects are prototypes with their own unique requirements and problems (Sawczuk, 1996). The construction process brings together a large number of organisations including manufacturers, suppliers, sub-contractors, contractors,

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consultants etc., each with their different contractual arrangements, objectives and responsibilities.

Risk communication in the building industry is very limited. As part of a research project undertaken by the author at Faculty of Design, Architecture and Building, University of Technology Sydney, it was found that it was unlikely for contractors to discuss risk allocation with clients or potential clients (Bajaj et. al., 1997), as a result risk related issues are rarely communicated in the construction industry. This leads to a situation where the contractors pass on risks (assuming that they know themselves) to sub-contractors at every given opportunity. The same goes for clients who pass on as much risk as possible to contractors. This is the most popular method of addressing risk allocation in the construction industry. The research also concluded that all the respondents (100%) agreed that the accuracy of their estimates for projects would improve if a systematic risk identification procedure were followed. Research has found that Profits are the driving objectives of all project participants, for clients it is the return on investment, for contractors it is the profit from the project, and similarly for consultants and sub-contractors. So one of the objectives of all the participants is common. The other most important objective is the sustainability and growth in business interests, which drives various participants, with sustainability from the short-term point of view and growth from the long-term point of view.

The principal medium for transferring and allocating risks is the building contract. The opportunity to manage risk through contract strategy decisions should not be undervalued (Hayes et al., 1986). Several studies in various countries examining choice of procurement method and formulation of contract documents have concluded:

- Contracts should allow the explicit allocation of specific identified risks between parties.
- Contracts should include incentives for risk control and

sound management practice.

- Risks should only be allocated to the parties who are best able to control them and/or sustain their effects (Lewis et al., 1992).

Strategic Risks

There are various approaches to risk. Risk has a variety of well-defined meanings in ordinary discourse, and individuals may be able to use the terms in a meaningful fashion. According to Collins and Ruefli (1996), while some formal conceptualisations of risk in the literature contain many of the properties of common usage, they fall short of providing a firm-level measure of risk appropriate to a strategic context.

Strategic risk could be from the point of view of the decision theoretic usage of risk, behavioural science usage of risk, finance usage of risk, or insurance industry usage of risk. From the project management point of view and that too in the construction industry, nearly all the four usages of risk would be utilised.

Collins and Ruefli (1996, p. 56) *define strategic risk for an individual firm as the probability of a firm moving from its present category to a lower ranked category and also the magnitude of that move.* Strategic risks on projects are ones that have the potential of impacting on the project success.

Strategic risk can be also defined as a risk that is generated and / or can be managed from strategic management and the decision-making involved in strategy for a construction firm. In project management in the construction industry the strategic risks range from market share, specialisation, marketing strategy, diversification in the industry, portfolio of projects maintained would be some of the strategic risks from a construction firm's point of view. These being apart from internal corporate decisions which impact on the projects and the firm.

Further to construction firm's strategic risks there are project related risks that would fall under the category of being strategic in nature. Project risks depending on different stages of the project could be classified as strategic. If the construction firm assesses project portfolio related risk and decides not to proceed with a particular project within an industry type then it would be a strategic risk of the company that they have responded to by that decision, yet it is still a project related strategic risk. Research findings of Raftery (1994) and Uher & Toakley (1997) demonstrate that maximum benefits can be derived from risk management if the process is applied continuously throughout the project—from conception to completion. There are three steps in risk assessment:

1. identifying and predicting
2. assessing and consolidating into a manageable form
3. managing and diffusing.

From this research point of view, the author wishes to maintain a different position on strategic risk. This paper will discuss strategic risks for a project from a construction firm's point of view and its communication to the client at the early stages of the project under consideration. This is the theme of project management in general as well.

Project scope, documentation of project for tender, experience of client in construction projects, financial funding of the client and project could be some of the potential strategic risks for the contractor or any other significant project participant. The appropriate communication of information could reduce the risks at the execution stage. This is where one has to distinguish between the project risks and strategic risks on the project. Project risks that will occur during the execution stage cannot be all eliminated at the early stages of the project. However, if proper channels of communication are set-up and the handling of strategic risks discussed and agreed upon at the initial stages of the project, then the project risks would be easy to deal since the cooperation amongst the participants would be expected to be better than in the traditional approach.

Results of Sydney Olympics Project Survey

In order to establish the best way to obtain the information we needed from construction professionals, interviews were conducted with both the contractors and client representatives on major Sydney Olympics projects. This seemed to be the most effective way of understanding about the strategic risks and the communication process. The interviewees all agreed that relations between the contractor and client did affect claims, which are linked to risks on projects that might have materialised, though it is difficult to quantify the effect.

The sample size for the study included 6 client representatives and 21 contractor representatives. The contractor and client representatives were selected at random with a phone call to the contractor's site office to get an agreement to the interview and to make an appointment. A summary of the important points of the interviews with client and contractor representatives is as follows.

Client Representatives:

The important statements that the 6 client representatives made are as follows:

1. Contractors go for anything, and they are more likely to be successful if they have a good relationship with the client.
2. A good relationship means they will have a better idea of what would be successful methodology, presentation and technique.
3. As far as the client goes the relationship makes no difference - they pay claims according to merit and entitlement.

4. Entitlement is the decisive factor in paying claims.
5. As far as contractors go the decisive factor is also entitlement - but their financial situation has an impact as well.
6. The most important factors in building a good relationship are respect and providing a professional, high quality job.
7. The variations that are most likely to be affected by a good relationship are the ones that are difficult to quantify - such as costs due to delay and disruption.

Contractor Representatives:

The important statements of the 21 contractor representatives are as follows:

1. Contractors agreed that personal relations between the contractor and client do make a difference.
2. If formal partnering is in place and it's working well then trade-offs and deals will often be made rather than going through the claim process. As far as the contractor goes - that's the ideal situation.
3. If there are sour relations and no flexibility then whenever there are grounds for a variation we'll put it in and keep the price up.
4. Contractors agreed that entitlement is the decisive factor for putting forward a variation claim.
5. Good relations have more of a positive affect than bad relations have a negative affect.
6. Most conflict arises over the interpretation of contractual obligations on design and construct projects. This conflict goes hand in hand with the claims we make.
7. A good relationship would cause us to not pursue claims too strongly. We would take a softer line on doubtful claims.
8. It really depends on the client - some clients have the room to be flexible on trade-offs and deals. They have to be private clients though the government can't do

that.

9. And generally private clients quibble over every dollar as they, in the long run, need to make profit as much as we do. Building a good relationship does come down to individuals. You need trust, credibility and respect. It's also important to be timely in coming forward with problems. You could be as nice as pie with the client but if you don't tell him when things are going wrong he's not going to think much of you.
10. Factors that make for a poor relationship are lack of communication of problems, telling lies, bad mouthing, speaking out of turn, being treated like idiots and lack of respect.
11. Past experience is not that important with clients but as far as subcontractors go it is extremely important.
12. The best way to develop a good working relationship is to have a professional approach without being too aggressive.
13. To encourage teamwork, you need a clear definition of roles and regular communication.
14. Everyone needs to work at their own level and not have to deal with barriers to get the information they need.
15. Partnering makes relations better but there is more to be gained from the client's point of view.
16. Many contractors feel that partnering aids in setting up this environment. The aim of partnering is to remove the combative nature of the tendering situation.
17. The main problems encountered in partnering are that the parties have not been committed to it. The contractors are, therefore, quite cynical about the whole process and tend to feel about partnering that it changes nothing i.e. it just makes people smile a bit more in the early days of a project.

Communication Processes

The contractors were asked about the processes in place for communication between the contractor and the client. Following are the questions that relate to the communication processes.

As communication is obviously important to a good relationship, the contractors were asked *what they do to aid good communication*. On the question *'Do you have formal processes in place to aid communication and feedback between you and the client?'* there are 76% respondents who have resorted to formal processes to improve communication and feedback between the client and themselves but 24% of them do not have any such process. A variety of processes have been suggested to evolve better communication.

- Types of Processes:
- Weekly/monthly regular meetings,
- Issue regulation process,
- Letters,
- Reports.

The question *'Do you believe having such processes in place would affect variation claims?'* was included in questionnaire to see how conscious they are of the need for formal procedures to support good communication. The summary of responses in this context indicates that 41% were conscious to adopt formal processes in order to ensure better communication. It is evident that 50% were not conscious of this need whereas 9% preferred to be non-committal. Surprisingly, given how much emphasis has been placed on the need for good communication contractors are split on the affect of the formal communication processes.

In general contractors seem to be quite cynical about company imposed communication and paperwork - they trust more what they personally say to someone. This implies trust as well as communication is very important.

Teamwork Processes

Teamwork is essential to the success of a contractor on a project and also as a business in the construction industry. The following questions were asked to get a sense of the importance placed on building good communication and teamwork by construction companies. The importance of measures or steps taken by the contractor has significance, as there is the client above the contractor with whom the good teamwork is required. Below the contractor is the sub-contractor(s) with which the contractor needs to have good teamwork for the goals of the project to be worked together. For the steps to be implemented the contractor organisations internally needs to have good teamwork between the staff involved.

On the question *'Is team-work a formal aspect of your management technique or something you just hope happens?'* there are 83% respondents who agree that the teamwork is a formal aspect management technique while 17% of them do not concur with this.

The contractors were made to respond how they establish or encourage teamwork was made to respond to see if again they tried to focus on the features they believe build a good relationship and to find out how much importance they place on establishing teamwork on their projects. Table 1 below summarises the responses.

Table 1: Factors to establish / encourage teamwork within the contractor organisation

Factors:
Communication
Team work (motivating everyone to involve and discuss)
Regular meeting and information sharing — showing appreciation and reward
Thus in one word — "good worker relations"

The following two questions were put to see how contractors

are similar in their approach to building good work relations.

Table 2: Factors to establish / encourage teamwork with the client

Factors:
Socialisation
Communication
Discussion of policies and attitudes
Keep them informed

The company responses on method of establishing or encouraging teamwork with the sub-contractor are summarised in the table 3 below.

Table 3: Methods used to establish or encourage teamwork with the sub-contractor

Factors:
Clear definition of roles
Regular communication
Paying in time
Respect their professionalism
Extra pay

The factors listed as contributing to good teamwork are very similar to those that create a good relationship between the client and contractor. It seems that all come down to communication, trust and being professional. When these factors are in place the path is free for people to get on, for the flow of information to be unimpeded and for variations to be dealt with appropriately.

Summary

Based on the analysis and presentation of the comments made by both the clients and contractors in the interviews, there is still a gap between the client and contractor view of the relationship. There is an element of mistrust between the parties, which is reflected from the comments made by representatives of both parties. Clients seem to think that contractors go for everything possible to claim on the project. Contractors are quite cynical about the partnering exercise and think it just makes people smile a bit more in the early stages of the project. Also, from the partnering process, client seems to gain more than anyone else. A major objective of partnering is to discuss the risks and more importantly the strategic ones that can influence the outcome of the project later. Discussion and resolution of strategic risks should be one of the major objectives of partnering workshop.

Furthermore, both client and contractor representatives agree that good relationship helps in resolving issues and partnering is a good way of achieving a good understanding of the perspectives. Both agree that teamwork is good to achieve the client objectives and also in communicating between the participants, they both have the intent and it all works well as long as there is no problem. As soon as there are problems, the communications and teamwork seems to breakdown. This is one of the reasons why there is scepticism towards the partnering process, which was supposed to get over those barriers.

Conceptual model

Since profit is an important objective for any reasonable contractor, risk management for the contractor should be the top priority. Risk communication must also be in place so that the risks are managed to best capacity. One problem is that current perception is that one party's gain is another party's loss. Hence it is believed that to have a competitive edge risks need to be kept confidential and uncertainty needs to be allowed for without letting the client know. If the client knows it is assumed the client will try to pass on the risk without paying for it. I think one has to stop thinking from that narrow view, as the party finally paying is the client. In a normal scenario more information means less unknown and therefore less contingency or premium is required to manage it, whoever is the party in that position.

The conceptual model of risk communication in the construction industry is based on the assumption that the client pays for the project from the inception to the handover phase, including the errors and mistakes made by the project participants in not accounting for the risks involved on the project. The client pays if the contractor has made a mistake at the tendering stage of the project by not quoting the right price inclusive of the contingency, one can dispute this if it is a fixed price lump sum contract. Clients pay for mistakes by way of variation claims; disputes and conflicts on site; reduced quality; time delay; strained relations; sub-contractors being squeezed; client losing reputation for delay in project; litigation costs; contractor going bust - lost time to find replacement etc. to mention some of them.

The challenge is to sit together and price the risks so that the most competitive price amongst the project participants is given the task of managing the risk, of course one would have to see if the party can manage the risk or not.

Conceptual model is based on the following principles:

- communication of information on risks and their allocation;
- consultative approach to contract drafting;
- real partnering on the project.

Communication of information on risks and their allocation

Communications plans for sharing of information must be built and include (Donnelley,1997):

- Research
- Strategy
- Targeted presentation
- Monitoring and Measurement
- Flexibility for modification.

Plans for communication should be just as straight forward for all the parties to be involved or involved on the project. The client should be open and flexible during the communication process allowing modifications to the contract to make the project a success. The risks should be accepted and managed by the party best capable to control them and the rest should be insured.

Consultative approach to contract drafting

Contract drafting is the process of choosing the most suitable contractual arrangement for a project, with project objectives in mind. The process also includes choosing and formulating contract conditions. Standard conditions of contract when modified by way of additional conditions are also part of the contract drafting process. Specification of works is also part of a contract and should be appropriate to the project objectives and especially quality objectives, as a substantial number of disputes at site arise from quality objectives (Bajaj, 1997).

Reaching an appropriate contract strategy for a project requires careful consideration of:

- the choice of the type of contract;
- how the contractor should be selected eg. select competition, negotiation;
- the choice of organisational structure to control design, construction and their interface;
- the selection of the content, extent and sequencing of the work packages;
- selection and preparation of tender documents, including the Conditions of Contract - the primary vehicle for the allocation of risk between client and contractor (Hayes et al., 1986).

If, as is often the case, the risks are allocated without consultation and agreement, those parties who are often very undercapitalised relative to the size of the risks imposed on them by contract, are moved to adopt defensive strategies including:

1. Imposing contingency charges (either explicitly or inflated unit prices) to cover construction risks that are frequently uncontrollable.
2. Adopting conservative approaches to product design and construction methodology.
3. Refusing to utilise design alternatives involving new technology because of potential liabilities arising from undue cost or failure to perform.
4. Resorting to litigation or arbitration for any possible type of dispute, whether warranted or not (Levitt et al., 1981).

Clients (customers) have learned from experience that their risks are not appreciably reduced on entry into a contract, although, under most contracts, the contractors (suppliers) are committed to achieving performance in terms of quality, schedule and support services (Wearne, 1992).

To be ready for contract drafting in consultation, the client and contractor have to be ready with the background work, which will involve risks on the project and clauses in the contract related, so that the risks are taken by the party capable to control and manage them. This will involve discussions and negotiations, which can only take place if the contractor is provided with sufficient information. New approaches to project procurement force contractors to research the project in much greater detail than when using traditional procurement methods.

Hence, 'risk management study' will become an essential part of the bidding process. To make it a success the clients will have to decide on an integrated tendering and contractor selection strategy upfront. This is the theme behind the proposed approach, which will head towards 'real partnering' if there is a free and sincere flow of information over the various stages of project cycle and the project participants.

The main stakeholders in the project should use partnering. The client and contractor need to come together for a successful project. All the risks must be discussed, shared and allocated to the party(s) best capable to take and manage the risk (Bajaj, 1994). It is not practically possible to involve all parties, though ideally it should be the case.

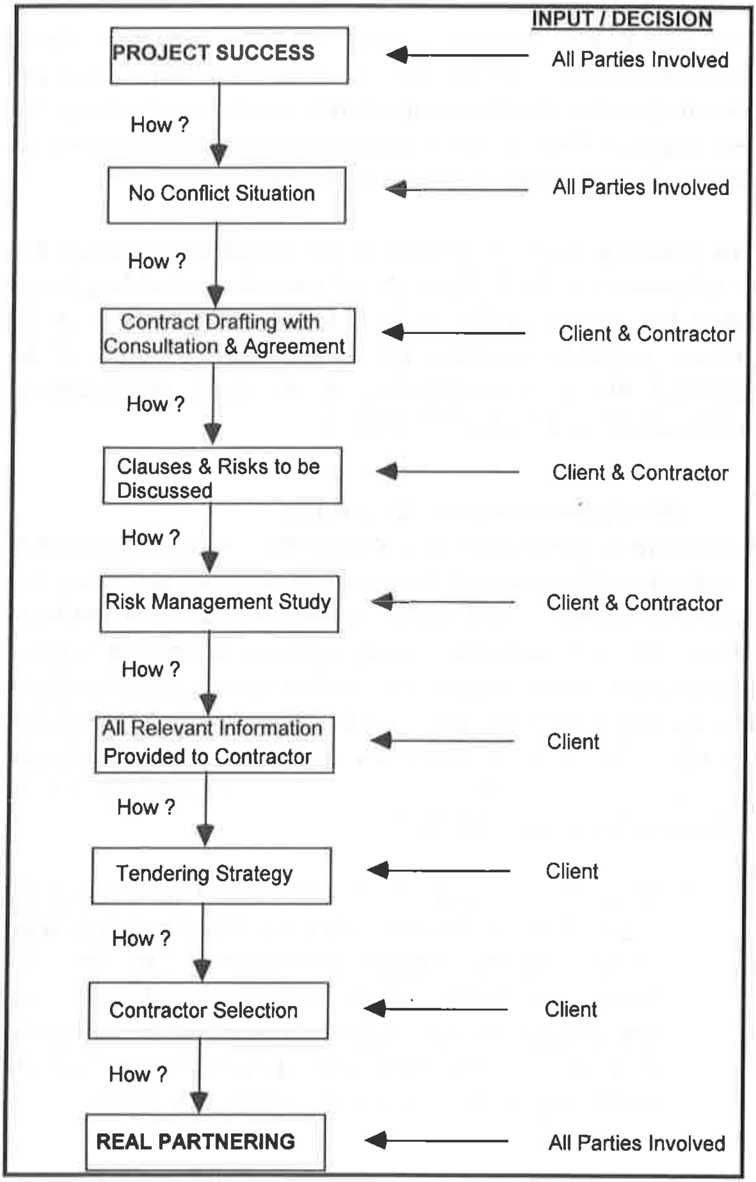
The challenge to be addressed in the consultative approach is to introduce the basic elements of competitive bidding to get value for money on the project. Competitive flavour in the process would be essential for the long-term viability of the approach due to accountability of the many organisations, which would stand to benefit from it.

Real partnering on the project

According to Schultzel and Unrup(1996), 'Partnering involves a major transformation of business attitudes and practices. It is a liberating process that strives to help the best that can be to realise their full potential.' In my opinion, partnering is about reducing uncertainty on projects and increasing the certainty of making profit from the participants' point of view. To achieve the objective of profit, the risks involved for the participants have to be identified and communicated to the parties when the information becomes available.

There are two basic levels of partnering. One being at the higher level of the entity view i.e. the situation of legal entities that are engaged in partnering. The other one being the lower level with personal view i.e. individuals who are personally engaged in partnering. In most situations, principles of partnering can exist in both levels as well as in either of the two levels.

Figure 1: Flow Chart of Consultative Approach (Source: Bajaj(1997))



The author for the following reasons is introducing the term real partnering:

- commitment of the parties should be real;
- commitment of the individuals should be genuine;
- commitment of the client initiating the partnering in the first place for open forum and not being used as a buzzword of the industry;
- client to share the risk profile of the project;
- client has to follow the whole process at various critical points of decision making (refer Figure 1) to get the best outcome for the project.

A research study in 1995 by a student under my supervision in Construction Management Unit of UTS on 'Partnering in construction industry in NSW Public Works Projects' concluded that the benefits of successful partnering include: *better documentation (at least on DD&C and D&C projects) which leads to greater buildability, improved site management methods, improved cost performance and management as a result of increased communications between project participants, reduced claims and disputes and a general decrease in tensions*. The study also found on the question of structural elements to partnering on a scale of 1-10 if they had worked or not, found that *Partnering Charter at 6.1, Communications framework at 8.9, Evaluation Procedure at 6.9 and Problem-solving Procedure at 7.9. By far the most beneficial aspects of partnering process has been the opening up of the communications amongst project participants, inclusive of the risk issues* (Lehmann,1995).

The other problem with hard dollar or lump sum contracts is that the contract is signed where the client has basically transferred the risks on the contractor without consultation and then asked the parties to come together through partnering, the contractor is still vulnerable to financial risks. If things go well on the project then it is said partnering is or was successful, however, if things start going wrong financially, then the objective of the contractor changes and it is to minimise the loss (Bajaj, 1994).

The model

The model for risk communication should be based on the following foundation of project tender and contractor selection as shown in the flow chart (Fig 2) below. In the model, the risk communication should start from the client itself, which means the client gets a risk management study or a risk assessment or even a risk identification study done at the conception stage of the project. This risk assessment study could have elements which are for the corporate of the client, which could be the confidential part and need not be shared with the participants but the other parts which are project specific should be shared and participants asked to price the risks as they see them from their perspective of managing them.

As seen in Fig 2, the eventual project success is dependent on real partnering being achieved on the project. The strategic risks are discussed in the initial stages of the project i.e. at the project tender stage and also at the contractor selection stage of the project. The project design development and also the management of the project process would be dependent on the procurement strategy selected by the client.

The communication of information and risks should take place early on in the project for most effective risk management strategies to be formulated and the participants appropriately rewarded for managing the risks. The importance of utilising the opportunity at the time of the partnering workshop to discuss and develop responses for strategic risks would make the workshop more meaningful and worthwhile and hopefully the communication and teamwork would still continue when the project and the relationship runs into trouble, which it invariably does on most projects.

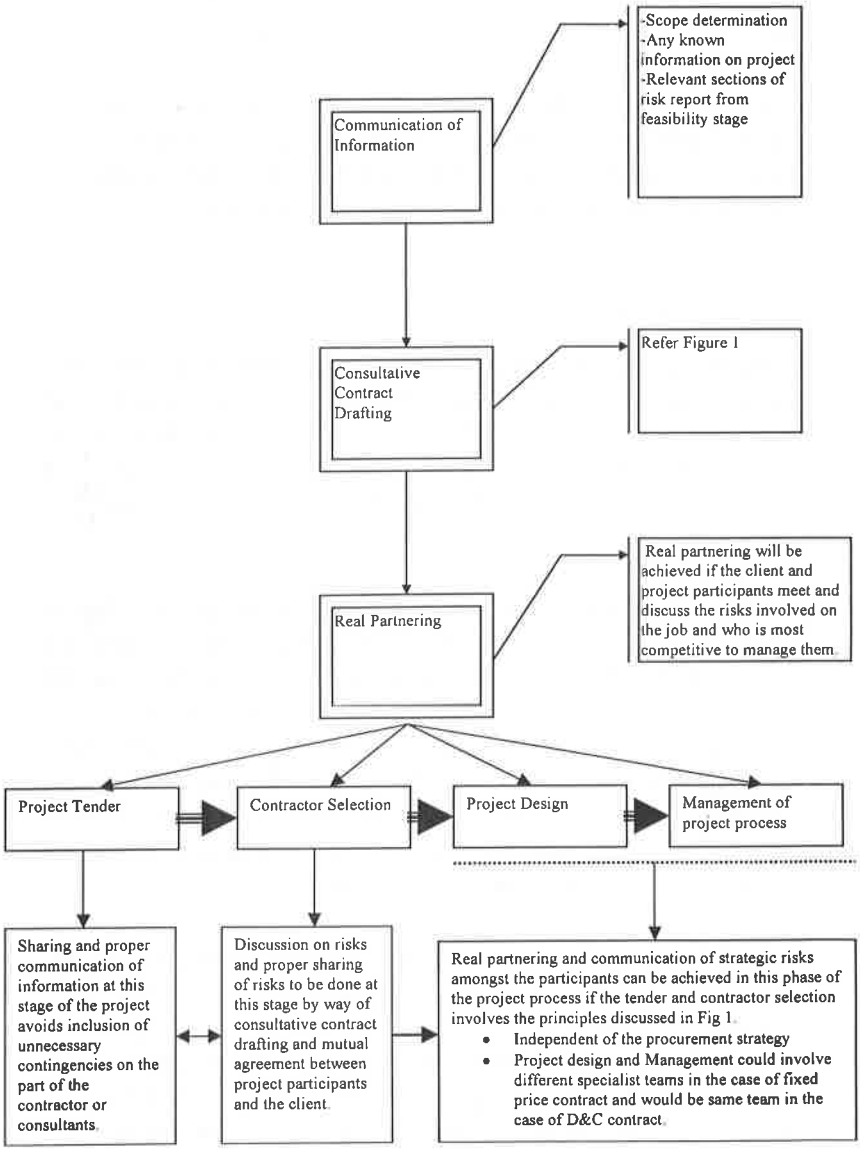


Figure 2: Conceptual Model of Risk Communication

Fig 2 presents that the project life cycle evolves from project tender to contractor selection, to project design and management of project process. The real partnering should take place as early on in the project and reduce the problems in the later stages. In this instance the project life starts from project tender, since the type of project being discussed is being procured on D&C system an hence the project tender would include the bid for design and construction.

Conclusion

For the conceptual model of risk communication process to be successful, the client has to set up the process of communication of risk right from the start of the discussions. The improved communication and cooperation between all parties will give the desired results of better profits and less vulnerability to project risks.

Furthermore, the leadership in the partnering process has to come from the client again, with the desire to discuss strategic risks on the project and the need to discuss them at the partnering workshop it self. With attempts to discuss risks will come the trust amongst the participants that the risk have been discussed and addressed for the project. By approaching the project in this way, there is more chance of project being successful and the participants leaving the project thinking that they achieved something along the way.

The difference between the project risks and strategic risks on the project is discussed. It is recommended that if proper channels of communication are set-up and the handling of strategic risks is discussed and agreed upon at the initial stages of the project by way of the partnering workshop, then the project risks would be easy to deal since the cooperation amongst the participants would be expected to be better than in the traditional approach.

References

Bajaj, D. (1994). Risk Management, Contract Drafting And Partnering: A New Relationship. *Construction conflict: management and dispute resolution. CIB Publication No 171.* International Council for Building Research, Studies and Documentation (CIB), The Netherlands, 1994. pp. 1-12.

Bajaj, D. (1997). Contract Drafting : A Consultative Approach. *The AIQS Refereed Journal*, Vol.1, Issue 1, pp.32-34.

Bajaj, D., Oluwoye, J. and Lenard, D. (1997). An analysis of contractor's approaches to risk identification in New South Wales, Australia. *Construction Management and Economics,* Vol.15, No.4, pp.363-369.

Collins, J.M. and Ruefli, T.W. (1996). *Strategic Risk: A state-defined approach*, Kluwer Academic Publishers, Norwell, MA. p.45.

Donnelley, M. (1997). Communications Risk. *ACEA Seminar on Risk Management*, Sydney. May 1997.

Hayes, R.W., Perry, J.G., Thompson, P.A. and Willmer, G. (1986) *Risk Management in Engineering Construction.* A research report supported by the SERC specially promoted programme in construction management and prepared by the project management group. UMIST

Lehmann, D. (1995). *Partnering with NSW Public Works Department.* Undergraduate Thesis for construction management degree at University of Technology, Sydney.

Levitt, R.E., Ashley, D.B. and Logcher, R.D. (1980) Allocating Risk and Incentive in Construction. *Journal of the Construction Division* September 1980, Vol. 106. (CO3), pp. 297-305.

Lewis J., Cheetham D.W. and Carter D.J. (1992) Avoiding Conflict by Risk Management - the role of the client's project manager. *Risk Management, Project Management, Conflict Avoidance, Construction Conflict Resolution,* 1992.

Sawczuk, B. (1996). *Risk avoidance for the building team.* First edition, E & FN Spon, London.

Schultzel,H. and Unruh,P.(1996). *Successful Partnering: Fundamentals for Project Owners and Contractors*. John Wiley and Sons. USA.

Uher, T.E. and Toakley A.R. (1997*) Risk management and the conceptual phase of the project development cycle.* Risk Management Research Unit, School of Building, The University of New South Wales.

Raftery, J. (1994). *Risk analysis in project management.* E&F.N. Spon, London.

Wearne, S.H. (1992) Contract Administration and Project Risks. *International Journal of Project Management* Vol 10 No 1 February 1992. pp. 39-41.

Identification of Critical Risks in Indian Road Projects

Through Build, Operate and Transfer (BOT) Procurement Approach

Satyanarayana N. Kalidindi[1] & A.V.Thomas[1]

Abstract

With the recent opening up of the Indian economy and its transition towards global market, the prospect of private sector participation in road and other infrastructure development is gaining acceptance and popularity in India. BOT (Build, Operate, and Transfer) approach is the most common form of private participation in road infrastructure development in India. Though massive investment opportunities are available in Indian road sector, private participation through BOT set up is not up to the expected level due to the high degree of risk exposure of such project procurement systems in Indian environment and also due to the variation in risk perception among major project participants. In this paper, the authors present some of the results of a detailed study to identify the various risk issues associated with Indian BOT road projects. Based on an all India questionnaire survey, a risk perception analysis among four major stake holders/participants such as promoters/developers, Government representatives, lenders and consultants is also carried out to evaluate the criticality of the identified risks.

Keywords: Infrastructure, Risk Management, BOT projects

Introduction

In India, till recently, the road infrastructure projects were fully funded by the government through internal budgetary allocation or with external borrowings. There is a shortage of internal budgetary resources to finance these projects and the

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growing debt burden in developing countries like India has resulted in reduction of its external borrowing capacity. The investments needed over the next six years, for the development of the National and State Highways in India, are estimated to total US$ 33.7 billion. Governments at central and state level in India have adopted the idea of private participation in the form of Build-Operate-Transfer (BOT) concession financing as a partial solution for resource constraints in road infrastructure procurement. The concept of road infrastructure development using BOT approach is relatively new in India. In the recent past, many highway projects under BOT procurement scheme have been taken up by National Highway Authority of India (NHAI) and various state governments. Few of them are under operational phase and the remaining are either in construction phase or developmental phase. (Banarjee, 2000)

Though the Government has taken many initiatives to improve the project environment for implementation of BOT road projects in India, the expected enthusiasm is not reflected from the private promoters and institutional lenders (Hindu Business Line, 2000). The main reason for the lukewarm response is the high degree of risks and obstacles in Indian BOT road projects especially during the developmental and operational phase. Many projects planned under BOT mechanism in India have been non-starters due to many factors including inadequate project information, difficulties in obtaining long term finance, absence of adequate government guarantees, inadequate legal and regulatory framework and lack of widely accepted risk management tools. Effective application of risk management principles to Indian road projects is crucial and risk strategies are to be incorporated at an earlier phase of the project.

Research objectives and methodology

This paper presents some of the findings of a study undertaken on the risk issues related to BOT road projects in India. The

specific research objectives addressed in this paper are:
To evaluate the relative importance of risk issues associated with development of BOT road projects in India
To identify the most critical risks associated with Indian BOT road projects

The methodology adopted for this research study are (i) a comprehensive literature review along with few case studies to identify initial risks and risk issues associated with BOT road projects in India; (ii) unstructured interviews and discussions with BOT road project participants to consolidate the risks identified through the first step (iii) An all India survey among four major stake holders/participants of Indian BOT road projects such as government representatives, promoters/developers, lenders and consultants. The consultants were included in the respondent category because of the fact that they play a vital role in both pre-bidding stage as well as implementation stage of a BOT road project.

Table 1 Details of the survey responses

Category	No of respondents				
	Experience				Total Number (%)
	Very High >8 projects	High 5-8 Projects	Medium 2-4 Projects	Low <2 Projects	
Government	4	3	2	6	15 (24%)
Promoters	6	6	4	2	18 (29%)
Lenders	4	5	4	3	13 (21%)
Consultants	4	4	3	2	16 (26)%)
Total	18 (29%)	18 (29%)	13 (21%)	13 (21%)	62 (100%)

The survey questionnaire was mailed to 124 very senior level officials who have experience in BOT road projects in India and 62 responses were received. Though the total number of respondents in each category is limited, the reliability of survey results is expected to be high because all the respondents are top-level experienced management officials in their organisations. The details of the survey respondents are given in Table 1.

About sixty percent of the respondents have high to very high experience in the area of Indian BOT road projects. The sample size is well distributed in terms of category as well as experience with in the total number of responses.

Important risk issues in Indian BOT road projects

Risk is often used in several distinct senses such as opportunity, hazard/threat or uncertainty (Koorp, 1999). Risks in BOT road projects could be viewed as opportunity in bidding phase for promoters in obtaining a better deal from the government and as a hazard/threat in the implementation phase, since they affect the goals and the economic performance of the promoters of the project. Improper identification and allocation/sharing of risks among stake holders (if not based on their capability of management) may lead to sub-optimality, and result in higher than necessary prices for risk transfer (Asian Development Bank, 2000).

There are various risk issues associated with the successful bidding and development of BOT road projects. These issues are likely to be the source of major risk events and are to be analysed and addressed during bidding and contract negotiation phase. A comprehensive list of possible risk issues was prepared based on literature review and further

Table 2 Rating system for risk issues and risk criticality

Rating score	Importance of risk issues	Criticality of risks
0	Not Applicable	Not Applicable
1	Not Important	Not Critical
2	Somewhat Important	Somewhat Critical
3	Important	Critical
4	Very Important	Very Critical
5	Most Important	Most Critical

consolidated through discussions with experienced BOT road project participants. The shortlisted issues were evaluated through all India survey to decide on the relative importance in Indian BOT road project environment. The rating scales used for evaluating importance of risk issues and criticality of risks are given in Table 2.

The survey responses were statistically analysed using SPSS 9.05 package and the issues are ranked based on the perception of each category of respondents and are given in Table 3.

Table 3 Importance of risk issues in Indian BOT road projects

RISK ISSUES	GOVERNMENT		PROMOTER		LENDER		CONSULTANT		COMBINED	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
Equity requirement	4.00*	7	4.28*	3	4.06*	6	3.69	11	4.03*	5
Amount of information available in bid/project	4.00*	5	3.83	9	3.94	10	3.85	10	3.90	10
Project preparation & bidding cost	3.60	12	3.94	7	3.50	14	3.08	17	3.56	15
Probity and integrity/transparency	4.00*	6	3.78	12	4.00*	9	4.15*	6	3.97	6
Chances of success in bid	2.60	19	2.50	19	3.19	18	2.85	19	2.77	19
Technical and financial capability of promoter	4.07*	4	4.00*	6	4.06*	7	3.69	12	3.97	7
Certainty of the tender process	3.07	17	3.17	18	3.38	16	3.38	16	3.24	17
Resettlement and Rehabilitation issues	3.33	14	3.78	13	3.88	12	4.00*	8	3.74	12
State road project or Central road project	1.73	20	2.17	20	2.94	19	2.23	20	2.27	20
Availability of land (free from	4.20*	3	4.22*	4	4.56*	2	4.54*	2	4.37*	3
Commercial justification (return	4.33*	2	4.44*	1	4.38*	4	4.62*	1	4.44*	1
Risk allocation	3.87	9	4.11*	5	4.44*	3	4.23*	5	4.23*	4
Bankability of the project	4.40*	1	4.39*	2	4.56*	1	4.31*	3	4.42*	2
State in which project located	2.80	18	3.22	17	2.88	20	2.85	18	2.95	18
The likely overrun in the project (time/cost)	3.73	10	3.50	16	3.50	15	3.62	13	3.58	13
Type of tolling (direct/shadow/annuity)	3.20	15	3.83	10	4.06*	5	4.00*	7	3.77	11
Environmental issues	3.07	16	3.72	14	3.88	13	3.62	14	3.58	14
Regulatory framework /authority	3.67	11	3.89	8	3.94	11	4.23*	4	3.92	9
Technical issues (technology/design	3.53	13	3.50	15	3.31	17	3.46	15	3.45	16
Regulatory restrictions (on user charge & rate	3.87	8	3.83	11	4.06*	8	3.92	19	3.92	8

* Very Important issues (mean score ≥ 4.00)

The issues rated with a mean score higher than 4.00 are treated as very important. The five most important risk issues (in the order of importance) to be considered during the bidding and development phase of a BOT road project based on the combined rating by participants are; i) commercial justification/return from project, ii) bankability of the project, iii) availability of land free from encumbrances, iv) risk allocation and v) equity requirement.

Though there are some variations in the relative importance of some of the above issues, the ranking correlation among the all the category of respondents are significant. The Spearman's rank correlations among different category of respondents are given in Table 4. This is an indication of the degree of understanding the survey respondents have on issues related to BOT road project development in India.

Table 4 Correlation among participants on importance of risk issues

	Government	Promoter	Lender	Consultant
Government	1	0.84**	0.81**	0.76**
Promoter		1	0.88**	0.76**
Lender			1	0.87**
Consultant				1

**Spearman's correlation is significant at the 0.05 level (2-tailed)

Both government representatives and lenders attach maximum importance to the bankability of the project, whereas the promoters and consultants attach maximum priority to likely commercial return from the project. Many projects in India have failed to take off due to delay in financial closure. For example, A BOT road bypass project for which concession agreement was signed 3 years back is yet to have financial closure. Lenders attach importance to bankability because of the non-recourse type of project finance. Invariably all the respondents have rated availability of land free from encumbrance is a serious issue to be considered and addressed. Most of the BOT road projects in India are faced with the risk of delay in project implementation mainly due to problems in the process of land acquisition.

Though promoters, lenders and consultants identified risk allocation in BOT road projects as an important issue, government representatives attach little importance to that issue. Equity requirement is a major concern for promoters. Majority of the promoters in India BOT road projects are medium sized contractors/joint ventures, who find difficulty in managing sufficient equity in time. The equity part of the total project cost is to be put upfront for getting the debt released from financial institutions. Though government representatives and consultants did not consider type of tolling as an important issue, promoters and lenders do consider them as crucial. Type of tolling decides with whom the tolling and traffic revenue risks are allocated.

Identification and classification of critical risks

Ramakrishnan (Ramakrishnan, 1995) has presented important risk factors affecting the privatisation of roads in India. Charoenpornpattana and Minato (Charoenpornpattana & Minato, (1999) have identified privatisation-induced risks in transportation projects in Thailand with an objective of pin pointing which risk could be shared between public and private sectors. They also identified privatisation-induced risks for various countries. Salzmann and Mohammed (Salzmann & Mohammed, 1999) have presented risk identification framework for international BOOT projects based on four super factor grouping, i.e. host country, investors, projects and project organisation/management. They also gave an overview of published/identified risk factors.

Raphel and Maguire (Raphel & Maguire, 1999) have carried out research in risk identification and allocation of Australian BOOT projects. Wang *et al* (Wang, *et al*, 2000). have studied in detail the criticality of political risks and effectiveness of the various management strategies in China's BOT project. The critical risks identified are credit worthiness and reliability of Chinese parties, change in law, force majeure, delay in approval, expropriation and corruption. However, all the above studies are country specific and have not covered risks in BOT road projects under Indian environment. Asian Development Bank (ADB) has published a list of risks in expressways under private sector investment in Asian countries (ADB, 2000). It covers mainly design, construction, traffic revenue, finance, operation and maintenance and there is no mention about developmental risk issues prior to the construction phase such as project identification, bidding cost, land acquisition, arrangement of finance in time etc.

Tiong (Tiong, 1990) classified BOT risks based on construction and operation phase where as Beidleman's (Beidleman, 1990) classification has an additional phase i.e. developmental phase. In this research, the authors have considered another phase i.e. project life cycle phase, in which risks occurring in more than one of the phase are included. Since the total duration of BOT road projects is very long, the project life cycle risks need special long term planning and are to be continuously monitored for a possible change in their criticality over a period of time. For project risk identification, preparation of a checklist *(PMBOK,* 1996)(Perry & Hayes, 1985) or Delphi process (Dey, 1999) have been suggested. The detailed checklist of risk events prepared under each risk is not included in this paper due to limitation of space. The important risk categories identified through literature review and unstructured interview are classified and listed in Table 5.

As per the classification developed, there are twenty-two major risk categories, which are likely to occur in a BOT road project. The survey respondents were asked to rate the criticality of these identified risks based on their perception and experience with Indian BOT road projects. The scale used for measuring risk criticality is shown in Table 2. Criticality is assumed to be the combined effect of probability of occurrence and the impact of occurrence of the risk.

Table 5 Classification of risks in BOT road projects

Project phase	Risk Code	Risk Category
Developmental Phase	DRC	Pre-investment risk, Resettlement and Rehabilitation risk, Delay in land acquisition, Permit/Approval risk, Delay in financial closure.
Construction Phase	CRC	Technology risk, Design and latent defect risk, Completion risk, Cost overrun risk.
Operation Phase	ORC	Traffic revenue risk, Operation and maintenance risk, Demand risk.
Project life cycle	PRC	Legal risk, Political risk (direct & indirect), Partnering risk, Regulatory risk, Debt servicing risk, Financial risk, Environmental risk, Physical risk, and Non political force majeure risk

Criticality of risks

The criticality index was calculated for each risk using the formula:

$$\text{Criticality Index} = \frac{5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5}{5\left(n_1 + n_2 + n_3 + n_4 + n_5\right)}$$

Where:

n_1= number of respondents who answered "Most Critical";
n_2= number of respondents who answered " Very Critical";
n_3= number of respondents who answered "Critical";
n_4= number of respondents who answered "Some What Critical"; and
n_5= number of respondents who answered "Not Critical";

Identification and classification of critical risks were done on the basis of combined mean score of risk criticality. The summery of classified risks are given in Table 6.

Table 6 Risk criticality rating by respondents

Risk	Government		Promoter		Lender		Consultant		ANOVA[a]		Combined		Risk Class #
	Mean	Crit. Index	Mean	Crit. Index	Mean	Crit. Index	Mean	Crit. Index	F value	Sig	Mean	Crit. Index	
Pre-Investment risk	2.27	0.45	2.11	0.42	2.88	0.61	2.54	0.51	1.25	0.29	2.44	0.50	NC
Delay in financial close	4.00	0.80	3.78	0.76	3.81	0.76	3.77	0.75	0.16	0.91	3.84	0.77	VC
Resettlement & rehabilitation	3.27	0.67	3.44	0.69	3.88	0.78	3.38	0.68	0.72	0.54	3.50	0.71	C
Delay in land acquisition	4.27	0.85	4.06	0.81	4.19	0.84	4.15	0.83	0.10	0.95	4.16	0.83	VC
Permit/ approval risk	2.87	0.57	3.50	0.70	3.44	0.69	3.31	0.66	1.25	0.29	3.29	0.66	C
Technology risk	2.20	0.44	2.72	0.54	2.63	0.53	2.38	0.48	1.05	0.36	2.50	0.50	NC
Design & latent defect risk	2.87	0.57	2.94	0.59	3.06	0.61	3.00	0.60	0.14	0.93	2.97	0.59	C
Cost overrun risk	3.60	0.72	3.61	0.72	3.81	0.76	3.77	0.75	0.23	0.87	3.69	0.74	VC
Completion risk	4.00	0.80	3.83	0.77	3.88	0.78	3.69	0.74	0.22	0.86	3.85	0.77	VC
Demand /market risk	4.07	0.81	4.06	0.81	4.31	0.86	3.77	0.75	0.71	0.54	4.06	0.81	VC
Traffic revenue risk	4.40	0.88	4.44	0.89	4.56	0.91	4.15	0.83	0.50	0.60	4.40	0.88	VC
O & M risk	3.20	0.64	2.72	0.54	2.88	0.58	2.77	0.55	0.79	0.50	2.89	0.58	C
Direct political risk	3.40	0.68	3.78	0.76	3.25	0.65	3.69	0.74	0.78	0.51	3.53	0.71	VC
Indirect political risk	3.40	0.68	3.61	0.72	3.63	0.73	3.23	0.65	0.46	0.70	3.48	0.70	C
Regulatory risk	3.20	0.64	3.33	0.67	3.94	0.79	3.38	0.68	2.13	0.11	3.42	0.68	C
Legal risk	3.13	0.61	3.44	0.69	3.81	0.76	3.23	0.65	1.52	0.21	3.40	0.68	C
Debt servicing risk	3.60	0.72	3.50	0.70	4.31	0.86	3.38	0.68	2.69	0.05	3.71	0.74	VC
Financial risk	3.60	0.72	3.28	0.66	3.56	0.71	3.23	0.65	0.48	0.69	3.42	0.68	C
Non political force majeure	2.40	0.48	3.06	0.61	3.13	0.63	2.46	0.49	2.12	0.10	2.79	0.56	C
Partnering Risk	2.80	0.56	2.50	0.50	3.00	0.60	2.54	0.51	0.98	0.40	2.71	0.54	C
Environmental risk	2.47	0.49	3.06	0.61	3.50	0.70	2.38	0.52	3.66	.01**	2.89	0.59	C
Physical risk	2.27	0.45	2.11	0.42	2.69	0.54	2.23	0.45	2.10	0.11	2.32	0.46	NC

[a] H_0: There is no significant difference in criticality rating by different category of respondents (at 5% significance level) ** H_0 Rejected

H_1: Significant difference in criticality rating among different category of respondents

VC: Very Critical C: Critical NC: Not Critical

The risk criticality rating by government officials, promoters, lenders and consultants are given in Table 6. One way ANOVA test (2- tailed) carried out for each risk shows that the there is high degree of agreement at 0.05 significance level, in risk criticality rating except environmental risk. There is also a high correlation among different participants in overall ranking of different risks. The Spearman's rank correlation for risk criticality is given in Table 7. This high degree of agreement on risk criticality shows that the respondents have understood the risks in Indian BOT roads and the reliability of their answers to various other risks related issues are likely to be high.

Table 7 Correlation among participants on risk criticality ranking

	Government	Promoter	Lender	Consultant
Government	1	0.91**	0.81**	0.95**
Promoter		1	0.83**	0.95**
Lender			1	0.85**
Consultant				1

**Spearman's correlation is significant at the 0.05 level (2-tailed)

The criteria on which risk criticality classification done is shown in Table 8.

Table 8 Risk criticality classification

Risk category based Criticality	Criteria
Not Critical	Mean score $\leq$ 2.50
Critical	Mean >2.5 to $\leq$3.5
Very Critical	Mean >3.50 to $\leq$4.50
Most Critical	Mean $\geq$4.50

All the categories of respondents rated traffic revenue risk as the most critical risk in Indian BOT road project. The classification shows that it is "Very Critical with highest mean score of 4.40 and a criticality index of 0.88. The risk of producing good traffic forecast is high in India due to lack of reliable traffic data. The model concession agreement (Model Concession Agreement, 2000) published by Ministry of Surface Transport (MOST) does not have any provision for traffic guarantee from the government. Though parallel toll free road in not mandatory for any BOT road, traffic diversion through alternate route is quite common in India. Moreover government does not give any guarantee against creation/improvement of any new/existing parallel toll free roads during the concession period.

The second most critical risk in Indian BOT road projects is delay in land acquisition. It is classified also "Very Critical" with a mean score rating of 4.16 and criticality index of 0.83. Road projects under BOT set up require large stretches of land free from all encumbrances. Delay in survey, notification and acquisition process, politically motivated resistance, non-availability of alternate land at reasonable cost, political patronage for encroaches, public litigation, delay due to court orders, resettlement and rehabilitation problems etc. arc quitc common in India. There are many road projects in India, where such issues became major reasons for inordinate delay in project implementation.

The other risks in Indian BOT road projects rated as "Very Critical" are demand risk, delay in financial closure, completion risks, cost overrun risk, debt servicing risk and direct political risks. The traffic revenue risks and demand risks are closely associated. Any change in road demand will affect the traffic revenue where as the increase in toll tariff can reduce the demand due to toll elasticity. Non-agreement between the contracting parties on the conditions in concession agreement, inadequate guarantees from government, delay in debt syndication, failure of promoter to rise necessary equity in time etc. often delay the financial closure of the project.

Majority of the BOT road projects in India are not able to achieve financial closure within the prescribed time limit because many of the conditions in the concession agreement between promoter(s) and Government are not acceptable to the lender(s). In some cases, the financial closure was achieved but the financial institutions delayed the disbursement of funds affecting the project promoters. The lenders of Indian BOT projects are often not involved in the negotiation prior to signing of concession agreement between promoter and government resulting a delay in debt syndication for the project.

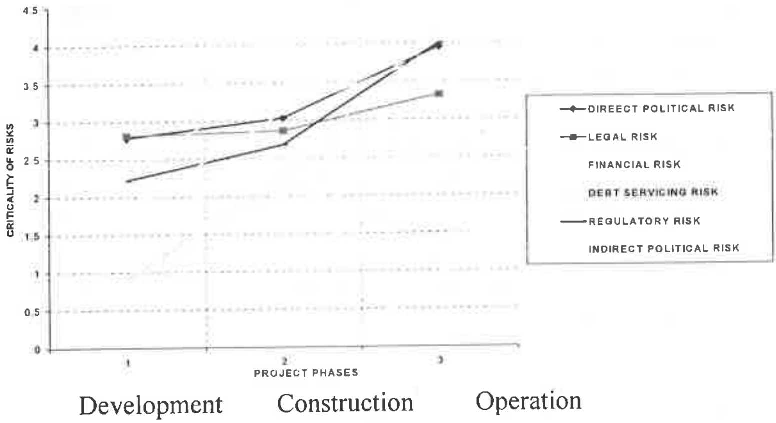

Figure 1. Project life cycle risks

As per the Ministry of Statistics and Program Implementation data (Annual report, 1999), during 8th plan (1992-97) out of the 421 infrastructure projects, 169 projects had reported cost overruns and 202 projects reported time overrun. The total cost overrun was of the order of US$ 6 billion. The Completion risk and cost overrun risk is rated as "Very Critical" with mean scores of 3.85 and 3.69 respectively. Some of the important project procurement and execution problems in India are inadequate/incomplete site investigation, non-receipt of drawings and instructions at site, non-availability of material and equipment as per schedule, delay in payments of the completed work due to paucity of funds, inadequate escalation clauses leading to disputes, lack of adequate dispute redress mechanisms etc. Debt servicing risk is rated as "very critical" with mean score of 3.71 and criticality Index 0.74. This risk is closely associated with traffic revenue and demand risks.

Project life cycle risks

There are many project life cycle risks such as direct political risks, legal risk, regulatory risk, and financial risks that have been rated from "Critical" to "Very Critical range". Though the government has taken many steps to improve the legal and regulatory environment in road sector, much improvement is still expected in the area of contract implementation, establishment of independent regulatory authority etc. The criticality of these risks changes with time during the project life cycle. The change in risk criticality of these risks in three different phases of the project life cycle (development phase, construction phase and operation phase) is evaluated from the phase wise risk rating given by survey respondents and is shown in Fig-1.

Conclusion

With limited availability of funding for development of road infrastructure, the Indian Government has adopted the BOT approach for some of the road projects being implemented. Though the Government has taken many initiatives to improve the project environment for implementation of BOT road projects in India, the expected enthusiasm is not reflected from the private promoters and institutional lenders The main reason for the lukewarm response from promoters and lenders is due to the high degree of risks and obstacles in Indian BOT road projects especially during the developmental and operational phase. The most important issues to be considered prior to BOT road project developments are commercial justification/return from project, bankability of the project, availability of land free from encumbrances, risk allocation, equity requirement, type of tolling, regulatory restrictions, probity and integrity/transparency of the bidding. The most critical risks in Indian BOT road projects identified in this study are traffic revenue risk, delay in land acquisition, demand risk, delay in financial close, cost and time overrun risks, debt servicing risk and direct political risk. The perception analysis between various categories of participants in BOT road projects shows a high degree of agreement in risk related issues. Unlike BOT projects in country like China, political force majeure and delay in approval risks are not "very critical" in India.

References

Banarjee, A. K. (2000). "Infrastructure Development in Highway Sector-An Overview." *Proceedings of Workshop on Developments in Civil Engineering Infrastructure*, Madras.

Poor FDI on Indian Roads. *The Hindu Business Line*, 2000, 7(274).

Koorp, J. (1999). "At What Risk…?." *The Management Accountant*, 10,735-736.

Asian Development Bank (ADB) Report. (2000). "Development of Best Practices for Promoting Private Investment in Infrastructure: Roads.", 101-106.

Ramakrishnan, R. (1995). "Entrepreneur's Risks on Privatisation of Road Projects." *Journal of Indian Construction,* Builders Association of India, 9, 7-14.

Charoenpornpattana, S., and Minato, T. (1999). "Privatization-Induced Risks: State-Owned Transportation Enterprises in Thailand." *Profitable Partnering in Construction*

Procurement, Edited by Ogunlana, SO, E&F.N Spon Ltd., London, 429-440.

Salzmann A., and Mohammed, S. (1999). "Risk Identification Frameworks for International BOOT Projects." *Profitable Partnering in Construction Procurement*, Edited by Ogunlana SO, E&F.N Spon Ltd., London, 475-486.

Raphel, R., and Maguire, G. (1999). "*Risk Allocation and Identification Project-Survey Report*." The University of Melbourne, The Department of Treasury and Finance, Melbourne.

Wang, S. Q., Tiong, R. L. K., Ting, S. K., and Ashley, D. (2000). "Evaluation and Management of Political Risks in China's BOT Projects." *ASCE Journal of Construction Engineering and Management,* 126(3), 242-250.

Tiong, R. L. K. (1990). "BOT Projects: Risk and Securities." *Construction Management & Economics*, E & FN Spon, 8, 315-328.

Beidleman, C. R. (1990). "On Allocating Risk: The Essence of Project Finance." *Sloan Management Review*, Spring, 47-55.

A Guide to the Project Management Body of Knowledge (PMBOK). (1996). Project Management Institute, Edited by William R. Duncan USA, 111-122.

Perry, J. G., and Hayes, R. W. (1985). "Risk and its Management in Construction Projects." *Proceedings of the Institute of Civil Engineering*, 78/1, 499-521.

Dey, P. K. (1999). "Process Re-engineering for Effective Implementation of Projects." *International Journal of Project Management*, 17(3), 147-159.

Model Concession Agreement for BOT roads. (2000). Ministry of Surface Transport, Government of India.

Annual report. (1999). Ministry of Statistics and Program Implementation, Government of India.

Stadium Australia

Reflecting on the Risk Factors of Boot Procurement

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Abstract

The private sector is playing an increasingly important role in the procurement process of public works and services. This has partly arisen out of a requirement for infrastructure development to be undertaken at a rate that maintains and allows growth. In turn this has become a major challenge that cannot be met by government alone. The emergence of Build-Own-Operate-Transfer (BOOT) schemes as a response to this challenge provides a means for developing the infrastructure of a country without directly impacting upon the government's budgetary constraints. The concepts of BOOT are without doubt extremely complex arrangements, which bring to the construction sector risks not experienced previously. This paper examines perceptions of BOOT schemes in order to develop a framework of risk factors established from a case study of Stadium Australia.

Keywords: BOOT procurement, case study, infrastructure challenge, risk factors, Stadium Australia

Introduction

According to McDermott (1999), a significant development in construction procurement has been the rapid increase in the use of Build-Own-Operate-Transfer (BOOT) arrangements. The private sector is playing an increasingly important role in the development of infrastructure growth. This in turn has become a major challenge for many countries, and particularly so where it is evident that these provisions cannot be met by government alone. The emergence of BOOT schemes as a response to this challenge provides a means for developing the

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infrastructure of a country without directly impacting on the government's budgetary constraints (Walker et al, 2000). The latest New South Wales (NSW) Government Green Paper attempts to capture this public-private sector joint venture opportunity in order to increase the benefits and comment on the issues and concerns (NSW Government, 2000).

This is a welcome opportunity to broaden relationships between the public and private sectors that may involve innovative recommendations and the formulation of new policies. Therefore, the aim of this paper is to examine perceptions of BOOT schemes to establish a framework of risk factors developed from a case study undertaken on a current project.

The BOT/BOOT Concept

The concept of private sector participation in infrastructure provision is not a new idea. It is however, only in the last two decades that Build-Operate-Transfer (BOT) concepts have become high on many government agendas. Australian examples of the BOT approach include the Sydney Harbour Tunnel, M4 and M5 tollways in NSW and the Ord River Hydro-Electric Scheme in Western Australia (Angeles & Walker, 2000).

When a private sector group has a concession to build and toll a motorway project for say 20 years, this is a BOT. If, however, their concession also allowed them to own, build and rent warehouse space (for the concession period of 20 years) at certain locations along the motorway then the contractual arrangement in place is described as a BOOT agreement (Walker & Smith 1995). Most BOT projects are first identified by the host government. In advertising or requesting for proposals, the host government asks for bids to have a particular project delivered on a BOT basis (UNIDO 1996).

Risk

Risk identification is an important step prior to risk analysis. In order to correctly manage risks through analysis, comprehensive identification at the preliminary stage is required (Salzman & Mohamed, 1999). Managing risk in an integral part of the procurement process (Akintoye & Taylor, 1997).

The NSW Government Department of State and Regional Development published its 'Guidelines for Private Sector Participation in the Provision of Public Infrastructure' in October 1997. These guidelines confirm the shift in attitudes toward asset planning and procurement by stating,

> *"The government aims to maximise private investment in infrastructure to the extent that this results in net benefits to the community beyond those from public provision. It also strives to promote an efficient allocation of risk between the public and private sectors to parties best able to manage them."* (NSW Government, 1997)

These changes have indeed opened new avenues to the government for the procurement of buildings. The utilisation of the BOT concept or its variations, is an example of the increased acceptance of these forms of procurement.

Identification of Risk

It is difficult to generalise about the risk characteristics of BOT infrastructure projects, given that each host country, each infrastructure sector, and indeed each specific project has it's own risk profile. Notwithstanding this, the development of a broad based framework listing all relevant general issues, is seen to have good application at the planning and conceptual stages of such projects.

Ma et al (1998) identified five main risk categories under the headings of political, construction and completion, market and revenue, operating and financial risks. They suggest that the identification, management and allocation of these risks is best served by the undertaking of comprehensive feasibility studies.

UNIDO (1996) attempted the development of a 'risk check-list', after dividing risks generally into two broad categories for the purposes of identification, namely general (or country) risks and specific project risks. The following table summarises the outcome.

General (Or Country) Risks		
Political risks	Country commercial risks	Country legal risks
Political support risks	Currency inconvertibility risks	Changes in laws and regulations
Taxation risks	Foreign exchange risks	Law enforcement risk
Nationalisation risks	Devaluation risks	Calculating compensation delay
Forced buy-out risks	Inflation risks	
Cancellation of concession	Interest rate risks	
Import/export restrictions		
Failure to obtain approvals		
Specific Project Risks		
Development risks	Construction/completion risks	Operating risks
Bidding risks	Delay risk	Associated infrastructure risks
Planning delay risks	Cost overrun risks	Technical risks
Approval risks	Re-performance risk	Demand risk (volume and price)
Transnational risks	Completion risk	Supply risk (volume and price)
	Force Majeure risk	Cost escalation risks
	Loss or damage to work	Management risks
	Liability risk	Force Majeure risk
		Loss/damage to project facilities
		Liability risk

Table 1: Risk checklist for BOT projects (UNIDO, 1996)

In noting the absence of a definitive list of risk factors applicable across BOT projects generally, Salzmann and Mohamed (1999) identified the need for development of a comprehensive risk framework. As previous lists of risk factor identification were based on different definitions, categories and studies, then these lists were not totally comprehensive across the broad spectrum. Subsequently, the development of their framework was done in such a manner as to include every possible aspect where risk may emanate from a BOT scheme. They saw it appropriate for the development of two risk frameworks, where categories are formed according to where the factors' influence is first encountered. The first framework lists those factors present throughout the feasibility to building stage, and is referred to by the authors as the development or 'build' phase. The second framework presents factors encountered throughout the 'own, operate and transfer' stages, and is referred to by the authors as the operations phase.

Their models are an attempt to encompass available published material but the frameworks have not been tested on a current BOOT project.

Research Methodology

Fellows and Liu (1997) comment that a case study yields deep but narrow results. The possibility of the case study results being 'narrow' is accepted in that they are restricted to the case study project in question. However, the case study will serve to test the validity of the risk factor issues identified from the related literature and subsequently develop a risk factor framework applicable to BOOT projects in general. A single case study has been selected as the most appropriate means for the research reported in this paper. Collection of evidence for the case study was achieved by reviewing the documentation and reports provided by the consortium stakeholders, government office and general project literature and an informal interview process with key senior project participants. The research has identified risk factor issues from the literature and they have been tested and developed through the interview process. The case study further validates these risk factors in a generic 'real world' context.

Project Background: Stadium Australia

The Olympic Co-ordination Authority (OCA) was established on 30 June 1995 by the NSW State Government to oversee the planning and development of facilities for the XXVII Olympiad. The NSW Government issued a call for proposals in August 1994 for private sector investment in the new Olympic stadium facility. This call was framed around a BOOT delivery scheme with an intention for the Government to shortlist successful tenderers (Magub and Hampson, 1999)

It was not until August 1996 that the OCA awarded the proposal to design, construct and operate the facility to the 'Australia Stadium 2000' consortium. The Stadium Australia Trust and OCA signed the project agreement in September 1996 (Stadium Australia Group 1996a). The A$615 project is now being run by Stadium Australia Management as a classic BOOT scheme.

The OCA granted the Stadium Australia Trust the Trust Lease on the completion date of the stadium, being March 1999. The term of the Trust Lease expires on 31 January 2031. On the lease expiry date, the ownership and operational rights of the project transfers to the government (OCA) for nominal consideration (Stadium Australia Group 1996a).

The financing of Stadium Australia has broken a number of barriers because of a unique set of structures and an innovative approach. Of the initial A$550 million investment, the public float raised A$350 million. The float was unsuccessful in that it finished short, but from a stadium viewpoint, it didn't make an enormous difference because the underwriters paid the shortfall (Jefferies et al., 2001). Equity funding for the project was raised via gold and platinum investors, founders and commercial investors. The capital structure of the Trust and Stadium Australia Management was such that at financial close, investors would hold or be obliged or entitled to subscribe for approximately 97.3 million units in the Trust, and an identical number of shares in Stadium Australia Management (Stadium Australia Group 1996b).

Stadium Australia was the first Australian Stock Exchange (ASX)- listed lifestyle product and also the first triple-stapled listed product. Stapled products involve add-ons which are designed to

	Party Bearing The Risk Factor				
Risk Factor	Project Company - Stadium Australia Trust	Insurance Company/ Under-writers	Contractor - Obayashi, then Multiplex	Other Project participants - Ogden IFC, Gardner Merchant etc.	Host Gov't - OCA
Construction time overrun			✓		
Construction cost overrun	✓		✓		
Design Risk	✓		✓		✓
Operational cost overrun	✓			✓	
Latent conditions			✓		
Changes in taxes/laws	✓				✓
Market Risk	✓			✓	
Industrial relations			✓	✓	
Bidding risk	✓				
Corruption	✓				✓
Political backdown					✓
Existing infrastructure	✓				
Raw material supply			✓	✓	
Inflation/	✓		✓		✓

	Party Bearing The Risk Factor				
Risk Factor	Project Company - Stadium Australia Trust	Insurance Company/ Under-writers	Contractor - Obayashi, then Multiplex	Other Project participants - Ogden IFC, Gardner Merchant etc.	Host Gov't - OCA
Interest rate					
Financing	✓	✓	✓	✓	
Country risk	✓				
Force Majeure	✓	✓	✓	✓	✓
Operation failure	✓			✓	
Market competition	✓			✓	✓
Project performance	✓			✓	
Operational safety regs	✓		✓	✓	
Warranties and guarantees	✓		✓	✓	
Project lifespan/ Life cycle	✓		✓	✓	✓
Native Title/ Land Claim	✓		✓		✓
Operating expenses	✓			✓	
Discretionary termination	✓		✓	✓	
Documentation Risk	✓	✓	✓	✓	✓
Ticket/ Membership rights				✓	
Environmental impact	✓				✓
Approval processes	✓		✓		✓
Project complexity	✓	✓	✓	✓	
Legal framework	✓				✓
Political (in)stability	✓				✓

Table 2: Risk Factor Framework – Established during interviews via the Case Study Project

make the overall product more attractive or to suit the particular needs of the project. In the original float offerings, gold and platinum packages involved three things - Olympic tickets, membership entitlements and equity investment; thus the recognition of a triple-stapled product (Jefferies et al., 2001).

The future financial success of the Trust and Stadium Australia Management depends substantially on their ability to generate corporate hospitality revenues and membership subscriptions. Revenue generated from corporate hospitality and membership subscriptions over the 32 year concession period, need to be adequate to cover interest payment, debt repayment, dividends on equity investment, operational costs and ideally a sufficient profit margin (Stadium Australia Group 1996b).

Results And Discussion

The 'ticks' in the following table indicate which particular risk factor is applicable to the relevant party managing or bearing the risk factor(s) in question: Ultimate responsibility for managing construction, and subsequently any construction related overruns, are borne by the contractor, Multiplex. The contractor was ultimately responsible for cost overrun by way of fixed price, lump sum Design and Construct (D & C) contract. The project company was responsible for the cost overrun associated with their initiated changes and variations or for items outside the D & C scope. Multiplex bore the substantial portion of design risk under the D & C contract. Project performance can have a significant effect on the efficiency during the operation of the project and the ultimate effect of an inefficient operation may result in lower revenue collection.

Operational risk is typically borne by the private sector operator under the terms and conditions of the operational and maintenance agreement. In this instance Ogden IFC. Gardner

Merchant also bears similar risk in the operation and provision of catering services. Risk identified with operational safety is significantly the responsibility of the Operations and Maintenance (O & M) contractor, Ogden IFC, but Multiplex bears some risk in undertaking the D & C contract to provide a facility that is 'fit for purpose'. Any risk associated with industrial relations are borne by Multiplex throughout the construction/development phase of the project and the O & M contractor throughout operational phase.

The Trustee is responsible for expenses and damages associated with site conditions, latent conditions, contamination, heritage and archaeological items, endangered flora and fauna. The Government indemnifies the Trust against any native land claim. If however a claim is based on artifacts or archaeological items found, then the Trust bears this risk. The risk of poor environmental management may be a private or public sector risk depending on arrangements and is particularly important given Sydney's bid for the Olympics as the 'Green Games'.

Financial risk is managed by the equity investment undertaken by the founders, commercial investors and public investors. Underwriters were forced to take up the balance of the under-subscribed public offering of gold packages. The works adjustment deed makes provision for any contract sum adjustment due to interest rate fluctuations up until financial close of the project. Any taxation risk is covered in that the Project Agreement states that the project company bears this risk except where a law/tax change is shown to be 'discriminatory', i.e. specifically affecting the project, the project and other privately owned venues within Homebush Bay area, or the project and other competitive stadiums.

Country risk was not seen as a key issue as Australia is viewed as a very stable and secure country in which to invest. The risk associated with changes in government or policy are largely with the project company. Corruption risk was assessed as being unlikely as the allocation of responsibility is dealt with by the underlying laws of Australia. Clear and transparent guidelines from the public perspective eased concern with regard to the possibility of corruption. The process was overseen by the government's 'due diligence' auditor. Any political backdown or failure to honour guarantee's was managed by the Project Agreement making provision for indemnification of the private sector. Political risk was offset by a Government that was very supportive of the project, given the country's responsibility in staging the Olympic games. By virtue of the concession period however, all BOOT projects will see changes in administration and this is a risk that the private sector can 'gamble' on in accepting exposure. Greater political stability and support will aid in success and management of risk.

Lifespan risk exists for the project company in that over the project lifespan/concession period, new technology or competition may introduce an element of obsolescence. At the transfer stage the government may be taking ownership of a partly outdated facility. Any infrastructure related risk was accounted for in that the facility depended on construction of adjacent infrastructure such as the new rail station, carparking, roads et al, which were promised by OCA in accordance with the Homebush Bay Masterplan Transportation Strategy. Existing infrastructure (Sydney Football Stadium, Sydney Cricket Ground and Parramatta Stadium) in the form of competition risk, was borne by project company.

All market risk is borne by the project company, but, significant feasibility and market research aims to mitigate this risk. Risk in the form of market competition is typically borne by the private sector operator under the terms and conditions of the operational and maintenance agreement. Risk is assessed by the private sector during feasibility stages and the project agreement does not restrict construction of similar venues.

However, the OCA undertakes to 'negotiate in good faith' with the Trustee over any financial loss associated with construction of a venue in excess of 25,000 seats and within a 50 km area of Stadium Australia. Market risk in the form of income or revenue change is managed by a comprehensive feasibility investigation using realistic forecasts and allowances for contingency factors. Risk does remain in that social and economic change in an area is likely throughout a 20-30 year concession period. Some mitigation may be provided by way of the project participants partially 'underwriting' certain revenues.

Conclusion

The emergence of BOOT schemes provides a means for developing the infrastructure of a country without directly impacting on the government's budgetary constraints. Consideration given to BOOT characteristics and perceptions has allowed the development of an overall risk factor framework. The framework serves the purpose of raising awareness to factors at an early planning stage, such that further consideration can be implemented where applicable. The framework considers issues from all perspectives throughout the construction and development phase through to the operational and eventual transfer phase. The undertaking of a case study allowed the identification of risk factors relevant to a large infrastructure project procured under the BOOT concept.

Country related risks of a political, legal and commercial nature are identified as the most significant as they are all issues that the project company has little or no control over. In developed countries, where 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. This logic was proven correct in the context of the case study project.

The case study project is classified as a high complexity of product/high complexity of market type operation. This classification of facility is considered most difficult to develop and operate because of its complex businesses serving a variety of customers in a variety of markets. The case study does show evidence required for a sustainable operation.

The next stage of the work is to refine the Risk Factors highlighted in this study and to identify their key attributes that make them success factors. Refined success factors are tested in continuing work case studying BOOT projects that were procured after Stadium Australia.

References

Akintoye, A. and Taylor, C. (1997) Risk Prioritisation of Private Sector Finance of Public Sector Projects. In (Eds) Davidson, C.H. and Abdel Meguid, T.A. *Procurement – A Key to Innovation,* Proceedings of CIB W92 International Symposium, Montreal, pp 1-10.

Angeles, N.H. and Walker D. (2000) "BOOT Schemes – A Project Delivery System for a New Millennium". *Chartered Building Professional*, March 2000, pp 21-23

Fellows, R. and Liu A. (1997) *Research Methods For Construction*. London, Blackwell Science.

Jefferies, M.C., Cook, M. and Rowlinson S. (2001) *The BOOT Approach for Stadium Australia: Reflecting on the Critical Factors for Success*. In (ed) Duncan, J. Performance in Product and Practice, *Proceedings of the CIB World Building Congress, 2-6 April, Wellington, NZ.*

Ma, T.Y.F., Chan, A. and Lam P.T.I. (1998) *A Study Into The Characteristics of BOT projects in Hong Kong*. The 6th East Asia-Pacific Conference on Structural Engineering and Construction, Taipei, Taiwan, pp1131-1136.

Magub, A and Hampson K. (1999) 'Sydney's Olympic Stadium: A World Class Event?' *Construction Process Re-*

engineering '99, Proceedings of the International Conference for Construction Process Re-engineering, 12-13 July, UNSW, Sydney, pp 121-132.

McDermott, P. (1999) "Strategic and Emergent Issues in Construction Procurement". In (eds) Rowlinson S. and McDermott, P., *Procurement Systems: A Guide to Best Practice*, E. and F.N. Spon, London, pp 3-26.

NSW Government (1997) *Guidelines for Private Sector Participation in the Provision of Public Infrastructure*. NSW Government, Department of State and Regional Development.

New South Wales Government (2000) *Working with Government – Private Financing of Infrastructure and Certain Government Services in NSW*. NSW Government Green Paper.

Salzmann A., Mohamed S. (1999) "Risk Identification Frameworks for International BOOT Projects". In (ed) Ogunlana S. *Profitable Partnering in Construction Procurement*, CIB W92 Proceedings Publication 224, pp 475-485.

Stadium Australia Group (1996a) *Stadium Australia Group - Summary of Material Contracts*. Sydney, Stadium Australia Group.

Stadium Australia Group (1996b) *Stadium Australia Group - Price Waterhouse Corporate Finance*- Independent Accountant's Report. September 1996, Sydney, Stadium Australia Group.

United Nations Industrial Development Organisation (1996) *Guidelines for Infrastructure Development through Build-Operate-Transfer (BOT) Projects*. UNIDO, Vienna.

Walker C. and Smith A.J. (1995) *Privatized Infrastructure: the BOT Approach*. London, Thomas Telford.

Walker, D.H.T., Hampson, K. and Peters, R. (2000) *Relationship Based Procurement Strategies for the 21st Century*. AusInfo, Canberra.

Yin, R.K. (1984) *Case Study Research Design and Methods*. California, Sage Publications.

The Interdependence of Procurement Strategies and Organizational Culture
From the Perspective of Innovation

G. Girmscheid[1], & A. Hartmann[1]

Abstract

In the last few years new procurement strategies have tried to consider the planning, construction and operation phase of a constructed facility from the beginning of a construction project on. On the one hand this leads to an increased innovation potential, as the constructed facility is viewed as a system in its total life cycle. On the other hand the innovation potential can only be used, if a corporate culture serves as a framework for the co-operation of all those who take part in the construction project.

The paper is based on the results of a survey on innovation from the point of view of the client and a detailed case study on the ability to innovate in a medium-sized contractor. In particular it shows how the organizational culture effects the innovativeness of the client and the contractor and which cultural changes are needed for intra-organizational solutions fostering innovations. Moreover, these findings will be transferred to inter-organizational solutions, which are deduced from the innovation potential provided by a changed procurement strategy of the client.

Keywords: innovation, procurement strategies, organizational culture

Introduction

In recent years a trend could be observed in the construction industry that expressed itself in a movement from the traditionally sequential procedure of a construction project

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towards an integrated one. Typical of this integrated procedure of a construction project is that the influences from the phases of execution and operation are already considered in the planning phase. One of the reasons for this trend is the change in the demands of the clients. Nowadays clients more and more ask for constructional solutions which will guarantee long-term low expenses for maintenance and operation and which can easily, flexibly and quickly be adapted to possible changes in utilization that might occur due to economics or technology. Another reason for the trend is that clients now transfer a part of the tasks they used to fulfil to construction companies. Correspondingly the procurement strategies of the client have changed. Constructed facilities are more and more only characterized by their functions and the requirements resulting from them. To find out how to meet these requirements is the companies' task. The client wants to have one contact person who takes on the responsibility for the constructional solution.

For the companies from the construction industry this trend is a challenge and a chance at the same time. On the one hand, using the innovative potential that results from viewing the constructed facility over its whole life cycle enables them to find constructional solutions that ideally match the clients' demands and thus also enables them to gain advantages in competition. On the other hand, in order to be able to use these innovative potentials, the construction companies are forced to find new forms of co-operation and as a prerequisite for that especially a new cultural orientation for their dealing with each other.

The Influence of the Organizational Culture on the Ability to Innovate

It has been known for a while that one of the conditions that foster innovations in organizations is creating an organic rather than a bureaucratic organizational structure. Characteristic of those organic organizational structures is that they have fewer

hierarchical levels, that they are decentralized, that the employees' tasks are extensive and their areas of competence far-reaching (Hill, Fehlbaum, Ulrich, 1994). It has remained unrecognised though, that organizations and especially companies consist of different units that are characterized by the various demands on the tasks and the structure of the organization. Difficulties arise from the necessity to co-ordinate the different units, as the different tasks and structures lead to different attitudes and behaviours on the part of the staff members (Kieser, 1986). This in return leads to conflicts in realizing innovations, because here different units have to work together. In order to solve the conflicts, a stabilizing framework is needed, which orientates all persons involved to the aims and strategies of the company and motivates them for fulfilling their tasks together. This means that common values and rules have to be conveyed (Kieser, 1986). The organizational culture with the values and rules, the way of thinking and the attitudes as a whole serves as this framework. Different empirical studies could proof this (Wagner, Kreuter, 1998), (Vahs, Trautwein, 2000).
Organizational cultures that foster innovation show the following features:

- high status of innovations
- freedom of the members of the organization to act autonomously and to be creative
- support for those members of the organization who are especially innovative
- preparedness to take risks and willingness to tolerate mistakes
- open communication on and between all levels and units of the organization

The Innovative Culture of the Client

A specific feature of the construction industry lies in the role of the client. He is not only the purchaser of the constructed facility as the product, but he decides if, when and how something is built. He defines the demands on the constructed facility, he provides the financial resources and chooses the procurement strategy. The decision for a procurement strategy here depends on how the demands on the constructed facility can be optimally transferred into a constructional solution. As innovations in this sense contribute to reaching the optimum, one criterion for choosing the procurement strategy can be the available innovative potential.

The innovative potential increases, if the constructed facility is viewed in its whole life cycle and therefore is enlarged by procurement strategies that bring together the knowledge of the single life phases at an early point in time (Girmscheid, Hartmann, 2001b).

To find out to what extent clients deliberately choose these procurement strategies a survey on the attitudes of professional clients from the commercial and private building construction sector was carried out by taking semi-structured interviews .

The status of innovations or the demand for innovative constructional solutions is the result of one of the main aims of professional clients. This main aim is obtaining a good return on investment with the constructed facility in the long term and preserving or enlarging its market value. But this aim can only be reached through a recognizable surplus value over the whole period of its useful life in comparison to similar constructed facilities nearby that are in competition with it. Investments and new developments in the field of heating and ventilation are an example for this. With the help of them energy consumption results can be achieved now that will already satisfy the requirements of future protective measures for the environment.

Here clients are forced to deal with an increasing intricacy of constructed facilities. A multitude of technical elements, which are related to each other in numerous ways, make it more difficult to assess the effects of innovative changes. Bringing together the technical knowledge of the planning, execution and operation phase at an early point in time by choosing an appropriate procurement strategy, the client can better assess the effects of innovations and thus the risk decreases. At the same time they regard an early co-operation as partners as a greater support for innovations.

Although the risk has been reduced, it cannot be guaranteed in advance that innovations will be successful. There will always be a remaining risk and the clients under investigation tended to be willing to take this risk, especially if they showed preparedness to take risks with regards to innovations in their core business, too.
These clients are also willing to bear the additional expenses on investments that often come along with innovations. For example, they raise internal funds to subsidize innovative constructional solutions, which otherwise would not have been realizable because of a lacking return on investment. They also create incentives for the construction companies to be innovative by implementing Bonus-Malus systems.

Nevertheless many clients still prefer the classical separation of planning and execution. A lack of confidence in the technical competence of construction companies as well as the opinion that the process of execution has no influence on the constructed facility often stop the use of other procurement strategies.

The Innovative Culture of Construction Companies

The case study in a medium-sized construction company aimed at determining the substantial influences on the innovative processes taking place in the company and with the help of the results at developing instruments that are suitable for fostering innovations.

In order to be able to reach this aim, a starting-point was chosen that considered the specific conditions of the company and put them into relation to the objects of an integrated innovation management. Company culture has been regarded as an indirect object, too, and has been included in the investigation (Girmscheid, Hartmann, 2001a).

One part of the case study's aim therefore was to determine the markedness of the company culture with regards to its support of innovations. This was intended to detect the prerequisites for designing innovation processes in the company and, if necessary, to be able to take measures that will change the culture. Data gathering was carried out by group discussions in the upper and middle management, semi-structured interviews on all levels of management and analysis of documents.

For a better understanding of the following results some additional information on the main characteristics of the company under investigation is given. It is a family-owned company with about 1,000 employees, offering execution work in different areas (i.e. building construction, tunnelling, road construction, maintenance of buildings etc). The company consists of technical and regional business units, with the technical business units operating from the company's headquarters. Both, technical and regional business units work as autonomous profit centres.

Desirable Values and Rules – The Management's Point of View

From the point of view of the company's management innovations play an important role, because they can serve as the company's reaction to changes of its environment. Innovations are regarded as one possibility to obtain advantages in competition. In particular, they are meant to contribute to achieving a higher extent of satisfaction of the clients demands and to securing the quality of the services offered.

This is why the management does not object to innovations, but has high expectations and applies a strict standard when assessing them. It is of great importance to them that the financial risk is restricted to a minimum.

While the dynamically changing environment can be seen as a reason for the necessity of innovations, personalized values, which originate from the tradition as a family-owned company, such as confidence, modesty, the willingness to perform and to tolerate mistakes have an influence on the way new developments are dealt with.

In order to support the staff members' preparedness to innovate, the management expresses the necessity to achieve a constant increase in efficiency and effectiveness and expects all employees to strive for this.

In addition to this, the possibility to work autonomously and the delegation of demanding tasks shall contribute to the staff's motivation and create freedom to act innovatively.

In the end innovating in the company is seen to be to a large extent depending on single staff members. Being innovative is regarded as a permanent and comprehensive task of every staff member, which has to be actively pursued, while the quality and the professionalism of the management on all levels is seen as a prerequisite for this.

The management believes that the communication within the company is active, which means that the necessary information is always available and that everybody knows where to get which information or where it is needed.

Existing Values and Rules – The Staff's Point of View

If the values and rules desired by the management actually exist in the company, was a question that could be answered by the employees.

The communication between the departments concerning the projects is going on without problems. The project-related work and the spatial closeness of the departments support the exchange of information. Short distances and the existence of public places (e.g. cafeteria) particularly stimulate the informal exchange of information. Partly the site managers complained about an insufficient flow of information with regards to the ideas that the calculator has on the execution while he is working on the offer.

Most of the staff members from all hierarchical levels think that there is little preparedness to take risks in connection with new ideas. There is a tendency only to implement innovations that have already proved themselves on the market. Here the attitude towards new activities that the management characterized as „careful" can be observed.

In addition, the fact that the responsibility for costs and deadlines is restricted to projects and departments partly prevents the departments from co-operating in new services. The risk has to be taken by the initiating department, while other departments help, but are not willing to share the risk. Therefore part of the work is not done using own capacities, but is obtained on the market for a better price. Synergies are not used as the thinking is restricted to the single departments.

The company under investigation allows its employees to work autonomously. It is possible to try and test new ideas. A further sign of the delegation of responsibility is the way mistakes are dealt with, which staff members are allowed to make in connection with new ideas.

However, the freedom to act innovatively, which is granted by the possibility to work autonomously, is restricted by a lack of time, which is characteristic of the whole building project. Furthermore, it is true that there is the possibility to try new ideas, but an employee's willingness to do so is seldom supported or appreciated by the superior. Here it is evident that it is not sufficient to call for new ideas. Additional efforts have to be made to give the employees freedom to be innovative or to highlight innovative action and acknowledge it.

Measures to Change the Culture

The results of the investigation revealed that the instruments which have to be developed, in order to organize the innovation processes, have to be accompanied by additional measures to change the culture. But to transfer a culture that is hostile to innovations into a culture that is open to innovations, is an extremely difficult task. It will be a long process that has to be carried out gradually and according to plan (Kieser, 1986).

The measures that were taken to change the culture mainly aimed at improving the support of innovative staff members by their superiors, at improving the communication between site manager and calculator and at providing the staff members with freedom to innovate.

The following concrete measures were taken to change the culture:

- bilateral talks between superiors and employees that take place regularly and are mainly intended to convey the importance of being innovative to the employee, to increase his openness to new ideas and to indicate the superior's support for innovative action. This also includes that the management has to communicate the importance of innovations to the heads of the departments more frequently, in order to support co-operation between the departments.

- a project checkpoint to examine the innovative potential of the project at different stages. This includes checking, if it is useful to take into account the knowledge of the site manager at an early point in time and to invite him to participate in decisions regarding the project.
- innovation groups as a permanent forum for innovation within the department, consisting of employees from the department who organize the groups themselves. These groups will help the staff members to permanently and intentionally think about improvements in the department and at their work station and to deliberately look for solutions to the problems. This measure also intends to further intensify the communication that is already going on well.
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Besides this, organizational solutions were developed which will reduce the problem of the lack of time for innovations and thus will indirectly strengthen the element of autonomy which is fostering innovations.

Taking into account the company's attitude towards risks, organizational instruments were developed that primarily support the implementation of incremental innovations.

Innovative Culture on the Project Level

The results of the investigation clearly show that the choice of a procurement strategy is on the one hand partly determined by the demand of the client for an innovative constructional solution and the innovative culture of the client's organisation. On the other hand the innovative potential that is created by the procurement strategy can only be used, if the organizational culture of construction companies is open to innovation.

A multitude of persons involved in the project act on the project level and these persons vary from project to project. This is why differently shaped organizational cultures come together at this point, which are not connected by a cultural framework. As a consequence it becomes more difficult to find solutions to conflicts and to take on risks that especially come along with innovations.

A cultural framework supporting innovation can emerge from the co-operation of different companies that goes beyond single projects. An example for this are strategic networks as a long-term form of co-operation (Girmscheid, Hartmann, 2001b).

By uniting companies that are specialized in different fields of service and work together as virtual companies according to the requirements of the project, strategic networks make it possible to orientate the companies to long-term aims and strategies. A common organizational culture makes this possible.

Therefore, companies that try to realize strategic co-operation, find themselves in a dilemma. On the one hand only a long-term co-operation can lead to a common culture, on the other hand a common culture is the prerequisite for a successful co-operation. This makes it evident once again that the establishment of common values and rules requires a long and complicated process with possible set-backs.

References

Girmscheid, G., Hartmann, A. *"Innovation management in construction companies - an integrated model"*. Proceedings of the CIB World Building Congress, Wellington, New Zealand, 2001a.

Girmscheid, G., Hartmann, A. *"The ability of contractors to co-operate - a key to innovative total solutions"*. Proceedings of the 1st International Conference on Innovation in AEC, Loughborough, UK, 2001b.

Hill, W., Fehlbaum, R., Ulrich, P. „Oganisationslehre 1" (in German). 5th ed., UTB, Bern, 1994.

Kieser, A. *„Unternehmenskultur und Innovation"* (in German). Management von Innovationen, Erich Staudt (editor), FAZ, Frankfurt am Main, 1986.

Vahs, D., Trautwein, H. „Innovationskultur als Erfolgsfaktor des Innovationsmanagements" (in German). *iomanagement*, 7/8, 2000, 20-26.

Wagner, M., Kreuter, A. „Erfolgsfaktoren innovativer Unternehmen" (in German). *iomanagement*, 10, 1998, 34-41.

Transformed Culture And Enhanced Procurement
Through Relational Contracting And Enlightened Selection

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Abstract

A cluster of recommendations that resonate through many high-powered reports on construction industries in different countries (e.g. UK, Singapore, Australia and Hong Kong) relate to the desperate need for radical 'cultural' changes. For example, the identified need to re-integrate fragmented functions and teams, has led to recommendations on cooperation and collaboration through approaches such as partnering and alliancing. Relational Contracting (RC) principles are at the core of such approaches and underpin the theoretical foundations for their growth. However, ad hoc and disjointed partnering and alliancing initiatives, while registering some success, would benefit from more focused applications: (1) firmly founded on holistic RC theory and (2) deriving a practical impetus through (a) re-engineered contractual systems and (b) realistic evaluation criteria for selecting team participants - throughout the supply chain of consultants, contractors, subcontractors and principal suppliers - that will require upfront commitments to the RC oriented culture change if they are to be selected. These theoretical justifications and practical imperatives would then empower the elusive 'cultural shift' and propel the 'new procurement paradigm' - from industry report rhetoric to reality. The rationale for the above is set out in this paper and illustrated with results from recent surveys in Hong Kong and examples of innovative 'good practice' from other countries.

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Keywords: Construction, Culture, Partnering, Procurement, Relational contracting, Selection.

Introduction

The construction industry is known to be highly adversarial (Latham 1994). Productivity levels are low compared to other industries and have even dropped in some countries (Schwegler et al 2001). Owners have been seen as risk evasive (Ahmed et al. 1999), and contracting parties interpret contract clauses differently (Hartman et al 1997), and for their own benefit (Clegg 1992). Contracting parties are seen to work 'at arms length' in disjointed and fragmented arrangements, usually motivated by conflicting 'self-benefits' that not surprisingly depress productivity levels. Other consequences include time and cost overruns, poor quality, customer dissatisfaction, lengthy and costly disputes, and disruption of relationships among the contracting parties. Moreover, purely price-based selection strategies induce tenderers to lower their bids to win contracts, relying on subsequent claims to recover their costs. These translate into more disputes and even lower overall productivity.

The above vicious circle/ downward spiral scenarios have been sketched in many high-powered reports on construction industries in different countries. These have called for radical 'cultural' changes and recommended cooperation and collaboration through approaches such as partnering and alliancing. Applications of these approaches, mainly between owners and contractors, have recently met with some successes. But the subcontractors carry out major parts of the works (Kumaraswamy and Matthews 2000), while consultants, suppliers and other stakeholders also play important roles in project delivery. They should therefore be brought into the 'one team' concept to optimise benefits (Lownds 1998). While classical contractual arrangements call for clear and definitive allocations of risks between stakeholders, all possible risks/ uncertainties are difficult to foresee and quantify at the outset (Macneil 1978). This calls for flexible contract conditions under which unforeseen risks would need to be dealt with using a 'Joint Risk Management' (JRM) strategy at the post-contract stage (Rahman and Kumaraswamy, under review-A). Relational Contracting (RC) principles underpin and justify efforts to lubricate consequent contractual 'transactions' with an additional focus on smoother risk management through JRM. More 'relationally-based' and performance oriented (rather than purely price-based) contractor selection would also encourage an amicable RC environment, more collaborative teamwork and higher productivity (Rahman et al 2001). These concepts may be extended to radically improve the selection strategy throughout the supply chain and to build a coalescent 'one team' to deliver optimal project performance. What is critical are the re-aligned attitudes and convergent culture of this coalesced team (Rahman and Kumaraswamy, under review-B).

Drawing on the above background observations, this paper discusses the required 're-engineering' of contractual systems and realistic evaluation criteria for selecting team participants through the applications of RC principles. These encourage long-term provisions on the basis of understanding each other's objectives and introduce a degree of flexibility into the contract, by considering a contract to be a relationship among the parties (Macneil 1980). The paper also demonstrates how RC principles may be applied in building a successful project team for JRM during the entire project life cycle i.e. at pre-contract, contracting and post-contact stages. This will be reinforced by relevant observations on the perceived desirability of JRM and the importance of different factors for developing a successful RC environment, based on recent surveys. Examples of some innovative 'good practice' will illustrate these observations.

Fundamentals of Relational Contracting

Relational Contracting (RC) is based on a recognition of mutual benefits and win-win scenarios through more cooperative relationships between the parties. RC principles underpin various approaches, such as partnering, project alliancing, strategic alliancing, joint venturing and other collaborative working arrangements and better risk sharing mechanisms (Alsagoff and McDermott 1994, Jones 2000A). At the core of RC, parties do not strictly follow the legal mechanisms incorporated in specific contracts, but they operate within a dynamic standpoint constantly pulled by a collection of contractual (legal), economic and behavioural forces (Macaulay 1963). Relationships between the parties are therefore very important. This is particularly so in complex, lengthy and evolving transactions, as seen in construction projects, where the circumstances underlying the contract may change considerably over time.

RC provides the means to sustain ongoing relations in long and complex contracts by adjustment processes of a more thoroughly transaction-specific, ongoing administrative kind. This may or may not include an original agreement; and if it does, the need for the contract may be of less importance (Macneil 1978). RC considers contracts as promises of doing something in the future. But not all the events can be 'presentiated' (perceived or realized), and, as all the information needed cannot be 'presentiated' at the time of contracting, mutual future planning is required. This may well give rise to 'opportunism', which is counteracted by the 'business trust' that is based on communities of shared ethical values, shared principles of fairness and convergent mutual expectations about informal obligations (Deakin et al 1997). These are achieved through motivation and individual attitudes that considerably influence the project outcomes (Drexler and Larson 2000). Such trust can sustain cooperative behaviour in the face of complexity and unforeseen problems.

RC approaches thus appear useful in achieving the overall objective, which is to reduce the sum of production and transaction costs (Walker and Chau 1999), by providing the necessary flexibility to adjust and adapt outside predetermined (purely contractual) response mechanisms. However, while non-legal enforcement mechanisms clearly play a major role in RC, legal mechanisms may also play a part in exchange arrangements. Equally, more formal contractual arrangements (i.e. classical and neoclassical) are present with an armoury of supportive non-legal mechanisms (Lyons and Mehta 1997). This is seen in some RC-type practices in the present construction industry e.g. through partnering: Project partners work as a team on the basis of a ' partnering charter' that is not legally binding and if there is any problem the original contract will take precedence.

The Issue of Transformed Culture

Hofstede (1980) describes 'culture' as the collective programming of the mind that distinguishes the members of one human group from another. It is usually reserved for societies or nations or for ethnic or regional groups, but it can be applied equally to other human collectivities or categories: an organization, a profession, or a family.

Culture in construction project scenarios is therefore the culture of the project team comprising different contracting parties in the supply chain and also include company-wide inter-departmental members and others who contribute in some way to the final product or service to be delivered (Mackay 1993). A project culture is thus built up from a number of sources - national, ownership, sectoral and style differences. At the project level, there are also other issues that affect the culture of the project. These arise from key variables flowing in from multiple organisational cultures, individualistic subcultures, professional subcultures and operational subcultures (Kumaraswamy et al 2001).

It is therefore vital to recognize the team, while the individuals in the project team are extremely important as well. What is needed is an understanding of how to structure, develop and reward both teams and individuals without detriment to either, while also shedding costs, improving margins, and being extremely client-responsive. These imply doing things effectively and efficiently at the first time (Mackay 1993). This requires a commitment to change and teambuilding very different from that of the past. Recent studies show that such ideas are now emerging in the construction industry, as will be discussed in subsequent sections. The combined 'mind-set' of the project team may need continuous and cooperative learning, in a direction that recognises changes in customer demands and expectations. Such collective 'culture acquisition' (or transformation) also depends on the 'real event' in all its complexity of place, people, atmosphere, and interactive responses that is derived from 'a set of relations' (Pitman et al 1989) and thus relates well to the previously discussed RC approaches.

Transformed Culture and JRM

The nature and extent of construction risks may change as a project progresses, new risks may emerge and existing risks may change in importance or be re-allocated, as not all the risks are foreseeable at the outset. Some of these risks may also require the combined efforts of contracting parties for their effective management.

Despite these facts, it has become almost a truism that the party best able to manage a risk should bear the risk (Nunn 2000). Yet, present risk allocation mechanisms on construction projects vary, depending on several client-specific attitudes and project-specific characteristics. For example, Table 1 presents a relevant summary of responses from 66 respondents around the globe to a Hong Kong based survey on an array of risks transferred to Design-Build contractors. A variation in risk allocation perceptions across different contractual regimes is observed from this summary. It may also be noted that design risks being passed on to the same contracting organization in this increasingly popular Design Build scenario (where there is already some in-built JRM) does not reflect the general construction scenario.

Table 1: Summary of responses on risks transferred to the Design-Builders

Risks that should be transferred to the Design-Builders	Percentage of respondents who ticked 'yes'			
	HK*	USA	OC**	Overall
Ground conditions	61.5	40.6	42.9	45.5
Discovery and relocation of utilities	53.8	68.8	81.0	69.7
Approvals and permits	53.8	71.9	33.3	56.1
Groundwater seepage	53.8	56.3	61.9	57.6
Hazardous wastes/ hazardous working conditions	38.5	37.5	61.9	45.5
Weather conditions	61.5	68.8	52.4	62.1
Variations to satisfy different users' requirements	23.1	43.8	23.8	33.3
Unforeseen environmental requirements	23.1	6.3	19.0	13.6
Acquisition/ possession of construction area	0	31.3	14.3	19.7
Quality control/ quality assurance	46.2	96.9	95.2	86.4
Design criteria	23.1	43.8	38.1	37.9
Design defects from client's initial design	7.7	46.9	42.9	37.9
Constructability of design	69.2	100	76.2	86.4
Co-ordination with other work/ agencies	61.5	93.8	85.7	84.8

* HK - Hong Kong, ** OC - Other countries

Table 2, on the other hand, presents a profile of average perceptions on JRM desirability that are extracted from a summary of relevant responses from 47 respondents to a different Hong Kong based survey that focused on risk management in construction projects in general. Here, it is evident that sizable components (percentages) of many of the 41 identified common construction project risks were perceived to be more suited for JRM, despite relatively small divergences between different groups. Table 3 shows the desirability for JRM of almost all of the same 41 risk items irrespective of contract conditions. It is seen from the total sample that 16 risk

Table 2: Average Perceptions on Joint Risk Management (JRM) based on groupings of 'working organisation' and 'nature of present job'

Percentage of risk that should be jointly managed	Number of risks (out of 41, used in the survey) in each category*						
		Working organisation			Nature of present job		
	Total (47)	CSL (14)	CTR (8)	OWN (15)	ACAD (10)	ENGG (18)	MGRL (19)
0	0	0	7	1	0	0	1
1 - 10	12	15	6	13	4	18	10
11 - 20	13	13	17	8	20	12	12
21 - 30	10	9	5	8	13	6	8
31 - 40	6	3	4	6	3	5	7
41 - 50		1	1	3	1		1
51 - 60			1	1			2
More than 60				1			
Total No.:	41	41	41	41	41	41	41

*Figures in parentheses () indicate the numbers of respondents in each group.

Notes: CSL - Consultants CTR - Contractors OWN - Owners
ACAD - Academics ENGG - Engineering MGRL - Managerial

items are perceived to be suited for JRM of more than 20%. Table 4 shows the percentages of these 16 risk items that are recommended for JRM under different sets of standard contract conditions.

All these show the collective attitude/ motivation of the industry towards the desperate need for more RC oriented and flexible contractual arrangements that are expected to enhance

Table 3: Summary of average perceptions on Joint Risk Management (JRM) based on contract categories (i.e. stand. conds. of contract)

% of risk that should be jointly managed	Number of risks (out of 41 used in the survey) in each category*			
	Total (47)	FIDIC (25)	HKGCC (8)	GENERAL (9)
0	0	0	0	1
1 - 10	12	20	9	5
11 - 20	13	14	5	11
21- 30	10	5	10	7
31 - 40	6	2	7	11
41 - 50			4	4
51 - 60			5	1
More than 60			1	1
Total No.:	41	41	41	41

*Figures in parentheses () indicate the number of responses. . Five responses were based on some other different contract conditions and those are not compared here as a separate category.
Notes: FIDIC: Fédération Internationale des Ingénieurs-Conseils (International Federation of Consulting Engineers); HKGCC: The General Conditions of Contract for Civil Engineering Works in Hong Kong; GENERAL: Not according to any particular conditions of contract

overall economic performance. The observations also reconfirm the increased importance of selecting the 'right' partner with whom clients can establish and maintain such relationships and achieve high performance levels in win-win scenarios (Rahman et al. 2001).

Initiating Cultural Transformations through Procurement and Selection Strategies

Partnering and alliancing are good examples of RC principles in practice. Recent industry practice and research trend show a tendency to encompass all the stakeholders in one team. For example, Thompson and Sanders (1998) observed that benefits from partnering-type RC increase with a migration of teamwork attitude from competition to cooperation, through to collaboration and finally to coalescence. Essentially,

Table 4: Comparing average perceptions on Risk items ranked as most suitable for Joint Risk Management (JRM) in general

Risk Items	Percentage of risks suitable for JRM *			
	Total (47)	FIDIC (25)	HKGCC (8)	General (9)
Cost of legal process	40	38	35	44
Delays in resolving contractual issues	39	31	55	38
Delays in resolving disputes	35	30	55	25
Public disorder	32	22	75	37
Envir. Control (as impacting on project)	32	17	36	59
Acts of God	31	18	60	45
Envir. hazards (project area only)	30	19	35	48
Buildability/ Constructability	30	23	41	42
Change order evaluation and negotiation	28	24	27	33
Physical impossibility	27	20	57	31
Unforeseen site conditions	26	15	46	15
Economic disaster	25	17	38	35
Third party delays	24	20	57	18
Conflicts in documents	24	21	24	40
Change in scope of work	23	11	25	14
Union strife	23	19	40	35

*Figures in parentheses ( ) indicate the number of responses. Five responses were based on some other different contract conditions and those are not compared here as a separate category.

Notes: FIDIC: Fédération Internationale des Ingénieurs-Conseils (International Federation of Consulting Engineers); HKGCC: The General Conditions of Contract for Civil Engineering Works in Hong Kong; GENERAL: Not according to any particular conditions of contract coalescence implies all stakeholders work in a 'one team' spirit. Ho (2000) indicated cost savings of 11% to 38% in Guaranteed Maximum Price (GMP) based procurement strategies that also included an open book approach when the contractor - together with his subcontractors' and suppliers' information - worked closely together with the consultant. Kumaraswamy et al. (2001) argue for a cultural transformation towards 'one team' consisting of all stakeholders and a project culture that can facilitate the required productivity gains. The Australian National Museum project (Walker et al. 2000), and also three out of 34 contracts of Tseung Kwan O Extension project of Hong Kong Mass Transit Railway Corporation (MTRC) (Bayliss 2000) were contracted and agreed on a target final account and 'pain-share/ gain-share' approach. The Heathrow Express Railway project will probably be an appropriate example of a completed successful teambuilding exercise in a changed culture (Lownds 1998). The project suffered an enormous setback when the tunnel in the central terminal area collapsed, yet the 'culture change' initiative of the client in the form of teambuilding and cooperation among 'all parties' concerned resulted in a reduction of 20% of costs it expected to carry after the collapse, made up critical construction time, and saw the opening date for the railway brought forward from early 1999 to June 1998. Regardless of their organisational affiliations, parties on this project had a slogan that they were not competing with each other but operating as 'one team' with overriding loyalty to the goal of delivering the railway. In fact, RC approaches are expected to work in almost any environment, if applied properly. However, this requires transforming traditional relationships towards a shared culture that transcends organisational boundaries (CII 1996). What are critical are the motivation and attitudes of the project participants.

Achieving such major cultural transformations after the various project participants are selected is not easy. For example they would each bring their 'own baggage' (or 'preconditioning') with little incentive to change and also may be under pressure to 'get on with the work' in 'tried and trusted' ways. It is therefore recommended to initiate the required cultural transformation by appropriate conditioning during the 'selection stage' i.e. by incorporating desired facets such as 'partnering history and/ or potential' into explicit selection criteria. Many public and private clients still prefer price-based selection strategies for various reasons, such as convenient evaluation, accountability concerns, and apparent economies. Moreover, there is an increasing trend for enlightened clients to seek other performance-related criteria to meet the special needs of their projects. For example, Rahman et al (2001) argued that more relational and performance oriented contractor selection would encourage an amicable RC environment and more collaborative teamwork. Kumaraswamy and Matthews (2000) found 10% tender pricing reductions by subcontractors based on savings anticipated in a partnering (i.e. RC-type) approach. The alliance team for the Australian National Museum project was selected with some 12 non-price based factors, to work in an open book approach (walker et al 2000). The alliancing contracts in Australia are also featured with 'no dispute' clause (Jones 2000B). The Utah Department of Transportation insists on 'partnering' as a mandatory precondition for contractor prequalification (UDT, 1997), while the MTRC in Hong Kong has an anecdotal reputation for achieving good relationships with contractors, hence minimizing disputes and associated costs through such 'relational' approaches.

It is observed from the above that the long-awaited paradigm shift is in progress. The following results from an ongoing survey on RC and JRM reconfirms this trend. Table 5 shows the perceptions on 'which project partner should be brought in at what stage' of the project. It can be noticed that only 4 of the 17 respondents to date preferred not to consider subcontractor and suppliers before contract award. Table 6 shows the perceptions on the importance of different factors for building a successful RC. The self-explanatory results show that the respondents have overwhelmingly rejected the traditional hierarchical contractual relationships. The pioneering role of the clients and the possibilities of future works are considered even less important than professional ethics and developing RC culture within an organisation. Comparatively lower standard deviations of the average results from the responses of 7 countries and diverse contracting parties indicate a consistency in the perceived need for RC approaches worldwide. This is reassuring in that it may hopefully indicate that we have now entered a transitional period of the long-awaited paradigmatic cultural shift in the construction industry.

Concluding Observations

There is increasing evidence of a growing appreciation of benefits from non price-based selection and innovative procurement strategies. Progressing from gradual improvements in contractor selection, these strategies are likely to gradually encompass the selection of consultants,

Table 5: Perceptions on Who should be brought in at Which stage of RC oriented approach for JRM

Stages/ Options	Consultant	Contractor	Sub-contractor	Supplier
Inception of the project	16	3	1	1
During Preliminary/ early stage of design	1	4	3	3
Towards end of design stage		6	2	4
After design, but before tendering		3	4	
During tendering, but before submission of bid		1	3	5
After awarding the contract			3	2
No need to consider			1	2
Total	17	17	17	17

Note: 17 responses from 7 countries, average experience =17.5 years, represent both public & private owners, academics, consultant and contractor

Table 6: Importance of factors for developing a successful RC for implementing JRM (measured on a scale of 1 to 10)

Items/ Factors	Average	STDEV *
Traditional owner, contractor, subcontractor hierarchy	3.82	2.51
Jointly organised social/ cultural activities (e.g. karaoke, sports)	4.29	2.39
Legal implications	6.00	2.45
Pioneering role of the owner/ client	6.12	2.45
Cost of implementing partnering	6.18	2.16
Possibility of future work	6.47	2.15
Partnering workshop	6.53	2.12
Role of partnering facilitator	6.59	1.66
Partnering experience	6.71	2.26
Developing a partnering culture, first, within the organisation	6.94	2.36
Alignment of objectives	7.21	2.49
Professional ethics	7.24	2.33
Agreed mechanism for performance appraisal	7.41	1.8
Compatible organisational cultures	7.41	1.87
Frequent formal and informal meetings	7.59	1.7
Agreed process for dispute resolution	7.82	2.04
Equitable and clear allocation of foreseeable and quantifiable risks	8.00	2.5
Collective responsibility, instead of personal responsibility	8.06	1.71
Effective coordination	8.18	1.55
Awareness of risks and rewards	8.24	1.09
Understanding each-other's objectives	8.50	1.22
Attitude of the project participants	8.59	1.28
Readiness to compromise on unclear issues	8.65	1.06
Open communication among the parties	8.65	1.84
Mutual trust	8.94	1.25

STDEV = Standard Deviation

Note: 17 responses from 7 countries, average experience =17.5 years, represent both public & private owners, academics, consultant and contractor subcontractors and suppliers, to form a more cohesive project team. A growing realisation of the advantages of JRM is being followed by an appreciation of less adversarial contracting frameworks. The industry is seen to be thrashing in the throes of a transition in transforming its traditional existing adversarial culture towards more relational holistic 'one team' approaches that also suit the nature of a particular project. RC theories and principles are also seen to be at the core of almost all these approaches, although these have not been discussed as such in recent literature. However, there has hitherto been a lack of theoretical foundation and justification for such approaches. If such RC principles are translated into practices that are made almost mandatory in contracting and selection procedures, all potential project partners will be forced to fit into 'the system' in order to win work and survive. This will plant the seeds for an RC culture and will help to propagate RC on a broader scale, through the whole supply chain, as a standard way of doing business. The 'next generation' of the construction industry can then be expected to be horizontally and vertically integrated in RC oriented virtual organisations that integrate multiple parallel functions and extended supply chains respectively, to provide effective, efficient, and seamlessly integrated innovative services.

The project team does not only consist of different contracting organisations, but the individuals within those organisations also vary in terms of position, education, skills, profession, ethical values, and many other background characteristics. It is therefore not easy to develop a desired project culture by blending them into a homogeneous solution. Instead, the desired culture may be compared to a well-cooked curry (or stew), where all the ingredients, their quantities and the time of adding them to the cooking pot are carefully chosen to bring out the special flavour in serving a particular target group of people; and where cubes/ small pieces of meat and supplementary items may absorb essences of various spices and yet preserve their individual identities, while producing the desired overall integrated impact on the senses!

References

Ahmed, S.M., Ahmad, R. and de Saram, D.D. (1999). Risk Management Trends in Hong Kong Construction Industry: a comparison of contractors and owners perceptions, *Engineering Construction and Architectural Management*, Vol. 6, No. 3, pp. 256-266.

Alsagoff, S.A. and McDermott, P. (1994). *Relational Contracting: A Prognosis for the UK Construction Industry?* Proceedings of CIB W92 - Procurement Systems - East Meets West. University of Hong Kong, ed. Dr. Steve Rowlinson, pp. 11-19.

Bayliss, R.F. (2000). *Project Partnering - A Case Study on MTR Corporation Ltd's Tseung Kwan O Extension*, Proceedings of the Millennium conference on Construction Project Management, HKIE et al., October, addendum, pp. 1-6.

CII (1996). *The Partnering Process - its benefits, implementation, and measurement*. Construction Industry Institute (CII), Bureau of Engineering Resources, University of Texas at Austin, USA.

Clegg, S.R. (1992). "Contracts Cause Conflicts", in *Construction Conflict Management and Resolution*, ed. Peter Fenn and Rod Gameson, pp. 128-144.

Deakin, S., Lane, C. and Wilkinson, F. (1997). "Contract Law, Trust Relations, and Incentives for Cooperation: A Comparative Study" in *Contracts, Co- operation and Competition, Studies in Economics, Management and Law*, ed. Deakin, S. and Michie, J., Oxford University press, pp. 105-139.

Drexler, J.A. Jr. and Larson, E.W. (2000). Partnering: Why Project Owner-Contractor Relationships Change. *ASCE Journal of Construction Engineering and Management*, Vol. 126, No. 4, pp. 293-297.

Hartman, F., Snelgrove, P. and Ashrafi, R. (1997). Effective

Wording to Improve Risk Allocation in Lump Sum Contracts, *Journal of Construction Engineering & Management*, Vol. 123, No. 4, pp. 379-387.

Ho, O.S. (2000). *Enhancing Construction Technology Through Strategic Partnering - A Contractor's Perspective*. Paper presented in the 'Quality Housing: Partnering Symposium 2000', Hong Kong October 19-20. http://www.info.gov.hk/hd/eng/events/conf00/day1.htm

Hofstede, G. (1980). *Culture's Consequences*, SAGE Publications, London

Jones, D. (2000A). *Project Alliances. Proceedings of Conference on 'Whose Risk? Managing Risk in Construction–Who Pays*?', Hong Kong, November 2000.

Jones, D. (2000B). *Alliance Contracting in Construction*. The Earthmover & Civil Contractor Industry Summit, Sheraton on the Park, Sydney 11-12 December 2000

Kumaraswamy, M.M. and Matthews, J.D. (2000). Improved Subcontractor Selection Employing Partnering Principles, *Journal of Management in Engineering*, Vol. 16, No. 3, pp. 47-57.

Kumaraswamy, M., Rowlinson, S.M. and Phua, F.T.T. (2001). *Origins and Desired Destinations of Construction Project Culture*. Proceedings of the CIB World Congress, TG23 Workshop on Culture in Construction, New Zealand, April 2001.

Latham, M. (1994). *Constructing the Team: Joint Review of Procurement and Contractual Arrangements in the UK Construction Industry*, Department of the Environment, London.

Lownds, S. (1998). Fast Track to Change on the Heathrow Express, IPD, UK

Lyons, B. and Mehta, J. (1997). "Private Sector Business Contracts: The Text between the Lines" in *Contracts, Co-operation and Competition, Studies in Economics, Management and Law*, ed. Deakin, S. and Michie, J., Oxford Univ. Press, pp. 43-66.

Macaulay, S. (1963). Non-Contractual relations in Business: A Preliminary Study. *American Sociological Review*, Vol. 28, pp. 55-67.

Mackay, A. (1993). *Team Up for Excellence*, Oxford University press

Macneil, I.R. (1978). Contracts: Adjustment of Long-Term Economic Relations Under Classical, Neoclassical, and Relational Contract Law, *North-western University Law Review*, Vol. 72, No. 5, Part 2, pp. 854-905.

Macneil I.R. (1980). *The New Social Contract: An Inquiry into Modern Contractual Relations*, New Haven, NJ, Yale University Press.

Nunn, P. (2000). *Should Contractors have Legislative Protection to Ensure Prompt Payment*. Proceedings of the conference on "Who's Risk? Managing Risk in Construction - Who Pays?", Hong Kong, November.

Pitman, M.A., Eisikovits, R.A. and Dobbert M.L. (1989). *Culture Acquisition: A Holistic Approach to Human Learning*. Praeger Publishers, New York, USA

Rahman, M.M. and Kumaraswamy, M.M. (Under review-A). Joint Risk Management Through Transactionally Efficient Relational Contracting, (for "*Construction Management and Economics*")

Rahman, M.M. and Kumaraswamy, M.M. (Under review - B). Minimising Transaction Costs, Maximising Relational Benefits and Optimising Risk Management - through Partnering in Hong Kong Projects, (for "*International Journal for Construction Marketing*").

Rahman, M., Palaneeswaran, E. and Kumaraswamy, M. (2001). *Applying Transaction Costing and Relational Contracting Principles to Improved Risk Management and Contractor Selection*. Proceedings of the International Conference on Project Cost Management, Beijing, May 2001, pp. 171-181.

Schwegler, B.R., Fischer, M.A., O'Connell, M.J., Hänninen, R. and Laitinen, J. (2001). *Near-Medium- and Long-Term benefits of Information Technology in Construction*.

Proceedings of the International Conference on Construction, Hong Kong, Volume One, pp. xxiii-xxxviii.

Thompson, P.J. and Sanders, S.R. (1998). Partnering Continuum. *ASCE Journal of Management in Engineering*, Vol. 14, No. 5, pp. 73-78.

UDT (1997) *I - 15 Corridor Reconstruction Project: Special Experimental Project 14 - Design/Build Contracting, Initial Report*, Oct. 1997, Utah Department of Transportation (UDT), USA.

Walker, A. and Chau, K.W. (1999). The Relationship between Construction Project Management Theory and Transaction Cost Economics. *Engineering, Construction and Architectural Management*, Vol. 6, No. 2, pp. 166-176.

Walker, D.H.T., Hampson, K. and Peters, R. (2000). *Project Alliancing and Project Partnering - What's the Difference? - Partner Selection on the Australian National Museum Project - a Case Study*. Proceedings of the CIB W92 Conference, pp. 641-655, Chile.

Innovative Delivery Systems For Municipal Infrastructure Projects In South Africa
How Prepared Are Municipal Authorities?

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Abstract

South Africa's 821 municipal authorities face tremendous service delivery challenges that are somewhat unique among emerging economies. With the end of the apartheid era, the South African government began investigating a variety of innovative approaches to municipal (local government) service delivery that many other countries had refined and tested during the long period of South Africa's international isolation. Often grouped together as 'public-private partnerships (PPPs)' – also referred to as municipal service partnerships (MSPs) to include possibilities for public-private partnerships – these approaches include long-term concession and lease contracts, management and service contracts, as well as outright sales of government assets. Local authorities as clients in these PPPs, and especially Local Authorities Departments of Public Works (LADPW), need to be equipped in the understanding of dynamics attached to controlling demands of projects and making choices within constraints. Due to sophistication of projects delivery systems LADPWs need to have personnel well conversant with allocation of budget and contingencies – capable of managing the cost parameter; adjustment of timing, time-scales and floats – capable of managing the schedule (time) parameter; adjustment of specifications (to basic, medium or high) – capable of managing the quality parameter; and making value judgements between higher initial costs and longer-term savings – capable of managing the subsystem focussing on the utility parameter. This paper focuses on one of the four project parameters indicated above - Quality. It reports the results of an investigation into

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Total Quality Management (TQM) implementation and understanding in Public Works Departments of the Western Cape Province Local Authorities. It reports on LADPW's perceptions about TQM principles, commitment to implementing the philosophy, and beliefs about its effect relative to more "traditional" management philosophies; it reports on the LADPW' perceptions about obstacle(s) to successful TQM implementation; it identifies measures that LADPW can use to determine the success of TQM efforts; and finally recommendations and conclusions are made.

Keywords: innovative approaches, public-private partnerships, quality , TQM implementation, South Africa

Introduction

In 1998, after two years of preparation, the South African national government paved the way for public-private partnerships (PPPs) by creating the Municipal Infrastructure Investment Unit (MIIU), a non-profit company tasked with providing technical assistance and grant funding to municipalities investigating innovative service delivery partnerships. The long term aim of MIIU is to develop a market place in which informed local authority officials and professionals can obtain the services of private sector advisers, investors and service providers - as well as other public sector service providers and experts - to find more cost-effective ways of providing urban services to citizens.

Discussion with stakeholders in the government and the private sector, as well as analysis of policy and guidelines documents, procedures and international literature, have highlighted a number of constraints, opportunities and necessary conditions for PPPs in South Africa. For a greater number of PPPs to be implemented successfully, it is essential for these issues to be dealt with decisively: *need for policy reform* (*the need for cross-departmental policy coherence and consistency*); *legal and procedural reform required* (*the need for reform that would make the legal environment more PPP-friendly*); *public* *finance issues* (*the need for an appropriate framework to balance priorities between sectors and to ensure prudent control over the government's financial commitments*); *capacity and training issues* (*functional capacity to engage in partnership-type transactions*); and *institutional arrangements* (*a regulatory and support framework, which is driven and monitored by effective institutions*).

This paper focuses on one of the above issues: *capacity and training issues*. The need for capacity and training is approached from Masterman's (1992) argument about experienced clients – *municipal authorities are considered as experienced clients*. According to Masterman (1992), experienced clients regularly carry out construction work and have little difficulty in obtaining information from, and dealing with, the construction industry as they will have developed a method of working, based upon past experience, which should enable a high level of success to be attained.

The capacity and training issues are considered from the project performance focus, where the need for client satisfaction is considered as fundamental in PPPs projects success. The municipal authorities capacity to meet client objectives, by managing project parameters through their Local Authorities Departments of Public Works their (LADPWs) is considered as significant in facilitating innovative delivery systems for infrastructure projects.

Defining terms

Project delivery system

The principal argument of this paper rests on the ability of Municipal authorities to select and manage innovative delivery systems in infrastructure projects delivery. The selection of the most appropriate organisation for the design and construction of the project – herein referred to as the project delivery system (PDS) is an important component towards successful PPPs in South African municipal authorities. Masterman (1992), refers to phrases such as 'building procurement method', 'procurement form' and procurement path' which have been used by various authorities when referring to this concept.

According to Franks (1984), PDS is 'the amalgam of activities undertaken by a client to obtain a building'. The term project delivery (PDS) has therefore been adopted and used throughout this paper. This term is generally used in this paper to describe:
"The organisational structure adopted by the client to manage all stages of the project from inception to completion and certain situations including post completion phase(s)" [Rwelamila (1996)].

Public-private partnership (PPP)

Public-private partnership (PPP) under the South African Municipal Services Partnership (MSP) Policy is defined as:
"...a contract between a local authority and 'an individual or a privately owned or controlled partnership, company, trust or other for-profit' juridical person."

This definition is used in this in this paper.

According to Rwelamila and Savile (1994) the client's objectives in the construction project are the achievement of quality, cost, time, and utility. Quality is the structure level of conformance to specification, while cost relates to first cost or price of the structure. Time is timing, or the completion of the project in accordance with the planned time. Whereas utility includes running costs, maintenance issues, constructability and flexibility for alterations or other uses (Rwelamila, *et al.* 1999).

The above four parameters present constraints and choices to the project management team, the balancing should, therefore, be struck to achieve them without compromising resources available on the project. Most of construction projects are procured based on only two of these objective parameters, namely: cost and time (Rwelamila, 1996). The optimum *utility* of a construction project can be obtained by making value judgements between higher initial costs and longer-term savings (Rwelamila and Savile, 1994). Quality, one of the primary focus of this paper, has been neglected (Rwelamila, 1996). According to Rounce (1998) the main attributes to the neglect of quality among others are; firstly, broken promises on likely availability of design information. Secondly, frequently re-design or re-working of drawings. Thirdly, not solving root causes of design management problems and lastly, the inadequate definition of client's brief before starting the design. The true cost of quality neglect or quality non-conformance in projects is, therefore, the total cost of meeting the client's requirements (Rounce, 1998).

According to Wright (1996), quality is too important to be left to the managers. Everybody in the organisation has to be involved to achieve quality excellence. An organisation that upholds TQM is on a different level, by concerning more than just to standards and conformance, but also by having an over riding culture of quality (Wright, 1996: Kasi, 1995). Crosby (1984) argues that TQM creates a culture where everyone in the organisation seriously believes that not one day should go without the firm in some way improving the quality of its goods and service. Based on these arguments, it is clear that, if Municipal Authorities are to provide essential urban services in a way that spreads the benefits of development to all South African citizens through PPPs -where appropriate delivery systems are employed (Cox and Townsend, 1998; Cox and Thompson, 1998), they need to be smart clients embracing TQM among other fundamentals.

Context

Although Municipal authorities seem to fit into the Masterman's (1992) definition of experienced clients, there are strong indications to suggest that the skills required for effective negotiation and implementation of PPPs are still in relatively supply. There are strong indications to suggest that Municipal authorities do not have capacity to manage project parameters, hence the need to assess the extent of the problem.

As part of a major project, this paper, reports on a study, which critically looked at one of the project parameters – Quality - in one of the three South African major provinces (based on economic activity and population), the Western Cape Province. The study focussed on the implementation of Total Quality Management (TQM) in LADPW.

This paper reports on:

- the LADPW's perceptions about TQM principles, commitment to implementing the philosophy, and beliefs about its effect relative to more "traditional" management philosophies;
- the LADPW' perceptions about obstacle(s) to successful TQM implementation in their organisations;
- the measures that LADPW can use to determine the success of TQM efforts;
- the factors that effect process quality; and finally it advances recommendations and conclusions based on the findings of the research.

The Survey

The Western Cape Province consists of 20 local authorities. Ten of which were selected by systematic sampling survey as a research sample. A total of 31 questionnaires were distributed which represented 3 questionnaires to each of the 10 local authorities including an extra one for Cape Town Metropolitan Provincial Administration. The bias was accorded to Cape Town Metropolitan Provincial Administration due to its enormous responsibility and the fact that Cape Town Metropolitan Provincial Administration handles more work compared to the other local authorities.

Survey response

As indicated in Table 1, a response rate of approximately 80 % from all the sampled LADPWs in the Western Cape was attained. Also the response rate of 32 % from the questionnaires sent was achieved.

The respondents gave various reasons as to why they did not fill in the questionnaires: *some cited lack of interest; some claimed not to have received the questionnaire; some reported to be too busy and therefore could not spare time to fill in the questionnaire.*

Table 1. Response

Total actual sample (number)	**10 LADPWs**
Total questionnaire sent (number)	31
Total response of questionnaire (number)	10
Total response from LADPWs (number)	8
Percentage of response rate of questionnaires	32 %
Percentage of response from LADPWs	80 %

Familiarity with TQM principles

The majority of respondents reported to be generally unfamiliar with TQM principles. In addition, they believed that their colleagues, their superiors, and their subordinates to be equally unfamiliar, with TQM principles.

Adoption versus implementation of TQM
The respondents clearly acknowledged that TQM had not been formally adopted as a quality improvement strategy. The LADPWs showed no commitment to implement TQM principles in their operations. It can be concluded that in the absence of formally adoption of TQM principles, there can hardly be any fruitful efforts towards quality and customer service, which constitute vital pillars of quality management.

Value added by TQM implementation to current management practice
A majority of the respondents believe that implementing TQM principles can add value to the current management practice. They also believe that their peers are as enthusiastic as their senior management about TQM, thus suggesting existence of a broad awareness of the surveyed subject matter. Nevertheless these results yield no relevance as to the implementation in-as much as there were no existing initiatives of integrating TQM in the LADPWs.

Customer service focus
Majority of the respondents reported that their departments had not formally identified their customers applicable under TQM principles. This is confirmed by their ranking of the upper management as the most important category of their customers. This suggests a "top down" mode of management in the LADPWs. Nevertheless, the respondents managed to identify public and private sectors among their important customers.

The respondents perception on how to implement TQM
The respondents indicated that the LADPWs need a comprehensive and formal TQM implementation program. In order to execute the program, respondents also indicated the need for a comprehensive TQM training at all levels of management and non-management personnel. Where constrains exist a ½ to 1 day TQM overview for all employees

per month or a comprehensive TQM training for management personnel was recommended.

Barriers to TQM implementation

The respondents did not give priority to *"resistance to change"* and *" tried it and found it didn't help"* as potential barriers to TQM. Neither did they found that *"takes too much time from real work"* nor that *"TQM is perceived as just another fashionable system"* as being potential barriers. It can, therefore, be deduced that despite the fact that the respondents were able to point out the potential barriers to TQM implementation, there is however, a clear indication of a lack of implementation of TQM in LADPWs. This is shown by the respondents' failure to point out "resistance to change" in-as much as to its importance as one of the crucial barriers to TQM implementation. Hence rendering these results contrary to the results of a similar study *in the USA,* by Burati and Oswald (1993), which showed "resistance to change" as a major obstacle to TQM implementation.

Measuring of TQM success

In the absence of the respondents' suggestions as to how LADPWs could measure TQM success, it is necessary for this study, to point out a few measures germane to LADPWs. In a similar study done in the USA's Department of Transportation (DOT) by McCambridge and Tucker (1998), the following were found. Firstly, the use of customer surveys and focus groups (external and internal customers). Secondly, establishing performance measures (e.g., pavement condition reports, bridge reports, design cost/total cost ratios), and thirdly formal team effectiveness reviews. LADPWs in South Africa could equally apply these measures.

According to McCambridge and Tucker (1998) other relevant measures for TQM success, which could be applicable to LADPWs in South Africa, are:

- Change in number of and response time to customer complaints

- Reduction in number and size of tort claims
- Number of processes re-evaluated and process improvement results (e.g., shorter cycle time, cost savings, waste reduction, re-work improvements, product quality improvements, reduced change order)
- Reduced equipment down time
- Improved employee morale, productivity, satisfaction, turnover, and absenteeism.

The above represent but a few measures which the respondents could have suggested should they had a shred of knowledge on TQM implementation.

Marketing practices as related to TQM principles
Very few respondents pointed out the examples of LADPWs' efforts to enhance their image and how successful/unsuccessful they have been. These examples given include: *preparation of budgets and conducting of public meetings; subdividing the LADPWs into smaller task sections aimed at servicing specific client, such as education-schools, health-hospitals etc.; and writing and delivering national and international papers for conferences or journals.*

The above results strongly suggest that LADPWs lack capacity in managing one of the four primary project parameters - Quality. There are strong indications to speculate, that Municipal Authorities may be facing a significant capacity problem in embracing other primary project parameters.

Conclusions and Recommendations

Conclusions

Based on the research findings, the following conclusions may be drawn:

- LADPWs were generally unfamiliar with TQM principles. This suggests a total lack of TQM understanding within the LADPWs.

- LADPWs clearly acknowledged that TQM had not been formally adopted as a quality improvement strategy. They showed no commitment to implement TQM principles in their operations. This could be inferred that in the absence of formal adoption of TQM principles, there can hardly be any fruitful efforts towards quality and customer service, which embody all quality improvement strategies.
- The respondents indicated that the LADPWs need a comprehensive and formally TQM implementation program. In order to execute the program, respondents also indicated the need for a comprehensive TQM training for all management and non-management personnel. Where constraints exist, a ½ to 1 day TQM overview for all employees per month or a comprehensive TQM training for management personnel was suggested. This strongly suggest that LADPWs perceive the need to implement TQM as a means of improving quality of their products and services to their clients.
- Contrary to the findings of similar studies elsewhere, USA in particular, the "resistance to change" was not found to form one of the potential barriers to TQM implementation. The respondents indicated: the lack of administrative support for TQM; general lack of awareness/understanding of TQM; lack of financial resources; and difficulty in measuring the effectiveness of TQM improvement, as the most conspicuous barriers to successful TQM implementation.
- Surprisingly the respondents failed to suggest any ways to measure TQM success. Which maybe attributed to the respondents' lack of understanding of TQM, despite the fact that there are many ways of which one could measure the success of the any program implementation.
- Few respondents pointed out the examples of LADPWs' efforts to enhance their image and how

successful/unsuccessful they have been. These examples include: preparation of budgets and conducting of public meetings; subdividing the LADPWs into smaller task sections aimed at servicing specific client, such as education-schools, health-hospitals etc.; and writing and delivering national and international papers for conferences or journals. These examples, however, are not in line with TQM strategies for enhancing the organisation's image, thus confirming the LADPWs lack of TQM understanding.

Recommendations

If South Africa Municipal authorities are going to effectively negotiate and implement innovative delivery systems for infrastructure projects, it is pertinent that they improve their capacities. The challenge for them is to foster a new a approach to local government service delivery, by providing affordable, good quality services in a timely and sustainable manner. This is possible if the municipal authorities become smart clients, and one of the requirement of a smart client is to adopt a TQM culture.

The following need to done if municipal authorities need to adopt a TQM culture:

- LADPWs should adopt and implement TQM principles. This is in order to establish a culture of excellence within LADPWs and add value to the LADPWs management in terms of client focus, leadership, participative workplace and continuous improvement of department processes.
- LADPWs should deploy a customer service focus germane under TQM as a tool for marketing LADPWs practices to their clients as well as means of enhancing their image. In so doing, LADPWs would save resources that are likely to be wasted in the pursuit of activities, which otherwise bear no value to customers.
- In order to come up with the best possible way of

implementing TQM in LADPWs, there is a need to introduce benchmarking techniques on similar public ventures, which are doing remarkably well with TQM programme elsewhere in the world. This should enhance the LADPWs knowledge on obstacles and necessary measures in order to bring about a successful TQM implementation.

- Whilst this study has concentrated on TQM implementation in the LADPWs in the Western Cape Province, it is clear that a similar study could be carried out focusing on all LADPWs. Such a study should shed more light as to what extent TQM implementation has occurred in South Africa's LADPWs practices, and what are obstacles encountered and measures taken to overcome them.

References

Burati, J.L and Oswald, T, H (1993) Implementing TQM in Engineering and Construction. *Journal of Management in Engineering*, 9(4), pp 456-470.

Cox, A. and Townsend, M. (1998) *Strategic procurement in construction*. Thomas Telford, London.

Cox, A. and Thompson, I. (1998) *Contracting for business success*. Thomas Telford, London.

Crosby, P.B (1984) *Quality Without Tears.* McGraw-Hill Book Company. New York.

Franks, J (1984) *Building Procurement Systems – a Guide to Building Project Management*, The Chartered Institute of Building, Ascot.

Kasi, M, (1995) TQM on a Transportation Project. *Journal of Management in Engineering*. Vol.13.No.3, pp 21-23.

Masterman, J.W.E., (1992) *An Introduction to Building Procurement Systems*. E & FN Spon, London

McCambridge J.A and Tucker M.L (1998) TQM Implementation in State Departments of Transportation: View From The Firing Line. *Journal of Management in*

Engineering, 14(1), pp 49-57

Rounce, G (1998) Quality, Waste and Cost Considerations. *Architectural Building Design Management*, 16(2), pp 123-127.

Rwelamila, P.M.D (1996) *Quality Management in the Public Building Construction Process.* Unpublished PhD thesis, Department of Construction Economics and Management, University of Cape Town, Cape Town.

Rwelamila.P.M.D, Talukhaba and Ngowi.B (1999) Tracing the African Project Failure Syndrome: the significance of 'ubuntu' *The Journal of Engineering, Construction and Architectural Management,* 6(4), pp 335-346.

Rwelamila P.M.D and Savile P.W (1994) "Hybrid Vale engineering: the Challenge of Construction Project Management in the 1990s"*International Journal of Project Management.* 12(3) 157-164 Butterworth- Heinemann.

Wright, J.N., (1996) Creating a Quality Culture. *Journal of General Management*.Vol.21, No.3 pp 19-29.

Achieving Best Value in Construction
Through Non-Traditional Procurement Methods

David Greenwood[1]

Abstract

The successful outcome of construction projects appears to be profoundly influenced by the way they are procured, and the subject of procurement has been the subject of much investigation. In the UK, a recent report into the efficiency of the industry, commissioned by the Department of the Environment, Transport and the Regions (DETR), expressed a 'deep concern that the industry as a whole is under-achieving' and suggested 'radical changes to the processes through which it delivers its projects' (Construction Task Force, 1998). One of the suggested changes is to 'replace competitive tendering with long term relationships based on clear measurement of performance and sustained improvements in quality and efficiency'(Construction Task Force, 1998). This initiative effectively coincided with a radical shift in UK government policy to public sector procurement. Under the Local Government Act 1999, the requirement for Compulsory Competitive Tendering in public sector procurement was abolished, and replaced with the requirement to demonstrate 'Best Value'. The result is that local authority clients are enabled to experiment with alternatives to tendering, and this opportunity has been taken by a number of public sector clients. In one such initiative, a Local Authority have created a partnering agreement with a small group of contractors to implement its school-building programme over the next four years. At the root of the agreement is a system of non-adversarial working underpinned by rigorous performance measurement and targets for improvement. The paper represents a work-in-progress report upon a larger piece of research funded by the DETR to investigate the success of this project. The impact of non-adversarial patterns of working on project and business performance should be of major interest to clients, practitioners and policy-makers throughout the construction industry, particularly in the public sector, and indeed to a wider audience.

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Keywords : Best Value, Non-adversarial contracting, Partnering, Procurement, Public sector.

Introduction

It is generally accepted that the way construction work is procured has a fundamental influence on a number of things, including the cost of tendering (Latham, 1993) and that innovative procurement practices may reduce these costs (Hughes *et al.* 2001). In particular, it has been argued that non-traditional procurement methods such as partnering, will not only produce these immediately accessible savings, but also an improvement in relationships that may further increase overall value for money (Construction Task Force, 1998). The earliest experiments with partnering were in the USA, where examples of non-adversarial relationships between contractors and owners were studied (Construction Industry Institute, 1991; Weston and Gibson, 1993; Loraine, 1994, Larson, 1995). In the UK construction industry, partnering has become an popular topic following several highly publicized client-led initiatives and the impetus given to it by the publication of the report by Sir Michael Latham (Latham,1994). There followed a number of influential publications that demonstrated the benefits of partnering (*e.g.* Barlow *et al.,*1997; Bennett and Jayes, 1998; Construction Industry Board, 1997a) and indeed, others that were more sceptical. In the manufacturing industry for example, Bresnen (1996: 127) has observed that in many cases the so-called 'partnerships' between buyers and suppliers 'can be deconstructed to reveal the reality of control and market power that underpins the demand-supply relationship'. Often, the aim of innovative procurement practice is merely to pass costs and risks 'down the line': these mechanisms are often forced upon suppliers by their economically stronger 'partners' and reflect the power imbalance in their relationship (Powell, 1990, Morris and Imrie, 1992; Turnbull *et al.*,1992). Similar criticisms have recently been directed at the uncritical acceptance of 'partnering' by the UK construction establishment (see, for example, Green, 1999). However in the public sector, the major obstacle to its adoption has been the need for public accountability and demonstrable financial probity (Larson, 1995). A major turning point has been the 'Rethinking Construction' report (Construction Task Force, 1998) commissioned by the Department of the Environment, Transport and the Regions and produced by a 'task force' under the chairmanship of Sir John Egan. The report reported a concern that the UK construction industry was 'under-achieving' (Construction Task Force, 1998: paragraphs 4-6) and that in order to improve the industry needed to make 'radical changes to the processes through which it delivers its projects' (Construction Task Force, 1998: chapter 3). The report makes specific reference to the need to 'replace competitive tendering with long term relationships based on clear measurement of performance and sustained improvements in quality and efficiency' (Construction Task Force, 1998: paragraphs 67-71). This involves 'new criteria for the selection of partners' based, not on 'lowest price, but ultimately … best overall value for money' (Construction Task Force, 1998: chapter 4). Egan notes that this 'goes against the grain, especially for the public sector' (Construction Task Force, 1998).

However, public sector antipathy to partnering was overturned by a significant shift in government policy . On 1 April 2000, the Local Government Act 1999 removed the previous long-standing requirement for Compulsory Competitive Tendering, and replaced it with a requirement to obtain 'Best Value'. Broadly speaking 'Best Value' requires a council to seek improved performance by whatever means is best. It is likely to transform the way services are procured and delivered. The legislation requires authorities to *challenge* whether existing practices are still relevant, *consult* on better cost-effectiveness, *compare* its performance with others through benchmarking, and *compete* with the best solutions (Joseph Rowntree Foundation, 1999: 47). The result is that local authority clients were enabled to experiment with alternatives to tendering. The means by which individual organisations satisfy stakeholders (in particular council members and auditors) is open to debate. However, it is clear that performance measurement will be essential. In order to meet the requirement to demonstrate Best Value, a culture of 'management by fact' i.e. using hard, quantitative data will become the norm in the public sector.

The North Tyneside Partnering Agreement (NTPA)

North Tyneside is the local authority governing an area to the north of the city of Newcastle-upon-Tyne in the north-east of England. The authority is responsible for the construction, replacement and maintenance of a sizeable stock of public buildings, including public housing, schools and other non-housing provision. The Council has recently entered a partnering agreement (the NTPA) with three contractors for implementing its school-building programme over the next four years. The argument for this was grounded in the philosophies of Constructing the Team (Latham, 1993) and Rethinking Construction (Construction Task Force, 1998) and set in the context of the requirements of Best Value procurement of public services. In agreeing to waive its Standing Orders With Respect to Contracts to accommodate this initiative, the Council effectively took a ground-breaking lead in local government procurement.

Expressions of interest were invited and a process of selecting the partners - three building contractors - was completed early in 2000. The selection process was rigorous and transparent, but based upon quality criteria alone. After selection, the University of Northumbria was approached to facilitate the partnering process. The process commenced with a number of workshops designed to familiarize those involved with current thinking on partnering. The 'theoretical' input was provided by presentations by academics who sought to identify key issues, examine them and perform a needs-based analysis. The final stage was the agreement and completion of a Partnering Charter that clearly expressed the partners' objectives.

Researching The Performance Of NTPA: Aims And Methods

The University was also asked to carry out research to monitor the success of NTPA. The vehicle for this is a research project supported by the 'Partners in Innovation' scheme funded by the UK Government's Department of Environment Transport and the Regions (DETR). The project's first aim was to address the immediate requirements of the stakeholders in monitoring the effectiveness of what they have created. Three of the specific objectives of the partnering agreement that they entered were:

1. 'establishing appropriate performance indicators ... to measure and demonstrate continuous improvement';
2. 'establishing appropriate benchmark standards against which to monitor this';
3. and ensuring that all involved '... are supported and encouraged by education and training'.

The research will cover an eighteen month period, during which time it is anticipated that at least seven projects, ranging in value from £330,000 to £1.5millions will be 'live' and at different stages in their development. Data will be collected from these projects and comparisons made between past and current ways of working. Reference was made to developmental work on headline and operational KPI's by organisations such as the Construction Best Practice Programme, M4I, and the BRE. Consequently, mechanisms were put in place to monitor performance in a number of areas, including *time, cost, quality, client satisfaction, Health and Safety, and business performance.*

Initially, the KPI's used were those promoted by the UK Government (ref?). It was agreed that these required a more detailed definition, and over the course of three workshops, a set of *Detailed Performance Indicators* (DPIs) was developed. There followed a series of project-specific workshops, where, on project start-up, each project team agreed the appropriate method for capturing the DPI data, and the person responsible (in conjunction with the researchers) for doing so.

Results To Date

The project is in its early stages, and it will not be possible to pronounce categorically upon the outcome until the first projects come to an end. However, the results to-date show encouraging signs that post-partnering projects have benefited from considerable improvements especially in project *time* and *client satisfaction*. Interestingly, one project has performed particularly well in these areas, but badly in the area of *cost certainty*. Analysis of the cost overruns revealed shortcomings in the way project 'stakeholders' were defined, and their inputs catered for, under the client's existing organizational structures. These had been geared to reflect old ways of working (i.e. those based on Compulsory Competitive Tendering) and may no longer be appropriate under a Best Value regime, particularly where the chosen procurement method is through partnering. Indeed, defining the 'complex client' can be a difficult task on a school project and this has been identified as an area for further research.

Future Directions And Aspirations

The research is approaching a point where the data will enable the comparison between pre- and post-partnering performance. The second stage, that of monitoring improvements through the partnering programme, will then commence.

The project is already attracting a great deal of national, and even international attention. The expected outcomes of the research are both quantitative, in terms of key performance indicators, and qualitative, in terms of the impact of cultural factors and the extent to which culture change is engendered. In the context of business efficiency the study will examine the potential for reducing transactions costs, and any benefits thereby gained, while retaining incentives to perform in the absence of a traditional adversarial approach. These outcomes should be valuable to the stakeholders, but also to a wider audience and would complement the other recent and ongoing studies on partnering in helping to identify its benefits and the circumstances where these are most likely to be realised. This is particularly important in view of the recent requirements of Best Value procurement for the public sector. This requirement, together with pressure for change from the government in the light of the Egan report, will place a number of different pressures on the public sector. The focus will no longer be on the lowest price, but on 'adding value' and strategic partnering, with its team approach, appears to be an ideal vehicle for achieving this. The impact of non-adversarial patterns of working on project and business performance should be of major interest to clients, practitioners and policy-makers throughout the construction industry, particularly in the public sector.

References

Barlow, J, Cohen, M, Jashapara, A, and Simpson, Y (1997) *Towards positive partnering. Revealing the realities in the construction industry*. The Policy Press, Bristol.

Bennett, J and Jayes, S (1998) *The seven pillars of partnering.* Thomas Telford Publishing, London.

Bresnen, M (1996) An organisational perspective on changing buyer-supplier relations: a critical review of the evidence. *Organization* **3** (1) 121-146.

Construction Task Force (1998) (Sir John Egan, Chairman)

Rethinking construction. London: Department of the Environment, Transport and the Regions.

Construction Industry Board (1997a) *Partnering in the Team.* London: Thomas Telford.

Construction Industry Institute (1991) *In Search of Partnering Excellence*. CII Special Publication 17-1. Bureau of Engineering Research, University of Texas at Austin.

Green, S (1999) Partnering: the propaganda of corporatism, in Ogunlana, S. (ed.) *Profitable Partnering in Construction Procurement.* Proceedings of CIBW92, Chiangmai, Thailand.

Hughes, WP, Hillebrandt P, Lingard, H and Greenwood, DJ (2001) The impact of market and supply configurations on the costs of tendering in the construction industry. *Published Proceedings of the CIB World Building Congress*, April 2001, Wellington, New Zealand.

Joseph Rowntree Foundation, (1999) *Modernizing local government.*

Latham, Sir Michael (1993) *Trust and money: the interim report of the joint government/industry review of procurement and contractual arrangements in the UK construction industry*. London: HMSO.

Latham, M. 1994) Constructing the team: the final report of the joint government/industry review of procurement and contractual arrangements in the UK construction industry. London: HMSO.

Larson, E (1995) Project Partnering - Results of Study of 280 Construction Projects. *Journal of Management in Engineering* **11** (2): 30-35.

Loraine, R.K. (1994) Project Specific Partnering. *Engineering, Construction and Architectural Management,* **1** (1), 5-16.

Morris J and Imrie, R (1992) *Transforming Buyer-Supplier relations: Japanese-style Industrial Practices in a Western Context.* Macmillan, London.

Powell, WW (1990) Neither Market Nor Hierarchy: Network Forms of Organization *Research in Organizational Behavior* **12** 295-336.

Turnbull P, Oliver, N and Wilkinson, B (1992) Buyer-Supplier Relations in the UK Automotive Industry: Strategic Implications of the Japanese Manufacturing Model. *Strategic Management Journal* **13**, 159-168.

Weston DC and Gibson, GE (1993) Partnering - project performance in US Army Corps of Engineers. *Journal of Management in Engineering* **9** (4), 410-425.

The Impact of the Tendering Contract on the Opportunities for Contractor Innovation

Tony Sidwell[1] & Dedi Budiawan[1]

Abstract

The concept of the existence of a "tendering Contract" has arisen in recent years following international court decisions such as those made by the New Zealand court in *Pratt Contractors v. Palmerston North City Council (1995)* and the Canadian court in *Health Care Developers Inc. and Others v. The Queen in Right of Newfoundland (The Crown) (1996)*; and authors such as Craig (1997a) have suggested that this might impact on the ability of clients to solicit tenders from contractors which include provisions for innovation. Such an inhibition clearly militates against many developments in procurement strategies which have been designed to take advantage of the contribution that the contractor can make in improved technologies and processes. This paper reports on a three-year research project into the impact of such case law on the procurement process and the alternative mechanisms (strategies) that enable clients to find ways to foster a climate conducive to innovation with less likelihood of placing themselves at risk of such litigation. The research is led by an industry task force and sponsored by the Australian Research Grants Council and the Construction Industry Institute, Australia. The researchers have developed a model of the influencing variables in the process and have conducted a preliminary round of pilot case studies to test the model. Results from the preliminary cases will be reported.

Keywords: innovation, procurement method, contractual arrangement, conforming bid/tender, alternative tender, tendering contract/process contract.

Introduction

In the construction industry clients are focusing on achieving

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quality and value for money to get the most out of their investments in constructed facilities, on the other hand contractors seek competitive advantage through innovation in construction methods. However recent international case law has raised doubts about the ability of owners to seek alternative tenders without placing themselves at risk of litigation. It has indicated that a "tendering contract" may arise between the tenderer and the owner upon the submission of a conforming tender. In decisions of the Supreme Court of Canada in *"The Queen in Right of Ontario et al v. Ron Engineering & Construction Eastern Ltd (1981) SCR 111; 119 DLR (3d) 287, 272"* case and the High Court of New Zealand in *"Pratt Contractors Ltd v. Palmerston North City Council (1995) 1 NZLR 469"* the cases have established the owner's duty of fairness to all bidders. This duty may be breached when an owner accepts an alternative tender which does not conform to the conditions of tender (Craig 1999a, 1999b).

Craig questions whether the traditional tendering processes can facilitate innovation. He points out that the successful tenderer's scope to be innovative is very limited. All too often the focus is concerned with designing novel claims for extra cash and more time and with "bid shopping" to drive down subcontract prices. The time that contractors have for pricing the job before they submit the tender is too short for them to come up with "real" innovative ideas and by the time they reach the construction stage, it is too late for innovation; all they have time to do is finish the project according to all the documentation and specifications.

Given these circumstances, how can the industry provide clients and the community with access to contractors' innovative ideas without compromising contractors' commercial advantage? This research focuses on discovering the project context conducive to encouraging innovation.

Literature Review on Innovation

Definition

Innovation is defined as an idea, practice, or material artifact that is perceived as new by the relevant unit of adoption (Zaltman et al. 1973, Tornatzky et al. 1983). According to Rogers (1995), the perceived newness of the idea for the individual determines his or her reaction to it. If the idea seems new to the individual, it is an innovation. "Newness" of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt. Lenard & Bowen-James (1996) and Lenard & Eckersley (1997) provide more comprehensive and descriptive definition as "any idea, technique and/or process, old or new, that is uniquely applied to any aspect of the production of goods and services, such that it either directly or indirectly generates measurable benefits in the form of system or process efficiency, product quality or product type".

Product innovation may be development of a new product or modifications to an existing product through introduction of new features to enhance its value (Romano 1990). Process innovation may be application of a new element into an organisation's production or service operations – input materials, task specifications, work and information flow mechanisms, and equipment used to produce a product or render a service (Utterback and Abernathy 1975). Another distinction between process and product innovations was made by Rosenberg (1982) who specifies that process innovation enables a greater output per unit of input while product innovation results in a qualitatively superior product.

Another distinction of innovations, from organisational focus, is between technical and administrative innovations. Technical innovations bring change to the organisation by introducing changes in the technological core. They are concerned with products, services, and production process technology; they are related to basic work activities and can be associated with either product or process (Damanpour and Evan 1984). Administrative innovations, on the other hand, are changes that occur to an organisation's structure or its administrative processes (Damanpour 1987). These administrative innovations are directly related to the management of the organisation and indirectly to the basic work activity of the organisation (Kimberly and Evanisko 1981).

The adoption of innovation is viewed as a process that includes activities that lead to a decision to adopt as well as activities that facilitate putting an innovation into use and continuing to use it (Damanpour 1991). The adoption process consists of two stages: initiation and implementation (Zaltman et al. 1973 and Rogers 1995). The initiation stage is characterised by all activities related to a problem perception, information gathering, attitude formation and evaluation, and resource attainment leading to the decision to adopt. The implementation stage consists of all events, actions, and decisions involved in putting an innovation into use (Rogers 1995, Damanpour 1991). Past research has revealed that the process of initiation and implementation of the three types of innovations mentioned previously differ in significant ways (Daft and Becker 1978, Kimberly and Evanisko 1981).

Rogers (1995) asserts that the innovation process in organisations is complex. Implementation typically involves a number of individuals, each of whom plays a different role in the innovation-decision process. Further, implementation amounts to mutual adaptation in which both the innovation and the organisation change in important ways.

Innovation in Construction

Despite the fact that innovation is generally perceived by the construction industry as a rare occurrence, in reality it comes about consistently throughout the sectors of the industry (Dibner and Lemer 1992, Slaughter 1993, 1998). In fact, construction actually incorporates innovations at the same rate as other industries, and these innovations are more likely to be originated by the people working on site rather than manufacturers or research laboratories (Slaughter 1993).

In construction industry, there are many different ways in which innovation may be introduced. These may include (Smith and Wilkin1997):

- the development of new or improved products,
- improved construction management techniques,
- developments in construction technology (i.e. the process by which products are assembled to satisfy the client's needs),
- 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,
- improved approaches to construction procurement.

As to the stages of the innovation-adoption process, Stewart and Tatum (1988) describe five major steps based on case studies of innovation in construction projects, which can be seen to encompass the initiation and implementation stages mentioned previously. The five major steps are:

- recognising forces to innovate,
- planning to identify options for methods,
- selecting and defining construction methods,
- implementing and developing the innovation, and
- transferring the innovation to future projects.

The Research Project

Figure 1 illustrates the research design including its methodology adopted for this research. The industry task force in essence performed similar role to that performed by experts in the Delphi peer group method. The development of the theoretical framework and the research instrument has gone through a number of iterations in consultation with the taskforce members. As the figure shows, the taskforce took part from the very beginning of the research project in the research problem definition, interviews in relation to the development of the theoretical framework, and pilot studies in the development of the research instrument.

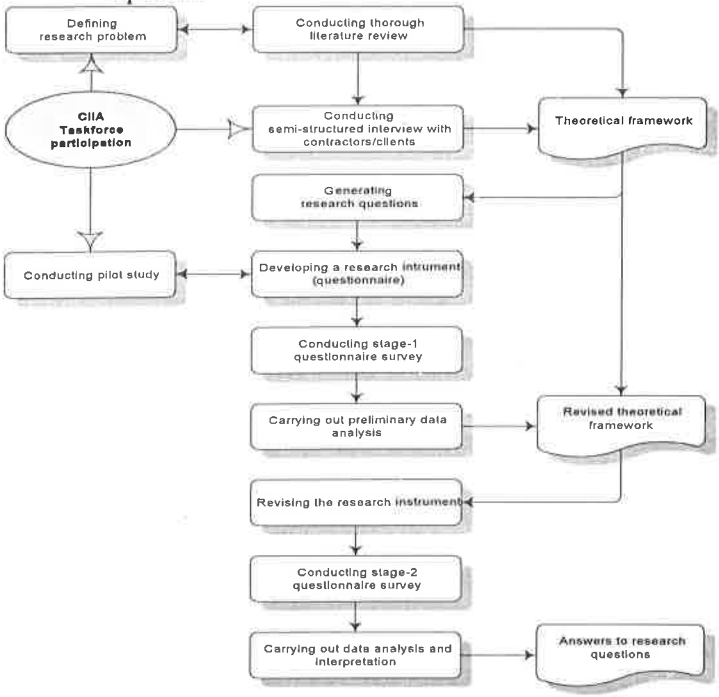

Figure 1. Research Design

The theoretical framework encapsulated 68 variables that were thought as determinants of the process of innovation adoption in construction project. These variables were grouped into contractor's characteristics, client's characteristics, project team performance characteristics, project team management characteristics, construction management actions, documentation quality characteristics and contract strategy characteristics.

To fill in the questionnaire of the preliminary stage-1 survey, the respondents were required to select a completed project that had some content of contractor innovation, on which the responses would be based. The questionnaire also specified the types of innovation cited by Smith and Wilkin (1997), to which the respondents were asked to relate the innovation occurring in their project. The response to each variable was recorded on a seven-point scale to allow for quantitative analyses. The reason for giving respondents seven alternative answers was to measure variables at higher levels so that more powerful statistical procedures may be used. However, as Neuman (1997) points out, increasing the number of categories beyond eight or nine is not probably meaningful and will confuse people. The respondents were asked to rate the degree of effect of each variable on the process of bringing about the innovation. The questionnaires were disseminated to contractors in Queensland, Australia. Only those who were in the middle-to-top level position and involved in construction projects, such as project managers, construction managers, design managers, operations managers, were chosen as sample targets. A total of 44 valid responses were obtained out of the 118 questionnaires dispatched, resulting in 40% response rate. The seven-point scale used was anchored with “1” denoting “not affected” and “7” denoting “greatly affected”. Several statistical techniques were used to analyse the data. These included one-way ANOVA, Kruskal-Wallis test, independent-samples T test, Mann-Whitney test, and paired-samples T test.

Figure 2 shows the sample distribution by contractual arrangement. Eleven percent of all projects obtained in this preliminary survey were procured traditionally, 50% under design & construct method, 7% under alliancing, 20% under management contracting, and 11% under other methods. The fact that design & construct and contracting management methods stand out in this survey as a result of random variation

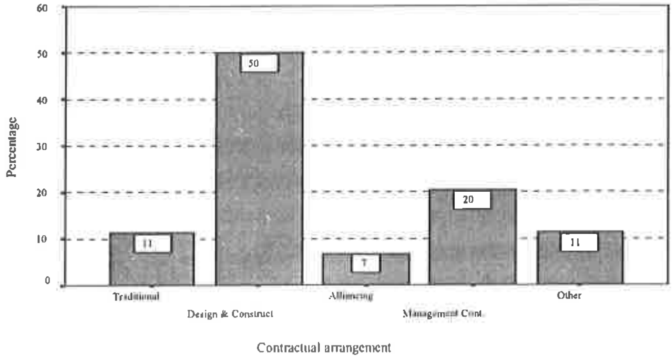

Figure 2. Sampling distribution by contractual arrangement

apparently supports the perception that contractual arrangements which allow more integration between design and construction or early involvement of contractor in the design development phase are more conducive to innovation.

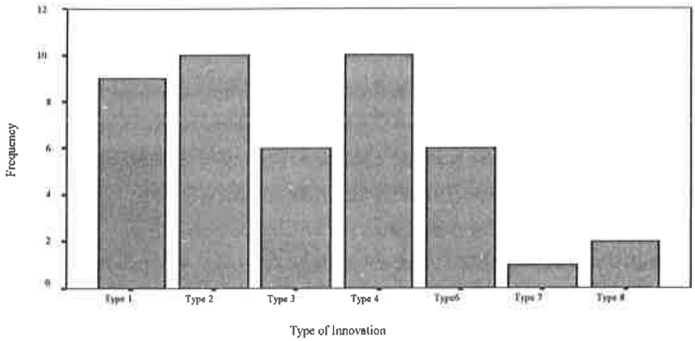

Figure 3. Frequency distribution of various innovation types
Note: no response obtained for type 5
Type 1: Process by which a constructed product is assembled, Type 2: Improved construction management, Type 3: Improved approaches to construction procurement, Type 4: New approaches to architectural and engineering design, Type 5: Development and/or application of new equipment or tools, Type 6: Use of alternative materials or equipment, Type 7: Development of new or improved product, and Type 8: Other.

Figure 3 shows the frequency distribution of the responses associated with the types of innovation being investigated.

Visual inspection on this figure shows that three types of innovation predominate in this preliminary survey as a result of random variation; the researcher had no control over the respondents to choose or not to choose a particular type of innovation. These three types of innovation are type 1 (process by which a constructed product is assembled), type 2 (improved construction management), and type 4 (new approaches to architectural and engineering design). Given that:

- this study is looking more at construction innovations originated by contractor;
- the process of bringing about an innovation may significantly vary from one type of innovation to another e.g. product vs. process innovation, technical vs. administrative innovation;
- there is need to concentrate on a specific aspect so that more useful and meaningful outcomes can be drawn out of this research;

the researchers decided to focus on only one type of innovation i.e. type 1 – process by which a constructed product is assembled. This major type of innovation is hereafter referred to as "process innovation". As a matter of fact, process innovation is closely linked to other types of innovation shown in Figure 3. For example, an innovation in architectural and engineering design may require new methods of construction to build the facility; product innovation usually brings about process innovation in construction (Stewart and Tatum 1988). By the same token, new methods of construction may require an application of new equipment or the use of alternative equipment.

As process innovation becomes the focus of this research, data of other innovation types were compared with those of process innovation to examine if there was any significance difference between them. If no significance difference was found between a determinant of a particular innovation type and the corresponding determinant of process innovation, the data of these two innovation types were pooled together for that particular determinant. To do this, in addition to the independent-samples t test, the nonparametric Mann-Whitney test was carried out at the 5% significance level. This analysis was performed for all the 68 variables identified in the theoretical framework.

After the data pooling process had been performed and determinants ranked in descending order of their mean scores, the next stage was to compare the ranked determinants, one with another so that determinants of the same significance level could be grouped together. This process was carried out by the paired-samples t test and the independent-samples t test at the 5% significance level. Both tests resulted in similar results. These analyses enabled the researchers to extract 39 most important determinants by taking into account the top three groups. A closer examination of these determinants revealed that the lowest mean score is just above 4, which is in fact the middle point of the 7-point scale used in this research. The revised theoretical framework consisting of the 39 variables is shown in Figure 4.

Summary

This paper reports the preliminary survey on determinants of project context conducive to the process of innovation adoption in construction projects. Several statistical procedures were applied in attempts to determine the most significant determinants among those already identified in the initial theoretical framework.

Process innovation was chosen by the researchers to be investigated further for several reasons. Firstly, the study is looking more at construction innovations originated by contractor. Secondly, this innovation type is broad and is likely to be associated with other innovation types. Lastly, focusing on a specific aspect will result in more useful and meaningful outcomes.

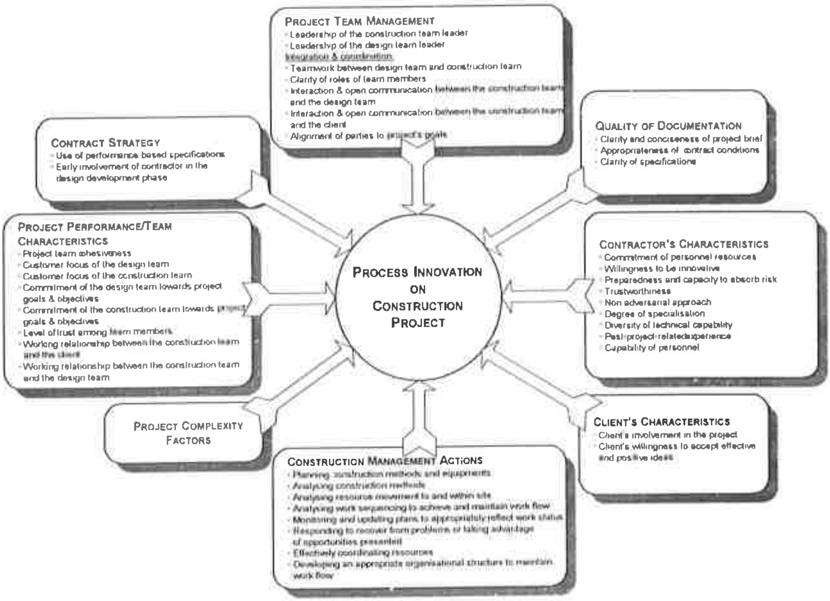

Figure 4. Revised theoretical framework

The research is continuing with further survey based on the revised theoretical framework produced at this preliminary stage. The questionnaire will first be revised to encompass only the most significant variables. Thorough analyses using multi-variate statistical procedure will be carried out in attempts to find out project context conducive to process innovation.

References

Craig, R. (1999a). "How Innovative is the Common Law of Tendering?" *Journal of Construction Procurement,* May 1999, pp. 15-26.

Craig, R. (1999b). "Protecting the Integrity of Construction

Procurement by Imposed or Assumed Contractual Obligations". *The International Construction Law Review*, 16(2), pp. 263-286.

Craig, R. (1997a). "The 'Tendering Contract': Fairness, Equality and Innovation". *Proceedings, CIB W92 International Symposium, Procurement – a Key to Innovation* (ed. C.H. Davidson and T. A. A. Meguid). pp. 91-100. Montréal: I.F. Research Corp.

Craig, R. (1997b). "Competitive Advantage through Tendering Innovation". *CII Australia, Fourth Annual Conference.* Melbourne.

Daft, R. L. and Becker, S. W. (1978). *The Innovative Organisation*. New York: Elsevier.

Damanpour, F. (1991). "Organizational Innovation: A Meta-analysis of Effects of Determinants and Moderators". *Acad. Manage. J.*, 34(3), pp. 555-590.

Damanpour, F. (1987). "The Adoption of Technological, Administrative, and Ancillary Innovations: The Impact of Organizational Factors". *Journal of Management*, 13, pp. 675-688.

Damanpour, F. and Evan, W. M. (1984). "Organizational Innovation and Performance: the Problem of Organizational Lag". *Administrative Science Quarterly*, 29, pp. 392-409.

Dibner, D. R. and Lemer, A. C. (1992). *The Role of Public Agencies in Fostering New Technology and Innovation in Building*. Washington D. C.: National Academy of Sciences Press.

Kimberly, J. R. and Evanisko, M. (1981). "Organisational Innovation: the Influence of Individual, Organisational and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations". *Academy of Management Journal*, 24(4), pp. 689-713.

Lenard, D. and Bowen-James, A. (1996). *Innovation: The Key to Competitive Advantage,* RR9. Adelaide: Construction Industry Institute, Australia.

Lenard, D. and Eckersley, Y. (1997). *Driving Innovation: the*

Role of the Client and the Contractor, RR11. Adelaide: Construction Industry Institute, Australia.

Neuman, L. W. (1997). *Social Research Methods: Qualitative and Quantitative Approaches*. Allyn and Bacon.

Rogers, E. M. (1995). *Diffusion of Innovations*. Fourth Edition. New York: The Free Press.

Romano, C. A. (1990). "Identifying Factors which Influence Product Innovation: A Case Study Approach". *Journal of Management Studies*, 27, pp. 75-95.

Rosenberg, N. (1982). *Inside the Black Box: Technology and Economics,* Cambridge.

Slaughter, E. S. (1993). "Builders as Sources of Construction Innovation". Journal of Construction Engineering and Management, 119(3), pp. 532-549.

Slaughter, E. S. (1998). "Models of Construction Innovation". Journal of Construction Engineering and Management, 124(3), pp. 226-231.

Smith, A.J. and Wilkins, B. (1997). "Procurement Strategy, Innovation and the Assessment of Project Success". *Proceedings, CIB W92 International Symposium, Procurement – a Key to Innovation* (ed. C.H. Davidson and T. A. A. Meguid). pp. 703-710

Stewart, W. S. and Tatum, C. B. (1988). "Segmental Placement of Renton Outfall: Construction Innovation". *Journal of Construction Engineering and Management,* 114(3), pp. 390-407.

Tornatzky, L. G., Eveland, J. D., Boylan, M. G., Hetzner, W. A., Johnson, E. C., Roitman, D., and Schneider, J. (1983). *The Process of Technological Innovation: Reviewing the Literature*. National Science Foundation, Productivity Improvement Research Section.

Utterback, J. M. (1974). "Innovation in Industry and the Diffusion of Technology". *Science*, 183, pp. 658-662.

Zaltman, G., Duncan, R. and Holbeck, J. (1973). *Innovations and Organisations*. New York: Wiley.

Face-to-Face Communication in Construction

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Abstract

In the construction process communication between the involved parties plays an essential part of the service delivery; in addition new developments in IT and telecommunication have facilitated new and easy ways of communication. However, in many cases, design consultants or contractor employees need to meet the customer or building user face-to-face to convey information, trust or security. With findings from the fields of communication and service management, the significance of face-to-face communication between service providers and customers, especially between craftsmen and building users, is highlighted and practical implications are outlined.

Keywords: communications, face-to-face, construction projects

Introduction

Face-to-face communication between users and contractor employees exists in many types of construction; two examples are: (1) refurbishment of flats or offices with users in occupancy and (2) offices "shells", to be completed after the users have moved in. Both of these types of construction are cost saving, as neither temporary accommodation nor additional moving are needed. Thus, they are frequently used despite the potential of being more distressing for users.

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Refurbishment should be seen as a service (Holm, 2000a) and recent investigations of seven refurbishment or completion projects with users in occupancy in Sweden showed that the service quality provided by contractor employees has a major impact on the users' willingness to recommend the contractors (Holm and Bröchner, 1999; Holm and Bröchner, 2000; Holm, 2000b; Holm, 2000c). Moreover, the investigated projects not only revealed frequent visual interaction between the users and the craftsmen but also almost as frequent oral communication. The mean frequency of visual interaction or oral communication varied between projects but spanned in the housing refurbishment projects from once a fortnight to several times a week. However, written communication from contractors to users was much less frequent when investigated.

Evidently, face-to-face communication is part of the contractor's service delivery and consequently the mentioned investigations also pinpointed communicating well as one of the major influences on the users' willingness to recommend the contractor.

As stated, face-to-face communication not only exists in refurbishment projects but also in many other types of construction. Thus, there seems to be a potential, in the light of the mentioned investigations of refurbishment projects, to discuss face-to-face communication between the various parties involved in building processes, especially the case of communication between craftsmen and building users, aiming at an increased understanding of the impact of face-to-face communication.

Interaction in construction

Let us assume that there are five ways of interaction between craftsmen and building users in occupancy: (1) observation, (2) face-to-face communication, (3) space sharing, (4) indirect effects and (5) service recovery. These five groups of interaction can be compared with the five criteria tangibles, reliability, responsiveness, assurance and empathy that customers use to evaluate services according to Zeithaml *et al.* (1990). In construction projects there is also the quality of work which is generally acknowledged as influential in achieving customer satisfaction in the industry. The five ways of interaction assumed, while not always mutually exclusive, lead to different expected impacts on user satisfaction.

Observation

Observation can be interpreted as visual interaction. This first type of interaction includes several factors that may contribute to satisfaction or dissatisfaction, such as if the craftsmen, in the eyes of the users, have the right equipment or if they seem skilled. Furthermore this type of interaction also includes if the users are able to identify the contracting firms from logotypes or brand names on signs or clothes; without such recognition, many benefits from satisfying the customer may well be lost.

Face-to-face communication

Face-to-face communication is our second and most obvious type of interaction. A user sends a message to (= asks) a craftsmen in order to obtain information. However, during such a transmission of information, obstacles as noise, impaired hearing and language difficulties may obscure parts of the message. This can be compared with the classic mathematical theory of communication (Shannon and Weaver, 1949), where a message passes from the information source to the destination through transmitter and receiver and where a noise source may affect the transmitted message. It can be also assumed that the craftsman interprets the received message and formulates an answer. This answer depends, in addition to the interpretation of the message, upon the skills of the employee. These skills may be divided into six categories: (1) ability to listen (being receptive); (2) ability to phrase an answer suited for the user (rhetorical); (3) knowledge (educational), (4) skills acquired by experience, or (5) project related skills, and (6) empathy. Next it can be assumed that the user will analyse the answer, including a comparison with the original request so as to establish whether it is a response to the original message, and an identification of the skills of the employee. The user understands more or less of the received information and may consider the answer adequate or choose to formulate a further question to acquire additional information. The process may thus include more than one message sent in either direction. Finally, the communication ends and the user is feeling more or less understood which eventually contributes to user satisfaction or dissatisfaction.

Space sharing

Space sharing, that the users and the craftsmen share the same space, is an issue of accessibility and co-operation. This third type of interaction means that craftsmen and users need to perform their individual tasks under a co-operative regime, whether they like it or not. In addition both parties often need to store equipment and materials in such a way that it minimizes mutual damage. This, in many cases forced, co-operation should have a potential to contribute to user satisfaction or dissatisfaction.

Indirect effects

Dust and noise are examples of how conversion work may influence user opinion of contractors negatively without direct personal interaction. Furthermore, indirect effects may also include user-to-user communication regarding information and opinions on the contractors or subcontractors, thus influencing each other and probably resulting in that opinions from leaders (informal or formal) have an amplified impact on the other users' opinions. Such an effect can be predicted if the "two-step flow" hypothesis is applicable to the situation (Lazarsfeld *et al.*, 1948). This hypothesis suggests that ideas from media often reach the public indirectly through people, so-called opinion leaders, who are more active in discussions and consume more media than less interested people.

Service recovery

The impact of service recovery on customer satisfaction in hotels and restaurants is shown in a study by Smith *et al.* (1999). In both service settings, customers were less satisfied after service failures than after outcome failures.

Implications for the construction industry

At least the first two of the five groups of interaction can be considered as visual communication – (1) observation, as signals are transmitted to the observer consciously or unconsciously and (2) face-to-face communication. Focusing on face-to-face communication, it exists in various shapes in the construction industry, for instance between contractor employees, design consultants, clients and building users in the construction industry. A commonly used expression in the service marketing literature is "the service encounter", which is the time the consumer directly interacts with a service (Shostack, 1985). Face-to-face communication in a restaurant service setting has earlier been analysed by Haring and Mattsson (1999). Examples of face-to-face communication in construction are between:

- craftsmen and users during refurbishment projects with users in occupancy;
- craftsmen and users during repair and maintenance activities;
- sellers and users when new flats are produced and sold;
- contractor employees and the client, during a building project and when a construction project is procured;
- design consultants and building owner, during the design phase;
- contractor and subcontractors, during the physical construction process;
- individual employees within one or more of the involved

companies;
- various groups within the contractor's organization.

The several studies mentioned earlier (Holm and Bröchner, 1999; Holm and Bröchner, 2000; Holm, 2000b; Holm, 2000c), pinpointed the significance of face-to-face communication between craftsmen and users in a refurbishment setting with users in occupancy. They also revealed that only a minority of the users used the possibility to rank the quality of work provided by the various trades. The latter finding may indicate that the users have difficulties in discerning between the individual trades. If this is true, many users will see the subcontractors as representatives of the main contractor – often building contractor. To be remembered is also that the main contractor is responsible for its subcontractors in a contractual sense. Having these two things in mind, it is easy to understand that the service quality provided is particularly important for the main contractor, often building contractor, as the provided service quality influences the users' willingness to recommend the contractors. Potential referrals that in turn may lead to increased possibilities to achieve new contracts. Recommendations have earlier shown to be an important way to generate new work for the UK repair and maintenance industry (Leather and Rolfe, 1997) and one of the factors influencing developers' selection of contractors in Thailand (Ogunlana and Khaewkhaseng, 2000).

This research does not include comparisons between written and face-to-face communication. However, focusing on the craftsman-user communication: (1) written communication to users is seldom used by craftsmen as such task seldom is in their line of responsibility, whereas (2) face-to-face communication between users and craftsmen is more often performed on an ad hoc basis and cannot be avoided (e.g. a user need information and asks one of the craftsmen). Moreover, Westmyer *et al.* (1998) showed that oral communication is preferred over written communication to fulfil interpersonal needs. All in all, this indicates the need for guiding principles in face-to-face communication for the craftsmen as a way for improved service quality delivery.

To summarize: face-to-face communication exists in many types of building projects and they have proved to be significant in a refurbishment setting. Nevertheless, further analyses of other types of building projects are needed to discern the full impact of face-to-face communication in construction. However, focusing on the role of the service-providing contractor, there could be a potential to highlight this type of communication to increase the service capability, particularly in the case of refurbishment.

Conclusions

Obviously, there exists various types of face-to-face communication during a construction process and it seems probable that this communication could influence the reputation of the service provider, not only in building refurbishment with users in occupancy but in many other types of construction as well.

Nevertheless, whereas the need for marketing communication may be evident for most construction companies, not much attention has so far been directed towards face-to-face communication, especially not in the case of the craftsmen. Therefore, there seems to be a potential for achieving an improved reputation in the market if the face-to-face communication skills were recognized and highlighted within contracting firms. A four step guide to better communication, between the service providing employees of the contractor and the building users could be (1) recognize the importance of face-to-face communication, (2) educate managers and craftsmen, (3) inform both craftsmen and users about the present project and finally (4) communicate well. These four steps would at least improve four of the six skills needed in communication earlier mentioned: ability to listen, ability to phrase an answer, knowledge and project related skills.

It could also be fruitful for a construction company to try to increase the number of face-to-face contacts between craftsmen and users as they, if well performed, may increase the potential for positive referrals.

References

Haring, M. den and Mattsson, J. (1999), "A linguistic approach to studying quality of face-to-face communication", *The Service Industries Journal*, Vol. 19 No. 2, pp. 28-48.

Holm, M.G., and Bröchner, J. (1999), "Satisfying the ultimate customer in housing refurbishment", in *Proceedings of CIB W70 International Symposium on Management, Maintenance and Modernisation of Building Facilities*, Singapore, 18-20 November 1998, pp. 205-212.

Holm, M.G., and Bröchner, J. (2000), "Office conversions: the effects of craftsman-user interaction", *Facilities*, Vol. 18 No. 13/14, pp. 535-544.

Holm, M.G. (2000a), "Service management in housing refurbishment: a theoretical approach", *Construction Management and Economics*, Vol. 18, No. 5, pp. 525-533.

Holm, M.G. (2000b), "Service quality and product quality in housing refurbishment", *International Journal of Quality and Reliability Management*, Vol. 17 No. 4/5, pp. 527-540.

Holm, M.G. (2000c), "Service provision in building refurbishment", in *Proceedings of CIB W70 International Symposium on Facilities Management and Maintenance*, Brisbane, 15-17 November 2000, pp. 541-545.

Lazarsfeld, P.F., Berelson, B. and Gaudet, H. (1948), *The People's Choice: How the Voter Makes Up His Mind in a Presidential Campaign*, 2nd edn, Columbia University Press, New York.

Leather, P. and Rolfe, S.J. (1997), "Fit for the task: the future of the small scale domestic repair and maintenance industry in the UK", *Construction Management and Economics*, Vol. 15, pp. 201-212.

Ogunlana, S. and Khaewkhaseng, N. (2000), "Customer satisfaction in the procurement of residential construction: the example from Bankok", in *Proceedings of CIB W92 International Procurement Systems Symposium on Information and Communication in Construction Procurement*, Santiago de Chile, 24-27 April 2000, pp. 219-231.

Shannon, C.E. and Weaver, W. (1949), *The Mathematical Theory of Communication*, University of Illinois Press, Urbana.

Shostack, G.L. (1985), "Planning the service encounter", in *The Service Encounter: Managing Employee/Customer Interaction in Service Businesses*, Czepiel, J.A, Solomon, M.R. and Surprenant C.F. (eds.), Lexington Books, Lexington MA, pp. 243-253.

Smith, A.K., Bolton, R.N. and Wagner, J. (1999), "A model of customer satisfaction with service encounters involving failure and recovery", *Journal of Marketing Research*, Vol. 36 No. 3, pp. 356-372.

Westmyer, S.A., DiCioccio, R.L. and Rubin, R.B. (1998), "Appropriateness and effectiveness of communication channels in competent interpersonal communication", *Journal of Communication*, Vol. 48 Summer, pp. 27-48.

Zeithaml, V.A., Parasuraman, A. and Berry, L.L. (1990), *Delivering Quality Service: Balancing Customer Perceptions and Expectations*, The Free Press, New York.

Problems of Trust and Control in Client-Contractor Relations

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Abstract

Adversarial inter-organisational relations have since long been considered a major problem in the construction industry. In Sweden, however, clients have been hesitant to abandon traditional procurement practices, and there are still only a few examples of explicit partnering projects. In this paper, research on trust in exchange relations is employed to analyse client-contractor relations in construction projects. Several potentially dysfunctional mechanisms are identified. Notably, rational models tend to predict distrust and the logic of interaction in contingent claims contracts contradict intuitive perceptions of how a trustworthy exchange partner should behave. It is proposed that a combination of unobtrusive control strategies and communication is needed to ensure viable co-operation.

Keywords: trust, control, dysfunctional mechanisms, rational models

Background

In Sweden, contractual relations in construction are considered to be less adversarial than in, for example, UK and US. Most conflicts are negotiated and resolved within the projects, and few cases reach either formal adjudication or courts. Still, there is considerable dissatisfaction with the level of conflict and the working climate within the Swedish construction industry, and the interest in developing more co-operative client-contractor relations has increased in recent years. However, concrete examples of explicit partnering projects are

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still quite few, and clients hesitate to increase the contractor's responsibility in influencing design. The aim of this paper is to analyse the clients' doubt and to suggest more co-operative and yet viable strategies.

Traditional Contracts

In traditional Swedish contractual arrangements, the client appoints consultants to specify the building design and main contractors are then invited to tender. Often, a fixed price is set for the contract and as the specifications are detailed, it is normal to appoint the lowest bidder. Standard contractual agreements stipulate that when a client chooses to change the requirements, or when errors or omissions in the specifications are found, the appointed contractor has the right to carry out the "extra" work that follows. The pricing of this work is based on contractor cost and is not subject to competition. Thus, after the contract is signed, specification defects and client changes entail extra costs for the client and opportunities to improve profits for the contractor. After the contract is signed, specification defects and client changes entail extra costs for the client and opportunities to improve profits for the contractor. The client fears that the contractor will scrutinise the contractual documents for errors and ambiguities that may lead to claims, exploit their monopolist position by excessive pricing of extra work, or save money by shirking on quality. Consequently, the client often monitors site work quite closely and contractor claims and suggestions are critically examined to detect signs of opportunism.

Historically, it is the Swedish contractors who have been most dissatisfied with traditional, general construction contracts. They would prefer less specified design-build contracts, so that the contractors may participate in the initial phases of a project. Contractors argue that they may bring significant value to the process, and complain that their employees are dissatisfied and frustrated when they are not allowed to contribute their knowledge. Another important aspect is that competitive tendering on detailed specifications makes it difficult for contractors to make a profit.

A study of government sector clients (Björkman, Kadefors and Ranhem 1999) as well as two recent master theses (Gerle and Nyberg 2000; Hindrichsen, Kruus and Wahlqvist 2000) have investigated Swedish clients' attitudes towards closer co-operation with contractors and long term contractor relations. The studies showed that many clients share the view that closer co-operation with the contractor would be advantageous and look for ways to achieve better integration of design and construction and less conflict. They agree that current contracting practices fail to make use of the competencies of those involved, and that too much effort and resources are spent on finding out who is responsible for a problem and to little on constructive problem-solving. However, despite the perceived need for new forms of interaction, many clients were reluctant to abandon traditional, general contracts. Considering that competitive tendering admittedly tends to reduce contractor profitability, clients tended to view co-operation as something that primarily benefits the contractors rather than as a means for achieving a win-win situation. All the studies found that clients heavily stressed the importance of competitive tendering. In the next section, the clients' attitudes are analysed using literature on trust in business relations.

Rational Models and Control

In rational models, trust is seen as a product of the incentive structure shaping the interests of a person, and a perceiver's knowledge of these interests (Kramer 1999). Thus, a person will trust another person if it is in the other's interest to act in a way that is desirable to the first person. One such framework is Williamson's (1979, 1985) transaction cost theory. In this model, individuals are seen as motivated primarily by economic self-interest and transaction costs arise because of the need to specify, monitor and enforce contracts when the parties' interests diverge and there is risk for opportunism. Many construction management researchers have used Williamson's framework to analyse project relations in construction (Eccles 1981; Reve and Levitt 1984; Stinchcombe 1985; Winch 1989). The generally observe that the opportunities for opportunistic contractor strategies are substantial given the temporariness, interdependence and uncertainty of construction relations. Thus, rational assessments of the contractor's interests and opportunities for defection tend to lead to the conclusion that the contractor can not be entrusted with design responsibility other than in standardised and simple projects, were the specification uncertainty is low. Furthermore, it is considered necessary to employ quite close monitoring of contractor performance. Thus, recommendations based on rational analysis fit well with the traditional system. However, there are other important mechanisms involved in human interaction that may blur and even contradict the effectiveness of control strategies based on rational models.

Reciprocity and Self-Fulfilling Prophecies

According to rational models, detailed specifications and monitoring strengthen trust because the client's feelings of vulnerability are reduced and the willingness to trust increases. However, the actual relationship between control and trust is more ambiguous and formal mechanisms of control may act not only as facilitators but also as impediments to trust (Sitkin and Stickel 1996; Elangovan and Shapiro 1998). People tend to reciprocate both trust and distrust by the kind of behaviour these attitudes anticipate. Distrust communicates to the other party that opportunism is expected and, consequently, risks to induce opportunistic strategies such as shirking and work-to-rule behaviour. Furthermore, once suspicion has been raised about another person's motives or competence, the perceiver tends to apply a more active and mindful mode of analysis

(Fein 1994). As a consequence, monitoring is enhanced and it is more likely that bad performance will be detected. The implication is that highly specified contracts, close monitoring and sanctions for breach of contract may be interpreted as signs of distrust and may lead to reduced co-operation, thereby justifying the distrust.

Conversely, trust breeds trust, and people tend to reciprocate shown trust with a behaviour that justifies that trust. Trust communicates that co-operation is expected. Also, the trusting party subconsciously makes extra efforts to ensure that the trusted party succeeds, in the end justifying the original decision to trust (Hayashi, 2001). Thus, both trust and distrust tend to become self-fulfilling prophecies.

Contracts and Co-Operative Behaviour

Based on a review of trust literature, Mayer, Davis and Schoorman (1995) suggested that, apart from the trustor's propensity to trust, the most important antecedents of trust were the trustee's *ability*, *benevolence* and *integrity*. Ability is more or less equal to competence, and benevolence encompasses factors such as loyalty, receptivity, availability and caring. Integrity implies consistency, fairness, reliability, openness and value congruence. A closer look at client-contractor interaction suggests that a major problem of construction contracts and procurement practices may be that they produce behaviours and attitudes that contradict intuitive human understandings of what a co-operative relation implies and how a trustworthy exchange partner should behave.

First, consider the contractor's right to claim "extra" payment for additional work when the specifications are changed. After the contract is signed, all changes cost the client money. To the client, this is easily interpreted as a lack of benevolence, especially if it is not obvious that the proposed change leads to cost increases. Also, contractors often are entitled to extra payments when there are errors and omissions in the contract documents. Thus, the contractor may profit from adopting a critical attitude towards the contract documents. As it is the client and the client's consultants who have prepared these documents, contractors are perceived as taking advantage of the client's mistakes. Another aspect that affects perceived trustworthiness is that each contractor's chances of being awarded the contract increase if they do not disclose problems they find in the tendering documents. Instead, they may anticipate that errors may lead to change orders and reduce their bid correspondingly.

All these rules lead to contractor attitudes and behaviours that are easily perceived as violating the benevolence requirement by clients. As for the client, in traditional contractual arrangements the client role implies a suspicious attitude. During construction, the client involvement is mainly directed towards inspection and monitoring. As described above, distrust may start off vicious circles by discouraging co-operative contractor strategies. For example, co-operative moves by the contractor may be doubted and even interpreted as concealed opportunism. Furthermore, in traditional contracts all parties try to avoid being perceived as responsible. Thus, the contracts encourage both parties to criticise and blame each other participants, rather than to listen, assume responsibility and show respect.

Conclusions

Two interrelated mechanisms which contribute to the persistence of low-trust relations in construction have been discussed: that rational analysis emphasising economic self-interest tends to justify control-based strategies, and that the formal contractual roles give rise to attitudes and behaviours that are contradictory to factors generally considered by the trust literature as trust-enhancing. This indicates that it would be beneficial to develop more trusting relationships in construction. To increase contractor motivation and commitment, clients need to participate strategically in project communication to create meaning, communicate and develop goals and listen to contractor opinions. Future research should investigate the role of less obtrusive project control strategies based on communication, teamwork and constructive conflict likely to improve performance.

However, clients tend to assign great importance to the role of extrinsic incentives and competition in influencing contractor performance. Social and organisational norms are important in shaping trust behaviour (Creed and Miles 1996; Kramer, Brewer and Hanna 1996; Miller and Ratner 1998), and personal risk avoidance may keep client representatives from using alternative procurement options. Thus, a more viable alternative might be to combine co-operative arrangements with more unobtrusive control mechanisms. For example, formal interest alignment in the form of incentive contracts may be important as a signal that co-operation is legitimate and to be expected, thereby making relations more stable.

References

Björkman, L, Kadefors, A and Ranhem, L (1999) *Byggherrerollen. Intervjuer med statliga byggherrar*. Stockholm: Statliga Nätverket för entreprenad- och kvalitetsfrågor.

Creed, W E D, and Miles, R E (1996) Trust in Organizations: A Conceptual Framework Linking Organizational Forms, Managerial Philosophies, and the Opportunity Costs of Controls. In Kramer, R M and Tyler, T R (eds) *Trust in Organizations* Thousand Oaks, CA: Sage, 16-38.

Eccles, R (1981) The Quasifirm in the Construction Industry. *Journal of Economic Behavior and Organization*, Vol. 2, 335-357.

Elangovan, A R and Shapiro, D L (1998) Betrayal of trust in organizations, *Academy of Management Review*, Vol. 23:

547-67
Fein, S and Hilton, J L (1994) Judging others in the shadow of suspicion, *Motivation and Emotion*, Vol. 18: 167-98.
Gerle, C and Nyberg, L (2000) *Closer co-operation in building projects – Interviews with clients in the Göteborg region.* Göteborg: Chalmers University of Technology.
Hayashi, Alden M. (2001) When to trust your gut, *Harvard Business Review*, Vol. 79: 59-65.
Hindrichsen, R, Kruus, M and Wahlqvist, F (2000) *Trust and Longer Relations in Construction – Client Attitudes and Contractor Strategies.* Göteborg: Chalmers University of Technology.
Kramer, R M (1999) Trust and Distrust in Organizations: Emerging Perspectives, Enduring Questions, *Annual Review of Psychology*, Vol. 50: 569-598.
Kramer, R M, Brewer, M B and Hanna, B A (1996) Collective Trust and Collective Action: The Decision to Trust as a Social Decision. In Kramer, R M and Tyler, T R (eds) *Trust in Organizations.* Thousand Oaks, CA: Sage, 357-89
Mayer, R C, Davis, J H and Schoorman, F D (1995) An integrative model of organizational trust. *Academy of Management Review*, Vol. 20: 709-734.
Miller, DT. and Ratner, R K (1998) The disparity between the actual and assumed power of self-interest, *Journal of Personality and Social Psychology*, Vol. 74: 53-62
Reve, T and Levitt, R E (1984) "Organization and governance in construction," Project Management, Vol. 2: 17-25.
Sitkin, S B and Stickel, D (1996) The road to hell: the dynamics of distrust in the era of quality. In Kramer, R M and Tyler, T R (eds) *Trust in Organizations* Thousand Oaks, CA: Sage, 196-215.
Stinchcombe, A L (1985) Contracts as Hierarchical Documents. In Stinchcombe A L and Heimer, C A: *Organization Theory and Project Management. Administering Uncertainty in Norwegian Offshore Oil.* Bergen: Norwegian University Press.
Williamson, O E (1979) Transaction-Cost Economics: The

Governance of Contractual Relations, The Journal of Law and Economics, Vol. 22, 233-261.

Williamson, O E (1985) *Economic Organization. Firms, Markets and Policy Control*. Brighton: Wheatshef.

Winch, G (1989) The construction firm and the construction project: a transaction cost approach, *Construction Management and Economics*, Vol. 7: 331-345.

Trust in Construction

Conceptions of Trust in Project Relationships

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Abstract

The role of trust has been repeatedly highlighted as an important factor in the successful completion of construction projects (Latham 1994, Egan 1998, National Audit Office 2001). The Trust n Construction Project, carried our first for the EPSRC, has attempted to understand trust's role and impact on construction project performance.

Building on previous work of the research team (Wood and McDermott 1998), this first stage of the project has been to conduct 40 interviews, from trade level to director level, in an effort to understand the different views of trust and how it impacts relationships and work within construction projects. This paper documents how different individuals within project teams defined trust, considered how it was built or destroyed, and the role they felt that it had on the performance of the teams that they worked in.

Keywords: trust, relationships, teams, supplier chains

Introduction

This paper outlines the model developed from interviews undertaken during the Trust in Construction Project. The model looks at the conceptions of trust for a "trust event" or single game (Williams 2000). The trust event lies in the context of many other factors that influence trust (Wood and McDermott 1999), but allows us to see some of the issues that

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arise in exchanges in a project context.

The Trust in Construction project is an EPSRC (Engineering and Physical Sciences Research Council) funded study, investigating the role of trust in project teams. The project is framed within the context of the change agendas formulated in the UK construction sectors by Latham (1994) and Egan (1998). The role of trust in construction was once again highlighted in a National Audit Office Report (2001) "Modernising Construction", which endorsed the change agendas set in motion by Latham and Egan.

"These initiatives will only achieve improvements if there is sustained commitment across the whole industry to bringing about change built on mutual trust between client departments and construction firms and a common appreciation of their respective priorities." *(NAO 2001)*

The following reports on some of the preliminary work to identify conceptions of trust in relationships and the factors that influence its role within construction projects. These semi-structured interviews, conducted in parallel with a Social Network Analysis (Scott 1991) that informed this approach, were designed to allow the development of indicators for a "trust inventory" to measure trust in project teams (Bromiley and Cummings 1996).

Semi Structured Interviews

The interviewees were mainly drawn from the participants in two pilot case study projects. Additional interviewees were drawn from the project steering group organisations. The questions were based on the structure used by and previously reported to W92 by Wood and McDermott (1999).

The interviewees were drawn from many levels and disciplines in an attempt to get a more rounded conception of trust from different perspectives. The interviews lasted between 35 minutes to 1 hour 15 minutes.

Level in Organisation	Percentage of Trust Interviewee
Director	19%
Senior Manager	31%
Manager	34%
Supervisor	6%
Trade/ Production	9%

Table 1 – Interviewees Levels within their Organisations

The sample of interviewees was not representative of the individuals working on the project It did, however, allow all organisational levels to be questioned in an effort to establish broad conceptions of trust at the early stage of the trust project.

What is Trust?

Brenkert (1998) noted the growing importance of trust within and between business organisations, "Trust is said not only to reduce transaction costs, make possible the sharing of sensitive information, permit joint projects of various kinds, but also to provide a basis for expanded moral relations in business" (Brenkert 1998).

Trust is a multidimensional, (Sako 1992, Ganesan 1994, McAllister 1995), multifaceted social phenomenon (Fukuyama 1995, Misztal 1996), which is regarded by some as an attitude (Luhmann 1979, Flores & Solomon 1998), and by others as a vital social lubricant (Gambetta 1988, Fukuyama 1995). In spite of the large literature on the subject, Gambetta (1988) still saw trust as an elusive concept, and ten years later Misztal (1996) noted the continuing conceptual confusion that surrounded this social phenomenon. The difficulty of defining the concept in a functional sense lead the team to develop a working definition within which to investigate.

We define trust as a willingness to rely on the actions of others, to be dependent upon them, and thus be vulnerable to their actions. We are mainly interested in trust as it affects the willingness to co-operate (Wood and McDermott 1999, Smyth and Thompson 1999).

The first stage of the semi-structured interviews was to assess what individuals perceived trust as being, to allow them to provide their own definitions, based on their experience, and inform the team's understanding of what trust is. The main theme that ran through the interviews were (Swan et. Al 2001), Honest and open communications – can they be trusted? Reliance – what do you do when you trust someone? Outcomes – what happens when you trust?

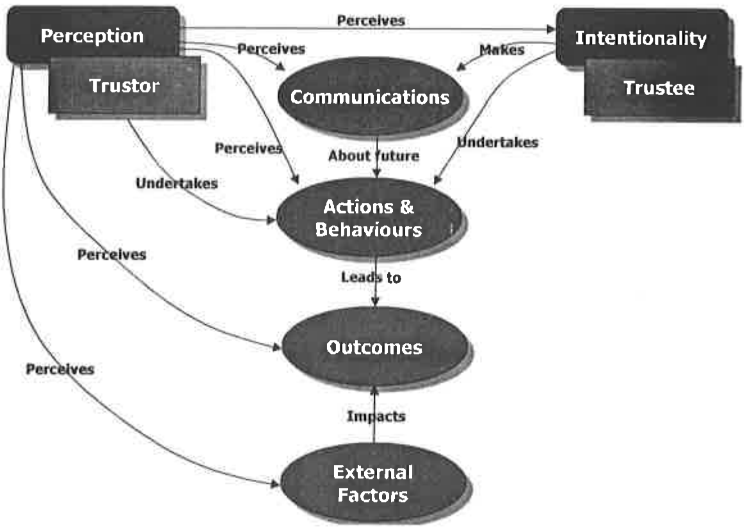

Figure 1 – Trust Event

These basic themes were identified as factors that occurred at the point, or a "trust event", that an individual trusted another.

Figure 1 highlights the relationship between the trustor, the person who trusts, and the trustee, the person who is trusted. This model for trust events has been developed on the basis of the semi- structured interviews.

Honest Communications

The majority of interviewees agreed that trust was concerned with the way people communicated with each other. People had to be open, willing to share important information with the rest of the team, and honest, giving information that reflected the real situation.
"To believe the facts that they produce."
"Someone makes a decision and they stand by it. You get good clear information in a reasonable amount of time."
"Whether they are open or honest and they are proved to be honest."

People stated that trust could only exist where these types of communications existed. It was felt to be important that people gave information when it was needed.

Actions and Behaviours

Individuals felt that the people they worked with had to match actions to communications. Trust will be built where the actions reflect what the trustee has communicated to the trustor. This requires people delivering what they promise and to an acceptable standard.

Outcomes

Ultimately, a project team is working together to complete a specific outcome. Trust can be built on actions and communications but, ultimately, people have to successfully complete the tasks that they are assigned to carry out in order to complete the project. The outcomes are the physical representations of the promises and actions, such as information and actual construction work.

"Spending time with people and working with them [is important]. Even if you have no experience of someone, there is trust there, but obviously the proof of the pudding is in the eating. If you have worked with a project and you have been let down you would not use that contractor again."

The only way individuals can prove they are competent is in the final outcome of their work. At site level this issue of competence and its role in trust was considered very important.

"Basically, I will look at someone and say whether I can I trust them? Just ask a simple question and you can usually see if they know what they are talking about. Take that on board. If you ask them a simple question and they give you a load of codswallop, you say to yourself there is something wrong here."

External Factors

The communications-behaviour-outcomes model functions at a very basic level. Individuals interviewed understood that external factors played a big role in construction.

"How they [sub-contractors] react to change is important, because change is a big thing in construction. It is not as simple as producing a drawing and them working to that drawing. There are external factors and it is how the contractor reacts to that that is important."

During a project information is likely to change. Through people acting on the trust of others this uncertainty may be reduced. However, there are factors that neither the trustor nor the trustee has control over. The interviewees felt it was important to consider these factors when outcomes did not match communications. If a trustor felt there were mitigating circumstances for the outcomes failing to meet their expectations then most stated this would not damage the trust in the relationship.

Perception and Intention

The trustor's trust is built through their expectations being met. If they understand that the trustee is going to bring about certain outcomes and they rely on this, then how they perceive the outcomes is important. If they perceive that their trust has been justified then the relationship will improve. Even if the outcomes are as predicted by the trustee, unless the trustor perceives them as such, then the relationship may not be strengthened.

Another factor is the trustor's perception of the trustee's intention. Many of the interviewees are aware that mistakes will happen and are prepared to forgive these without allowing trust to be damaged in the relationship. However, if the interviewees felt there was a negative intention in the behaviour, whether there was one or not, then this would damage relationships, possibly irreparably.

"If someone set me up on a project, and I found out, I would never forgive that. If people make genuine mistakes that is one thing, but if people put you in a position where you believe one thing I think that is just unforgivable, it depends on the intention."

Trust in Relationships

An event, or phenomenological, model is useful to understand trust in relationships. However, trust is built throughout relationships in which many repeats of these events will impact future exchange relationships (Williams 2000). Experience is considered to be the main driver of trust.

"As you get to know people it gets easier...past experience is important"

The trust "event" or "game" will occur many times in a relationship during the course of a construction project. Each present game will be impacted by past events and events in other relationships (Smith and Laage-Hellman 1992). In addition, this will be impacted by factors connected to project status, organisational issues and individual contexts (Wood and McDermott 1999). The trust "event" should not be viewed in isolation. What it does is isolate specific behaviours in a relationship to help us understand what happens when people actually trust.

Conclusions

The models developed have been suggested by recurring themes of the interviews. It is clear that trust exists at many different levels and there are many factors that can impact trust that have not been discussed in this paper. Procurement systems (Rook and Seymour 1995 from Liu and Fellows 1999), organisational (Liu and Fellows 1999), psychological (Bromiley and Cummings 1996) and macroeconomic factors can all influence relationships in construction project teams (Swan et al 2001). What is clear is that all levels of the organisation see the need to trust as vital to the way project teams need to work. As one interviewee noted,

"People are aware of how much you have to trust people. Even where there is mistrust there has to be something there to deliver, otherwise you would do the job yourself."

If we establish what trust is and how it is formed, then we can look towards measuring and managing the development of trusting relationships within project teams. If we are able to do this, then we can bring the benefits of flexibility, effective problem solving and reduced conflict, that the interviewees highlighted as important benefits of trust (Swan et al. 2001).

Bibliography

Brenkert, G. (1998) *Trust, Business and Business Ethics: An Introduction*, Business Ethics Quarterly, 8:2, 195-203

Cummings, L.L.; Bromiley, P. (1996) *The Organisational Trust Inventory* in Kramer and Tyler ed Trust in Organisations, 302 - 330 Sage Thousand Oaks

Egan, Sir John (1998) – *Rethinking Construction* –HMSO

Flores, F. & Solomon, R. C. (1998) '*Creating Trust*' Business Ethics Quarterly, 8:2, 205-232

Fukuyama, F (1995) *Trust: The Social Virtues and the Creation of Prosperity*, Harmondsworth, Penguin Books

Gambetta, D (ed) (1988) *Trust: making and breaking cooperative relations*, Oxford, Basil Blackwell

Ganesan, S (1994) *Determinants of long-term orientation in buyer-seller relationships*. Journal of Marketing, 58 (April), 1-19

Latham, M (1994) *Constructing the Team, Final Report of the joint Government/Industry Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry*, HMSO

Liu, Anita; Fellows, Richard 1999) – *Cultural Issues* in. McDermott and Rowlinson (ed) Procurement Systems: A Guide to Best Practice in Construction) (139 – 162 E & FN Spon London

Luhmann, N. (1988) '*Familiarity, confidence, trust: Problems and alternatives*', in Gambetta, D. (ed.) (1988) Trust: making and breaking cooperative relations: 94-108 Oxford, Basil Blackwell

McAllister, D.J. (1995) 'Affect and cognition based trust as a foundation for interpersonal cooperation in organisations', *Academy of Management Review*, 38:1, 24-59

Misztal, Barbara A. (1996) *Trust in Modern Societies*,

Cambridge, The Polity Press
National Audit Office – *Modernising Construction* – (2001) HMSO
Scott, John (1991) *Social Network Analysis: A Handbook* – Sage Publications: London
Smith, P.C; Laage-Hellman, J (1992) *Small Group Analysis in Industrial Networks,* ed Axelsson, B; Easton, G. Industrial Networks: A New View of Reality - Routledge
Smyth, H.J; Thompson, N.J (1999*) Partnering and the Conditions of Trust* ed. Bowen, P.; Hindle, R - CIB W55 & W65 Joint Triennial Symposium: Customer Satisfaction: A Focus for Research and Practice
Swan, William; Wood, Graham; McDermott, Peter; Cooper, Rachel – *Trust in Construction: Interim Report* (Forthcoming 2001) – Centre for Construction Innovation
Williams, Bernard (2000) '*Formal Structures and Social Reality'*, in Gambetta, Diego (ed.) Trust: Making and Breaking Cooperative Relations, electronic edition, Department of Sociology, University of Oxford, pp. 3-13, <http://www.sociology.ox.ac.uk/ papers/williams3-13.doc>.
Wood, Graham; McDermott, Peter – *Searching for Trust in the UK Construction Industry: An Interim View* – CIB W92 Procurement Systems Conference (1999) - Thailand

Ethics of Hong Kong Surveyors – in an Organizational Context

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Abstract

Surveyors are regarded as one of the key professionals involved in construction projects. However, there has been a general lack of study on the ethics of surveyors. In the paper, literature of ethics and professional ethics are reviewed. The similarities and differences between ethical theories in the East and the West are examined. Contextual analysis suggests that the identification of groups affect the level of analysis of ethics, such levels include individual, local and cosmopolitan. The local level, generally refers to organisations, is emphasised in this research. A suggested methodology is proposed to study the ethical climate and culture of organisations where surveyors work.

Keywords: Contextual Analysis, Ethics, Professional Ethics

Introduction

While there have been previous studies on ethics of architects (such as Abramowitz, 1998; Takahashi, 1997) and engineers (such as Alhemoud, 1996; Davis, 1991), there seems to be a general lack of such study in the surveying profession.

This paper investigates ethics of Hong Kong professional surveyors in an organizational context. According to the definition of the Hong Kong Institute of Surveyors (and under the notion of the old RICS system in surveying divisions), the title of a "Surveyor" embraces a number of the disciplines involved with land and its development with buildings. Their

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services embrace site setting out, contractual arrangements, project cost control, land valuation, property management etc.

The study of teleological and deontological ethics provide a platform for individuals to justify their principles of (professional) judgement. Moral rules may be regarded as more authoritative and objective than government laws or rules of etiquette. Professional conducts and codes are being prepared and developed as the society prospers and advances. The major significance in studying ethics is not in the guidance it may give in particular cases but in the development of width and outlook and seriousness of purpose in dealing with moral and professional matters generally.

Ethics

There is no guarantee that those who understand the difference between right and wrong will necessarily follow the right. The purpose of studying ethics does not necessarily provide answers but aims to justify principles of judgment. Moral philosophy provides a starting point and method for coming to reasoned judgments but promises few definite answers to specific problems (Lillie, 1951). People's ethical standards in Hong Kong are subject to much influence of both western and eastern countries. The understanding of the prominent ethical theories in the West and East is essential in developing a research model.

According to Lillie (1951), there are different classification of ethical theories in the West: absolute and relative ethics; naturalistic and non-naturalistic ethics; teleological and deontological ethics. The classification of teleological and deontological ethics is commonly used by philosophers (Pettit, 1993; Carlson, 1995; Oderberg, 2000). Teleological theories hold that the rightness and wrongness of an action depends on its consequences or results. A deontological theory holds that the rightness or wrongness of an action depends on the action itself and not on the consequences. The means, rather than the ends, are used to arrive at ethical decisions.

Ivanhoe (1993) distinguishes between western and Chinese ethics. Western philosophers have been much more concerned with the definition of what goodness is. On the other hand, Chinese thinkers focus on how to become good. *De* ( ) is an early form of Chinese character since the oracle bone inscriptions. *De* is similar to the concept of virtue which includes kindness or even self-sacrifice (Ivanhoe, 1993). Stewart (1995) compares Aristotle's concept of virtue with Chinese Confucians. Stewart contends that the former is concerned with definition of virtue while the latter concentrates on the practical questions of how to teach and achieve virtue. However, Steward claims that Aristotle and Confucius seem to agree on what qualities go to make someone a virtuous person.

The foundation of Confucian ethics is in the concept of *jen* ( ), which is variously translated as love or benevolence or humanism. According to Stewart (1995), there are similarities between Confucian and occidental values. The concept of yen coincides with Christ's injunction to "love your neighbor as yourself". Hsu (1991) contends that Confucian ethics is deontological and denies consequential or rule-based ethics as the emphasis of Confucian ethics: "*Jen* is not necessarily related to a consequence, rather it is an intrinsic characteristic in which its manifested behavior or norms of behavior is only secondary" (Hsu 1991 p.19).

According to Harbour (1995), a shared core of human moral values of different cultures does exist, but only at the most basic level such as the approval of beneficence, justice, courage and so on. However, secondary and tertiary moral values differ between societies. Secondary values are elaboration and specifications of the general values in the form of culturally shaped definitions and principles of conduct.

Tertiary values are specific codes of behavior. Basic, foundation-level moral values are shared across cultures because they share the same objective property. Therefore, the most unambiguous evaluations are at the primary level such as murder is wrong, courage is good.

There are four possible relationships between professional ethics and general morality:

1. Professional ethics is independent of morality
   Professional ethics represents a distinctive ethical system. This advocates norms which are central to the profession and it permits conduct which is completely different from non-professional morality (Green, 1990).
2. Professional ethics is identical with morality
   Professional ethics should fall under the same general principle of morality as do all other branches of ethics (Gewirth, 1986).
3. Professional ethics is the specification of morality
   It means that universal norms are specified in relation to different situations and circumstances that the professionals encounter. (Bayles, 1989)
4. Professional ethics is functionally related to morality

Professionals possess specific roles, have additional duties that ordinary people do not have (Bayles, 1989). Conduct, which is not in line with general morality, may be permitted if it can be justified by the values shared among the professionals. According to Ng (1994), there are broad and narrow perspectives of professional ethics. The narrow perspective restricts professional ethics which mainly deals with ethical dilemmas and problems found in the practice of any profession. Professional ethics is defined in terms of value conflicts occurring in the practice of professional activities (Becker, 1992). The broad perspective suggests that professional ethics encompasses all issues involving ethics and values in the roles of the professions and conduct of professionals in society (Bayles, 1988; Annis, 1989).

Research Model

Contextual analysis is the study of the role of group context on actions and attitudes of individuals and it is widely used in social sciences research (e.g. Brown, 2000; Kawachi, 1999).

The concept of cosmopolitan versus local orientations was originally developed to differentiate between the two primary reference groups of influential community (Merton, 1957). For local orientation, the important reference groups or sources of role definitions and expectations are contained within the social system that one is embedded, i.e. the local role relates to service orientation to the organization (Ben-David, 1958) and is generally referred to the organizational level. For cosmopolitan orientation, the sources of role definition are in a social system external to the system in which the actor is embedded, i.e. a practitioner seeks recognition from the group (such as the surveying institution) to develop and maintain his expertise (Blau and Scott, 1962).

In addition to the cosmopolitan and local levels, a third level is the individual. According to Victor and Cullen (1988), the individual is external to the focal organization in the sense that the prevailing normative climate supports a referent for ethical reasoning located within the individual. It supports the use of one's personal ethics or the engagement in self-interested behavior. Also, Victor and Cullen (1988) argues that for cosmopolitan sources of ethical reasoning, it can be generated outside organizations but used inside as part of the institutionalized normative system.

Organizational (local) level is regarded as the central part of the model (fig. l) as it has much influence to a person's attitude and behavior. Some scholars (Waters, 1978; Clinard, 1983) suggests that there is much inter-relationship between ethics of individuals and that of the organization.

Individuals are the basis of the corporation. Any study of corporate ethics must include a study of the ethics of the employees of a firm. The ethics of employees result, to some extent, from their own moral characters developed prior to entering/joining an organisation. Also, ethics of employees result partly from the adherence to prevailing values of the organization after joining.

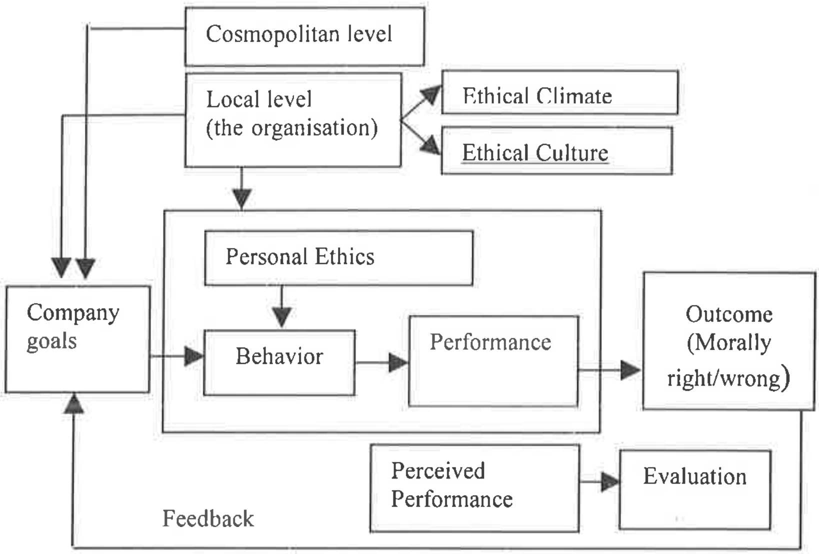

Figure 1. Ethics model in the organizational context

Outline Of Research Plan

To review western ethical theories (e.g. Lillie 1951, Oderberg 2000) and Chinese cultural theories (e.g. Hsu 1991, Ivanhoe 1993) in order to develop a model for studying professional ethics in the organizational context. To identify the level of analysis of ethics in relation to local and cosmopolitan orientations (Victor and Cullen 1988) and to incorporate the concept of "goals-behaviour-performance-outcome" in construction participants' behaviours from project management literature (Liu and Walker 1998) in the model. To collect data from different organization types in Hong Kong which employ surveyors and cost engineers. The two main types of employing organizations of surveyors are from the public sector and private sector (subdivided into developers, contractors and consultant firms).

Only respondents who have membership (including Honorary Fellows, Fellows, Associates and Student B membership) of the Hong Kong Institute of Surveyors will be included in the sample. Questionnaires are used to measure the ethical climate and culture of organizations. In order to investigate the convergence and divergence of the ethical climate and culture constructs, a principal component factor analysis is to be conducted on all ethical climate and culture questions. Then correlational analysis is conducted to determine whether correlations of within-constructs measures are higher on average than those of between-constructs (as this would suggest divergence of the two constructs). Analysis of variance (ANOVA) will be used to compare the four different types of organizations for their dominant climate and culture types, if any.

Findings

A total of 315 questionnaires were sent to the respondents as described in the research plan. Valid returns of 134 received indicating a 42.5% response rate. Fig. 2 shows the factor loadings of the ethical climate and culture dimensions. Fig. 3 shows the mean scores of each factor from the public / private sectors respondents and the coded / non-coded organizations' employees (coded indicates that the organization adopts a set of ethical codes known to the employees). The figures highlighted in bold (in fig. 3) denote significant differences(p=0.05) in the ANOVA results.

Figure 2. Factor loadings for ethical climate and culture dimensions

Ethical Climate Factors	**KMO sphericity 0.652 Cumulative variance 68.023%**							
Factor 1: Caring for People in Organization								
The most important concern is the good of all people in this organization.	0.883							
It is expected that each individual is cared for when making decisions here.	0.826							
Managers emphasize on human relationship and has a genuine concern for the employees.	0.648							
Factor 2: Company Efficiency								
The major responsibility of people is to consider efficiency first.		0.816						
The most efficient way is always the right way in this organization.		0.786						
The major responsibility of people is to control cost.		0.426						
People here are concerned with the company's interest-to the exclusion of all else.		0.484						
Factor 3: Personal Morality								
People are guided by their own personal ethics.			0.822					
Each person in this organization decides for himself / herself what is right and wrong.			0.519					
Factor 4: Laws and Professional Codes								
People are expected to strictly follow legal or professional standards.				0.472				

In this organization, the law or ethical code of the profession is the major consideration.				0.420				
In this organization, the first consideration is whether a decision violates any law.				0.713				
Factor 5: Friendly Atmosphere								
My organization emphasizes on viewing fellow staff members as colleagues rather than competitors.					0.425			
A friendly and sociable atmosphere prevails in my organization.					0.716			
Factor 6: Protection of interests								
People are actively concerned about the customer's and the public's interest.						0.518		
People protect their own interests above all else.						0.815		
Work is considered substandard only when it hurts the company's interest.						0.496		
Factor 7: Self Centrism								
*My organization emphasizes on individual contributions rather than team contributions.							-0.601	
You are expected to do what benefits yourself.							0.873	
Factor 8: Company Rules and Procedures								
Successful people in this organization go by the book.								0.685
* My organization emphasizes on meeting the demands of clients and reacting to changes in the external environment rather than setting internal organization routines such as developing rules and guidelines.								-0.789

* items with reversed scale

Ethical Culture Factors	KMO sphericity 0.608 Cumulative variance 50.785%	
Factor 1: Ethical Environment		
Management in this organization disciplines unethical behaviour when it occurs.	0.462	
Ethical behavior is rewarded in this organization.	0.731	
The top managers of this organization represent high ethical standards.	0.789	

Top managers of this organization guide decision making in an ethical direction.	0.724	
Factor 2: Obedience to Authority		
A person who wants to make his/her own work-related decisions would be quickly discouraged here.		0.790
There can be little action taken in this organization until a superior approves a decision.		0.567
The boss is always right in this organization.		0.653

Figure 3. Mean scores for the public and private sectors, coded and non-coded organisations

Organizational Type	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Public Sector	41	3.61	3.66	**3.54**	**4.60**	**4.41**	3.75	2.89	**3.49**	4.01	3.73
Private Sector	89	3.69	3.76	**3.92**	**4.26**	**4.04**	3.72	3.23	**3.16**	3.84	3.73
Total	130	3.67	3.73	3.80	4.37	4.16	3.73	3.12	3.27	3.90	3.73
Coded	88	**3.85**	3.66	3.79	**4.50**	**4.32**	**3.82**	3.15	3.21	**4.04**	3.70
Non-coded	42	**3.29**	3.88	3.82	**4.10**	**3.82**	**3.55**	3.07	3.38	**3.60**	3.81
Total	130	3.67	3.73	3.80	4.37	4.16	3.73	3.12	3.27	3.90	3.73

1. Caring for people in organization
2. Company efficiency
3. Personal morality
4. Laws and professional codes
5. Friendly atmosphere
6. Protection of interests
7. Self centrism
8. Company rules and procedures
9. Ethical environment
10. Obedience to authority

Conclusion

There are a number of key findings. Eight major ethical climate types can be identified in organizations, namely Caring for People in Organization, Company Efficiency, Personal Morality, Laws and Professional Codes, Friendly Atmosphere, Protection of Interests, Self Centrism and Company Rules and Procedures. Among them, the Personal Morality, Laws and Professional Codes and Company Rules and Procedures climates conform to the climate types suggested by the original instrument (Victor and Cullen, 1987).

Since there is more than one respondent from any organization, their divergent responses to the existence of an ethical code within the same organization indicates the possibility of employees' ignorance of ethical codes or that such codes are not well communicated to employees. When comparing the coded and non-coded organizations, it is found that the climates of Personal Morality and Company Rules and Procedures are significantly negatively related in organizations with ethical codes. This suggests that ethical codes, which give rise to over-formalization and inflexibility, hinder personal development of morality.

Organizations do not have single ethical climate, however, dominant climate can be found in different types of organizations. The dominant climate of Laws and Professional Codes and the least likely climate of Self Centrism are found in most of the key organizational types. This also confirms that social norms exist and Bayles' (1988) view that professional ethics is a system of norms. Laws and Professional Codes climate is thus the norm in the surveying profession while Self Centrism is not advocated by many organizations.

The public sector has significantly stronger climates of Laws and Professional Codes, Friendly Atmosphere and Company Rules and Procedures. Rules, including ethical codes are emphasized in the public sector. The private sector, on the other hand, has stronger climate of personal morality. People in the private sector may make their personal judgement more freely, instead of being constrained by formal codes and rules.

Ethical codes are more effectively implemented in the public sector. The existence of ethical codes in the private sector may be for window dressing only.

Organization with ethical codes have stronger climates of Caring for People in Organization, Laws and Professional Codes, Friendly Atmosphere, Protection of Interests and Ethical Environment. Also, human relationship is highly associated with implementation of ethical codes.

References

Abramowitz, A. (1998). A lawyer finds that architects, in the intense pursuit of ethics, often deny themselves a pragmatic practice. *Architectural Record.* 186 (11), 24-36.

Alhemoud, A. (1995) Engineering ethics is smart business. *Professional Safety*. 40, 42-43.

Annis, D.B. (1989). *Professional Ethics in Education: a Neglected Issue.* San Francisco, CA: American Educational Research Association

Bayles, M.D. (1988). The Professional-Client Relationship In: Callahan J.C. ed. Ethical Issues in Professional Life, pp. 113-119. Oxford: O.U.P.

Bayles, M.D. (1989). *Professional Ethics*. New York: Wadsworth.

Becker, L.C. (1992). *Encyclopedia of Ethics. Vol. II.*. Chicago: St. James Press.

Ben-David, J. (1958). The professional role of the physician in bureaucratized medicine: a study in role conflict. *Human Relations*, 4, 255-274.

Blau, P.M. and Scott W.R. (1962). *Formal Organizations: A Comparative Approach.* San Francisco: Chandler.

Brown, A. Ć. (2000) Rural Black women and depression: a contextual analysis. *Journal of Marriage and the Family.* 62(1), 187-199.

Carlson, E. (1995). *Consequentialism Reconsidered.* Dordrecht: Kluwer Academic Publishers.

Clinard, M.B. (1983). *Corporate Ethics and Crime*. Beverly Hills: Sage.

Davis, M. (1991). Thinking like an engineer: the place of a code of ethics in the practice of a profession. *Philosophy and Public Affairs*. 20, 150-167.

Gewirth A. (1986). Professional ethics: the separatist thesis. *Ethics*. Jan., 300-315.

Green, L. (1990). Legal ethics: sociology and morality. In Macniven D. ed. *Moral Expertise: Studies in Practical and Professional ethics*, pp. 101-105. New York: Routledge.

Harbour, F.V. (1995). Basic moral values: a shared core. *Business and International Affairs*, 9, 155-170.

Hsu, C. Y. (1991). Applying Confucian ethics to international relations. *Ethics and International Relations*, 5, 15-31.

Ivanhoe, P.J. (1993). *Confucian Moral Self Cultivation.* New York: Peter Lang Publishing Inc.

Kawachi, I. (1999 Aug.). Social capital and self-rated health: a contextual analysis. *American Journal of Public Health.* 89 (8), 1187-1194.

Lillie W. (1951). *An Introduction to Ethics.,* London: Methuen & Co. Ltd.

Liu A.M.M. and Walker A. (1998) Evaluation of Project Outcomes, *Construction Management and Economics*, 16, 209-219

Merton, R.K. (1957). *Social theory and Social Structure.* New York: Free Press.

Ng Chi Hung (1994). *Teachers Perceptions of Professional Ethics In Hong Kong.* Hong Kong: Hong Kong University M. Ed. Thesis.

Oderberg, D.S. (2000). *Applied Ethics : A Non-Consequentialist Approach.* Oxford: Blackwell Publishers

Pettit, P. (1993). *Consequentialism.* Aldershot, Hants: Dartmouth

Stewart S.(1995). The ethics of values and the value of ethics: should we be studying business values in Hong Kong? In: Stewart S. and Donleavy G. eds. Whose Business Values? Some Asian and Cross-Cultural Perspectives, pp. 2-18. Hong Kong: Hong Kong University Press.

Takahashi, E.K. (1997). Standards of care offer architects real-world applications of AIA code of ethics. *Architectural Records*, 185, 22-34.

Victor B. & Cullen J.B. (1988). The Organizational Bases of Ethical Work Climate. *Administrative Science Quarterly*, 33, 101-125.

Victor, B. & Cullen, J.B. (1987). A Theory and Measure of Ethical Climate in Organizations. In Frederick W.C. ed.. Research in Corporate Social Performance and Policy, pp. 51-71. Greenwich, CT: JAI Press,.

Waters, J.A. 1978). *Climate for Creativity*. Elmsford, NY: Pergamon.

Project Leadership's Influence on Costs of Human Errors

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Abstract

The paper concerns leadership in building projects and focuses on the site manager. It argues that the leadership influences the costs of human errors to a large extent. By leadership is meant that (a) the project members on site have confidence in the site manager, which depends on the site managers competence and the distance between the site manager and the project members, (b) the task is clearly laid down and defined for both the site manager and the project members on site, and that (c) the site manager get power and the organisational support he needs. These three major groups of factors are divided in twelve more specific factors. The analysis is based on close follow-ups on seven building projects and 92 interviews with key persons within the projects. It is recommended that the client demand the contractor's organisation to support the factors presented and that the contractor evaluates their project organisation in early stages based on the same factors.

Keywords: Project leadership, site management, success factors, human error, cost.

Introduction

'To err is human', is a common statement in general as well as in construction. But humans do mistakes too often. The costs for consequences of human errors in building projects have been found to be approximately 5% of the project cost (Josephson and Hammarlund, 1999). Numerous studies aiming at quantifying the cost of rework (e.g. Love et al, 1999) and costs of deviations (e.g. Burati et al, 1992) in building and

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civil engineering projects confirm that the costs of not perfect processes are considerable. Including indirect costs (e.g. Love et al, 2001), hidden costs (e.g. Josephson, 1990; Sörqvist, 1998), costs for consequences appearing during use and other losses the cost of human errors may be significantly higher. There is no doubt about the importance of reducing these costs.

The root-causes of human errors, rework and deviations have been analyzed in a number of studies. Most studies agree that the causes are complex. Short time, forced down prizes, weak organisations, unclear clients, type of contract form and weak project management are often mentioned. The same factors can be found in numerous studies of what characterises successful projects. Some of these studies are summarised in Belassi and Tukel (1996). There are also several studies of what characterises successful construction projects in general or specific types of construction projects (e.g. Ashley, et al., 1987; Sanvido et al., 1992; Songer and Molenaar, 1997).

Some root-causes, such as time pressure, cost pressure, divided organizations and processes, can be found in most building projects and are by practitioners often accepted as characteristics for building projects. An alternative approach to identify reasons for different outcomes is to compare two or more projects with each other. Josephson (1999a) compared a best and a worst case according to cost of human errors. The main reason for the variation was found in the project leadership. By comparing the two cases several factors significant for leadership were found. All factors had to do with the group's confidence in the leader, how clearly the task is laid down and defined, and the amount of power and organisational support to the leader. Thus, leadership is viewed as a group process, which includes not only the leader, but also the relation to the group as well as the relation to the superior. This view is in accordance with the modern view of leadership (Yukl, 1998), but differs from most empirical-oriented studies of project leadership, which still focuses on the leaders personal characteristics (e.g. Zimmerer and Yasin, 1998; El-Sabaa, 2001).

The purpose with this paper is to test the findings in Josephson (1999a). That is to say the purpose is to determine the project leadership's influence on costs of human errors in building projects. Focus is on the site manager as leader. Human errors include all types of errors and mistakes made by humans and which result in defects. Changes because of clients' changed needs are not considered as errors. The study is limited to costs arisen until finished project.

Method

The analysis is based on close follow-ups of seven building projects, presented in Table I. The costs of human errors were measured by seven observers, spending full-time on one site each. The researcher educated the observers in how to collect and analyse data on human errors. Several group discussions during the studies and regular contact with the researcher made sure that the differences in the analyses were minimised. The error cost is presented in Table II.

The data about leadership aspects was collected by interviews with 92 key persons in the projects: client representatives, architects, structural engineers and specialist designers, contractors' project managers, site managers, foremen, workmanship representatives, sub-contractors' managers and workmanship, and observers. The interviews lasted for 30-90 minutes each and aimed at getting the key persons views on what they considered to be important aspects in their projects. All interviews were tape-recorded and transcribed verbatim. Together with many informal discussions the interviews gave a relatively complete picture of the production process and the project end result.

The researcher analysed each interview and especially looked for comments on the identified leadership aspects. Each comment was valued on a five-point scale; i.e. "...we had no contact at all" meant 1 and "the best site manager I have ever had" meant 5. For each leadership aspect an average figure was calculated for each key person and then was an average figure calculated for each project. The key persons represent different actors. Of that reason their opinions varied to some extent. However, they had surprisingly similar views on most aspects. The leadership aspects and the average figures are presented in Table II.

Table 1: Details of the projects.

Proj. No	*Client*	*Type*	*New construction or re-furbishment*	*Type of contract*	*Production cost (MSEK)*	*Time (months)*
A	Munici-pality	Museum	New/Refur-bishment	Traditional lump sum contract	30	12
B	Munici-pality	School	New	Traditional lump sum contract	130	13
C	Own project	University building	New	Design-Build	100	16
D	Real estate company	Housing	New	Design-Build	21	14
E	Munici-pality	Industry	Refurbish-ment	Traditional lump sum contract	15	4
F	Munici-pality	Fire station	New	Design-Build	55	15
G	Insurance company	Shopping centre	Refurbish-ment	Traditional lump sum contract	30	13

Analysis

Twelve leadership aspects were identified by Josephson (1999a). They were classified in three major groups. The site manager is the leader in this analysis. He is situated on site and has full responsibility for all activities and all project members on site. The group consists of all project members on site, except the site manager.

The group's confidence in the leader

The first factor considers the relation between the leader and the group. It considers how much the group likes their leader and the confidence they have in him. It has to do with the leader's competence and the distance between the leader and the group.

All site managers were considered to have good *knowledge* and long *experience,* especially the managers in project C and project B. However, the site managers in project A and project D had little or no experience of the specific product. The *ability to give clear information* varied. The site manager in project C was known to always give clear information. If he couldn't answer a question he knew whom to ask. The site managers in project E and D often gave vague answers. *Social competence* and *trusting the group* is close related. The site managers in project C and F created good atmosphere on site. One reason was that they got everyone to feel important for the project. Another reason was that they dared to trust the group and consider their ideas.

The distance between the site manager and the group depends on the *site manager's role* and *earlier relations.* The site manager in project C was given a wide role with full responsibility for the project. The role was free with little control from the company. Every day he took a stroll around the site. In that way he had daily contact with all group members. He had worked together with most of the group in several projects before. The site manager in project B had less contact with the workmanship partly because of the large size of the project. The site manager in project E took an administrative role and seldom talked to the workmanship. The organisations in project E and D consisted of new groups, in which few project members had worked together before.

How clearly the task is laid down and defined

The second factor considers how well the task is defined. There are two levels of analysis. First, how clearly the task is *laid down and defined to the site manager*. Second, how clearly the *site manager instructs the group*.

In project C, the drawings were complete when the production began. There was also much communication with the designers. The designers often visited the site on their own initiative. The site manager were involved in the later part of the design phase and consequently had great knowledge of the product when the production started. In project D, the drawings were also complete when the production began. The design was only to modify the drawings from a similar project, situated close to the site. However, there was a wish for more detailed drawings. In project E, the communication with the designers was extremely limited. The site manager entered the project the week before the start of production.

The site managers' instructions to their groups varied, principally due to their respective roles. The site manager in project C had an active role, which involved frequent contacts with the group and giving the group clear instructions. The foremen imitated the leader in giving clear instructions. The site managers in project E and D were administrators, while their foremen had closer contacts with the group.

The amount of power and organisational support

The third factor considers the site managers' amount of power and organisational support.

All site managers, except one, had great deals of power. The companies gave them a large amount of *formal power*, including full responsibility for the production. The site managers had authority and, especially the site managers in project C and F, were accepted by their groups, which means that they also had a large amount of *informal power*. The exception is project D, in which the site manager had an administrative role and an assistant project manager were active during production.

In project C, three to four foremen supported the site manager on site. Both the site manager and the group thought that this support fitted the need. In project D and G, there were only one and two foremen respectively. The site managers asked their project managers for more support but without result. In both projects, the site managers and the groups agreed that this support was not enough. The organisational support from main office was limited in most projects. However, the site managers in project B and C thought they got enough support and they knew that they could ask for help whenever he needed. Again, the site manager in project D asked for more support without result. The project had low priority for the company.

Correlation between project leadership and costs of human errors

The project leadership correlates surprisingly well with the costs of human errors in this analysis. The rank order for good project leadership in the views used here and the rank order for low costs of human errors are the same with only one exception.

Project C was an extremely successful project. Despite a delayed building permit, which forced the contractor to shorten the production phase with a couple of months, they managed to finish the project in time. The costs of human errors were very low. Most comments on the project leadership aspects were positive or much positive. Project E and D were unsuccessful according to costs of human errors and project leadership. Most comments on project leadership aspects were negative, sometimes very negative. Noteworthy, the clients in project E and D had recently built similar buildings close to the sites. In these cases were good reference buildings not enough.

The ratings for each leadership factor are presented in Table II below.

Table II: Ratings on project leadership aspects.

Project	*C*	*B*	*F*	*A*	*G*	*E*	*D*
A The group's confidence in the leader							
The leader's competence							
- Knowledge and experience	5	5	4	3	4	4.5	1
- Ability to give clear information	5	4	4	3.5	3	2	1
- Trust the group	5	3	5	4.5	2	1	3
- Social competence	5	2	5	4.5	3	1	3
The distance between leader and group							
- The site managers role	5	2	4	3	3	1	3
- Earlier relations	5	3	3.5	2	3.5	1.5	1
B How clearly the task was laid down and defined							
- Communication with designers	4	4	4	3	3	2	5
- Knowledge of product at start	4	3	4	3.5	4	1	3
- Instructions to the group	5	3	3	3	3	2	1
C The amount of power and organisational support							
- Amount of power	4	4	4	4	3	3	1
- Organisational support on site	5	3	4	4	2	3	1
- Organisational support from main office	5	5	4	4	4	3.5	1
Average (A, B, C weight 1/3 each)	4.7	3.5	4.0	3.5	3.1	2.2	2.0
Error cost (%)	2.3	3.1	3.6	4.6	4.8	6.2	9.4

Conclusions

The analysis confirms that the project leadership described in Josephson (1999a) has a great influence on the costs of human errors. All project members, from client to workmanship, do errors. The errors can be traced back to all stages of projects and to environmental, organisational and individual aspects. The conclusion is that a successful project leadership, defined by three major groups of factors, reduces the cost of human errors. This is probably achieved by eliminating causes to errors on site, but also by reducing consequences on errors made earlier in the process.

The main recommendation to clients is to demand that the contractor's organisation support the factors presented here. It also means that the contractors must be involved in the design stage. The main recommendation to contractors is to evaluate their project organisations against the findings in this analysis and modify roles and support when needed.

The analysis is limited to seven building projects. However, a later study on 19 building projects (Josephson, 1999b), confirms the results.

References

Ashley, D.B., Lurie, C.S. och Jaselskis, E.J. (1987) Determinants of construction project success, *Project Management Journal*, 18 (2), pp. 69-77.

Belassi, W., and Tukel, O.I. (1996) A new framework for determining critical success/failure factors in projects. *International Journal of Project Management*, Vol. 14, No 3. pp. 141-51.

Burati, J.L., Farrington, J.J. and Ledbetter, W.B. (1992) Causes of Quality Deviations in Design and Construction. *Journal of Construction Engineering and Management*, 118 (1), pp. 34-49.

El-Sabaa, S. (2001) The skills and career path of an effective project manager, *International Journal of Project Management,* 19, pp. 1-7.

Josephson, P.-E. (1990) *Kvalitet i byggandet - En diskussion om kostnader för interna kvalitetsfel*, (In Swedish) Licentiate thesis, Report 25, Department of Building

Economics and Management, Chalmers University of Technology, Gothenburg.

Josephson, P.-E. (1999a) Effective management of building production. In *Proc. Joint Triennial Symposium CIB Commissions W65 and W55, 5-10 September 1999*, Vol. 2, 706-715. Cape Town: CIB.

Josephson, P.-E. (1999b) *Tre nycklar till framgångsrik byggproduktion - förtroende, tydlighet och stöd*, (In Swedish) *FoU-VästRAPPORT 9903*, The Swedish Construction Federation, Göteborg

Josephson, P.-E., and Hammarlund, Y. (1999) The causes and costs of defects in construction: a study of seven building projects. *Automation in Construction*, 8 (6), pp. 681-687.

Love, P.E.D., Mandal, P., and Li, H. 1999. Determining the causal structure of rework influences in construction. *Construction Management and Economics*, 17 (4), pp. 505-517.

Love, P., Josephson, P.-E., and Haupt, T. (2001) Determining the indirect costs associated with rework in a building construction project, *In Proc. of International Conference on Costs and Benefits Related to Quality and safety and Health in Construction, 22-23 October 2001, Barcelona,* Spain.

Sanvido, V.E., Grobler, F., Parfitt, K., and Guvenis, M. (1992) Critical success factors for construction projects. *Journal of Construction Engineering and Management*, ASCE, Vol. 118, No. 1. pp. 94-111.

Songer, A.D., och Molenaar, K.R. (1997) Project characteristics for successful public-sector design-build, *Journal of Construction Engineering and Management*, Vol. 123, No. 1, March, 1997.

Sörqvist, L. (1998) *Poor Quality Costing*, Doctoral thesis No. 23, The Royal Institute of Technology, Dept of Materials Processing Production Engineering, Stockholm.

Zimmerer, T.W., and Yasin, M.M. (1998) A leadership profile of American project managers, *IEEE Engineering Management Review*, Winter 1998, pp. 5-11.

Yukl, G. (1998) *Leadership in Organizations*, 4th Ed., Prentice Hall, New Jersey.

collectivist, project success, Hong Kong

Introduction

On a global basis, the construction industry is notoriously inefficient, backward and adversarial and continues to be plagued with 'project failures'; reports of clients' dissatisfaction due to poor quality of work and to time and costs overruns, low labour productivity, high levels of conflict and disputes resulting from acrimonious and adversarial project environments are rife (Kumaraswamy et al 2001, Latham, 1990; Egan, 1998). In Hong Kong the picture is not much rosier – its image is one that is synonymous with incompetency, inefficiency, and even corruption (Tang, 2001). Ironically, the nature of construction projects, which requires the heavy involvement and close collaboration of various project participants such as engineers, architects, surveyors, clients, contractors, etc., suggests that there should be a corresponding high level of cooperation between such participants that would lead to, among other things, better project performance. At its simplest, cooperation is defined as "the wilful contribution of personal effort to the completion of interdependent jobs" (Wagner, 1995:152) The fact that "cooperation on an industry wide basis is very limited" (Tang, 2001:17) implies that there could be some fundamental weakness in the overall construction system. This view is echoed by (Bresnen and Marshall, 2000:233) who commented that within the construction environment, "collaboration (rather than conflict) which is the aberration to the norm".

Assessing the relationship between construction industry characteristics and cooperation

One of the most common factors attributed to causing the industry's predicament is the highly fragmented and one-off nature of projects (Cherns and Bryant, 1984). Whether by design or default, the temporary-multi-organization (TMO)

Effects of Cultural Differences on Project Participants' Co-Operative Behaviour in Construction Projects
The Case Of Hong Kong

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Abstract

Construction management researchers have long recognized the important role cooperation plays in improving the inefficiency of the construction industry. However, current theories say little about the antecedents of co-operative behaviour of construction project participants. This study presents a conceptual model for analysing cooperation derived from the organizational culture perspective. According to this framework, organizations that are composed of people or under the leadership of people from collectivist cultural traditions would display more co-operative behaviour with members of their organization than individualistic ones because they tend to feel more interdependent with and more concerned about the results of their actions on members of their organization. However, this also suggests that there is a sharp difference in behaviour among organizational members toward people from other organizations whom they view as comprising the out-group and this results in greater hostility towards those which do not belong to one's own organization. This view sheds some interesting light on the general inefficiency of the Hong Kong construction industry where in essence construction companies may be performing well on their own and are competitive with one another but the collectivist predisposition of individuals tend to undermine overall project success because of the inter-organizational discrimination that arise due to the in-group versus out-group relationships.

Keywords: co-operative behaviour, cultural traditions, competitive,

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characteristic of the construction industry is often being argued by construction academics to be a construction industry peculiarity that defies easy identification and analysis of its associated problems. However, one would be hard pressed to be entirely convinced by this argument given that the formation of TMOs is growing in popularity in other industries and has recorded widespread success - with organizations downsizing and rightsizing, each trying to focus on only their core business, and outsourcing supplementary functions to external bodies.

The proper business of construction organizations like all economic organizations, is not so much to voluntarily avoid poor and ineffective construction methods but rather to properly identify and manage their business risks in a rational way, and to earn proper returns that are commensurate with those various levels of risk. This overarching and logical nexus casts the argument back to the much-discussed issues of cooperation and collaboration – the lack of which undermine the performance of so many organizations and the industry as a whole.

At the corporate level alliances, cooperation and partnerships are being formed for a commercial purpose. The implication of this view is similar to the resource-dependence perspective forwarded by Pfeffer and Salancik (1978) namely, that a primary reason for organizations to co-operate with one another depends in their realisation that they lack critical competences or skills which they do not possess or develop readily on their own. The strength of such cooperation lies in their specialization of skills, their efficiency, adaptability and flexibility, but not necessarily in the learning opportunities they provide in order for long term strategic cooperation to take place.

Within the construction industry, once the TMO structure has developed during the production phase of the project, the level of cooperation achieved is often the result of the dynamism of the level of individual interactions that take place between the respective project participants who are obliged to deal with each other. *In other words, the key emphasis of cooperation lies at the inter-organizational interactions that occur at the individual levels.* This view is supported by (Bresnen, 1991:248) who suggests that the use of a particular type contractual/procurement system in construction "provides only the structural framework within which actions are taken and decisions are reached" and while it may be an important condition for ensuring project performance, "it is necessary to examine the *behaviour* within that system" (p.248, emphasis in the original) in order to understand how it operates in practice. Therefore, in order to understand more clearly the conditions under which cooperation and participation are more or less likely to take place, there is a need to extend the analysis to incorporate variables that encapsulate the reality of what actually affects co-operative behaviour in construction organizations.

Cultural differences in factors related to inter-organizational cooperation

Given the conceptual and practical importance of cooperation in achieving overall organizational performance, much research has been undertaken by organizational researchers interested in understanding the behaviour of individuals and groups in organizations. In line with this, an important area of research suggests that culture may relate to co-operative behaviour and its correlates as important moderating variables of cooperation (Wagner, 1995; Chen et al. 1998). In particular, the distinction between individualist and collectivist cultures seems especially relevant and compelling. This cultural contingency perspective is consistent with Child's (1981) argument that cultural variables can moderate the effects of macro-level situational factors, such as organizational structure. Within the construction management arena, little has been done to integrate this area of research into the existing construction literature, although Liu and Fellows (2001) have incorporated the elements of the so-called Eastern (collectivist) culture into the construction industry context in order to improve the partnering process. An area where I believe research may assist the industry in understanding and perhaps improving the methods of dealing with a major cause, if not *the* major cause, of lack of cooperation in construction is the management of inter-organizational differentiation that arises out of the dealings of the individual members of two or more organizations with each other. Hence, the pertinent questions that need to be addressed are: *1) whether the development of differing cultural values and the management structures and objectives of different organizations lead to greater inter-organizational differentiation and 2) does such differentiation thereby resulting in lack of cooperation when organization members interact under the same project organization? 3) If so, what can be done to mitigate it?* I shall argue that these lines of inquiry are extremely significant for a better understanding of organization cooperation and its evolution and may be another potential avenue for improving our understanding and perhaps management of construction projects.

Research has shown that the individualism-collectivism dimension, while often examined at the societal level (Hofstede, 1980), is also central to characterizing how work is conducted at the organizational level (Earley, 1993; Chatman and Barsade, 1995). As defined by various academics (e.g Wagner and Moch, 1986; Hofstede, 1980; Leung and Bond, 1984; Hui and Triandis, 1986; Triandis, 1985) collectivism occurs when the demands and interests of groups take precedence over the desires and needs of individuals. Collectivists look out for the well-being of the groups to which they belong, even if such actions require that personal interests be disregarded. The opposite of collectivism, individualism is the condition in which personal interests are accorded greater group categorizations will tend to heighten inter-organizational discrimination. It is conceivable that the value that individuals associate with inter-organizational membership arises through different processes in the individualist and collectivist cultures and that this might affect the relationship between categorization and cooperation at the inter-organizational level. An important implication of this argument is that when analysing the dynamic and complex interplay between categorization and cooperation in project oriented environments such as the construction industry, individual differences in collectivism/individualism may be a moderating factor for inter-organizational cooperation and therefore serves as a mechanism that affects the success or failure of projects. In fact it has been found that some aspects of collectivism such as out-group hostility may generally inhibit economic development (Adelman and Morris, 1967; Triandis, 1984) whereas individualism has been associated with higher levels of productivity and gross national products of nations (Adelman and Morris, 1967; Hofstede, 1980; Sinha and Verma, 1987) mainly because it fosters contractual relationships which are based on the principles of economic exchanges. Generally, in the business milieu, companies with an individualistic inclination, who act according to cost-benefit analyses and who are more likely to adhere to contractual relationships based on the principles of exchange would do better than those dominated by internal in-group favouring behaviours. Taken together, these views underline an important aspect of the general inefficiency of the Hong Kong construction industry, where in essence construction companies may be performing well on their own and are competitive with one another but the collectivist predisposition of individuals tend to undermine overall project success because of the inter-organizational discrimination that arise due to the in-group versus out-group relationships.

The role of transformational leadership and its

implication for practice

Since one way to enhance cooperation is to increase the extent to which members view one another as part of their in-group, identifying and subsequently managing the factors that cause people to socially categorize some people as in-group members and others as out-group members becomes important. An organization's culture can influence which of its members' social categorisation is activated, whereby the emphasis on either individualism or collectivism may particularly affect the social categorization process. Translating this view into the Hong Kong construction industry context, it can be posited that because of the heightened priority placed on interdependence and cooperation, people in collectivistic organizational culture may be more likely to use organizational membership as a basis for social categorization. However, this phenomenon will further differentiate individual project participants along the in-group/out-group divide within the project organization unless there is some sort of transformational leadership (Jung and Avolio, 1999) within the project organization that can integrate the value orientations of individual project participants. Transformational leadership emphasizes the importance of subordinating individual needs to group goals and collectivists are expected to identify with their leaders' goals and the common purpose or shared vision of the group and organization. Hence, the congruence between group members' cultural values and a transformational leader's attempts to build identification with a collective vision is expected to enhance cooperation and performance among other group members. From this perspective, this argument has a much wider application in terms of enhancing group members' cooperation that extends into inter-organizational context such as the construction industry. Following this view, Figure 1 shows the model of cooperation which posits that cultural values affect cooperative behaviour either directly or by means of goal relationships that are instilled through the appropriate leadership style.

In collectivist cultures, the strong tendency to support organizational values and norms should fit with a transformational leader's efforts to align group members' personal values with a new mission or vision (Avolio and Bass, 1988). Group members from collectivist cultures are expected to more readily internalize their leader's vision than will individualists for at least two reasons.

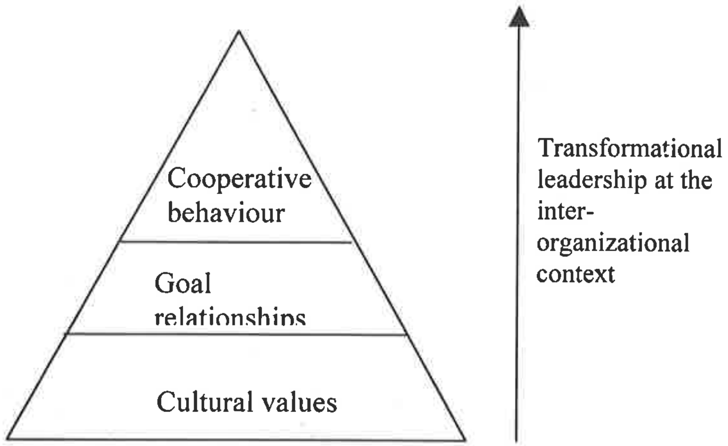

Figure 1: Conceptual Model of Cooperation (adapted from Chen et al 1998)

Firstly, collectivists tend to accept their leader's beliefs more readily because of the high power distance that exists in those cultures (Hofstede, 1980; Triandis, 1995). Secondly, there is typically a high level of value congruence between group members and leaders owing to extensive socialization processes in collectivist cultures. Consequently, one can postulate that a transformational leaders' emphasis on achieving collective goals would be more readily accepted when group members' cultural orientation was more collectivist.

Conclusion

The preceding discussion of cultural orientation has shed some useful light on one of the reasons for the general lack of cooperation within the Hong Kong construction industry. The effect of individualism-collectivism on project participants' cooperative behaviour is argued to stem from the in-group/out-group distinctions amongst individual project participants. Indeed, perceptions of in-group versus out-group among project participants that largely come from a collectivist society such as Hong Kong could have a significant effect on group members' attitudes toward each other as well as on their willingness to cooperate in the construction project environment.

While it is a beneficial characteristic to have in order to induce cooperation within each organization, it is argued that its benefits cannot be realised when group members with strong in-group/out-group perceptions work together in an inter-organizational environment. However, the effects that such perceptions have on group members' cooperative behaviour may suggest that within the construction industry, project organizations can help their leaders (project managers, project architects or project leader) manage cultural diverse groups more effectively by providing training on the differential effects of various leadership styles.

Certain leadership style may be more or less effective than others depending on the cultural orientation of group members. In sum, taking into consideration the issues that have been highlighted, it is argued that the cooperative behaviour of collectivists will be higher with a transformational leader that possesses the necessary management acuity to transform any in-group/out-group differentiations that project participants might have about each other into a homogeneous in-group organization so that each members can feel a stronger attachment to the project organization as well as in-group solidarity regardless of the fact that they originally come from different organizations.

The point that this article is trying to assert is that in order to mitigate the dire consequences of non-cooperation, in-group/out-group sentiments amongst project participants must be overcome and one way in which this can be achieved is through the use of transformational leadership in the project organization. It is believed that further research in this area can provide the impetus for discovering new paradigms of cooperation for collectivist cultures within the construction industry.

References

Adelman I. and Morris, C.T. (1967), *Society, Politics and Economic Development: A Quantitative Approach*, Baltimore: Johns Hopkins University Press.

Avolio, B.J. and Bass, B.M. (1988), Transformational leadership, charisma, and beyond, in Hunt, J.G., Balaga, B.R., Bachler, H.P. and Schriesheim C. (Eds.), *Emerging Leadership Vista*, 29-50, Emsford, NY: Pergamon Press.

Bresnen, M. J. (1991), Construction contracting in theory and practice: a case study, *Construction Management and Economics*, 9, 247-263

Bresnen, M. and Marshall, N. (2000), Partnering in construction: a critical review of issues, problems and dilemma, *Construction Management and Economics*, 18, 229-237.

Chatman, J.A. and Barsade, S.G. (1995), Personality, organizational culture and cooperation: Evidence from a business simulation, *Administrative Science Quarterly*, 40, 424-443.

Chen, C.C., Chen, X.P. and Meindl, J.R. (1998), How can cooperation be fostered? The cultural effects of individualism-collectivism, *Academy of Management Review*, 23, 285-304.

Cherns, A.B. and Bryant, D.T. (1984), Studying the clients' role in construction management, *Construction Management and Economics*, 2, 122-184.

Child, J. (1981), Culture, contingency and capitalism in the cross-cultural study of organizations, in Cummings, L.L. and Staw, B.M. (Eds.), *Research in Organizational Behaviour*, 3, 303-356, Greenwich, CT: JAI Press.

Earley, P.C. (1993), Social loafing and collectivism: A comparison of the United States and The People's Republic of China, *Administrative Science Quarterly*, 34, 565-581.

Egan, J. (1998), *Rethinking Construction: The Report of the Construction Industry Task Force*, HMSO, London.

Gomez, C., Kirkman, B.L. and Shapiro, D.L. (2000), The impact of collectivism and in-group/out-group membership on the evaluation generosity of team members, *Academy of Management Journal*, 43, 1097-1106.

Hofstede, G. (1980), *Culture's Consequences: International Differences in Work-related Values*, Beverly Hills, CA: Sage Publications.

Hui, C.H. and Triandis, H.C. (1986), Individualism-collectivism, *Journal of Cross-Cultural Psychology*, 17, 225-248.

Jung, D.I. and Avolio, B.J. (1999), Effects of leadership style and followers' cultural orientation on performance in group and individual task conditions, *Academy of Management Journal*, 42, 208-218.

Kumaraswamy, M., Rowlinson, S. & Phua, F.T.T. (2001), 'Origins and Desired Destinations of Construction Project Cultures', *Performance in Product and Practice, CIB World Building Congress*, Wellington, New Zealand, 2nd-6th April, pp 6.

Latham, M. (1994), *Constructing the Team*, DETR, London, UK.

Leung, K. and Bond, M.H. (1984), The impact of cultural collectivism on reward allocation, *Journal of Personality and Social Psychology*, 47: 793-804.

Liu, A.M.M. and Fellows, R. (2001), An Eastern perspective on partnering, *Engineering, Construction and Architectural Management*, 8, 9-19.

Mead, M. (1976), *Cooperation and Competition Among Primitive People*, Boston: Beacon.

Pfeffer, J., and Salancik, G.R. (1978), *The External Control of Organizations: A Resource Dependence Perspective*, New York: Harper and Row.

Sinha, J.B.P. and Verma, J. (1987), Structure and collectivism, in Kagitcibasi, C. (Ed.), *Growth and Progress in Cross-Cultural Psychology*, The Netherlands: Swets & Zeitlinger, 123-129.

Tajfel, H. (1982), Social psychology of intergroup relations, in Rosenzweig, M.R. and Porter, L.W. (Eds.), *Annual Review of Psychology*, 33, 1-39.

Tajfel, H. and Turner, J.C. (1986), The social identity theory of intergroup behaviour, in Worchel, S. and Austin, W.G. (Eds.) *Psychology of Intergroup Relations*, Chicago: Nelson-Hall, 7-24.

Tang, H. (2001) *'Construct for Excellence'* - Report of the Construction Industry Review Committee (CIRC), Hong Kong SAR Government, Hong Kong.

Triandis, H.C. (1984), Toward a psychological theory of economic growth, *International Journal of Psychology*, 19, 79-95.

Triandis, H.C. (1990), Cross-cultural studies of individualism and collectivism, in Berman, J. (Ed.), *Nebraska Symposium on Motivation*, Lincoln: University of Nebraska Press, 41-133.

Triandis, H.C. (1995), *Individualism and Collectivism*, Boulder, Colorado: Westview Press.

Triandis, H.C., McCusker, C. and Hui, C.H. (1990), Multimethod probes of individualism and collectivism, *Journal of Personality and Social Psychology*, 59, 1006-1020.

Turner, J.C., Sachdev, I., and Hogg, M.A. (1983), Social categorization, interpersonal attraction and group formation, *British Journal of Social Psychology*, 22, 227-

239.

Wagner, J.A. III. and Moch, M.K. (1986), Individualism-collectivism: Concept and measure, *Group and Organization Studies*, 11, 280-303.

Wagner, J.A. III (1995), Studies of individualism-collectivism: Effects on cooperation in groups, *Academy of Management Journal*, 38, 152-172.

Improving Technology-Transformation In Construction Industry By Understanding Culture's Influences

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Abstract

Due to a worldwide development of construction-activities there is a need for improving the technologies used in construction-industry. Not only in the 'modern' developed world, but also in the underdeveloped and emerging regions. But simply implementing 'western' technology into these emerging regions as a way of '*transferring* technology' seems to be just a hit-and-run-approach, and therefore only one part of the process: There has to be a structurized path of development, searching (and acting!) for the best ways of improving local activities, as a way of '*transforming* technology'. But then there have to be passed-over several barriers, related to e.g.: (1) *Technology*, (2) *Organization* and (3) *Culture.*
This paper focusses on aspects, especially related to the 'culture'-issue: It describes several approaches in which this issue is being looked at in construction industry nowadays. Two case-study are presented, dealing with improvement of local activities in construction, out of which lessons can be derived for a better understanding of 'culture'. It becomes clear that during a certain period a 'protected' suppportive local environment is needed, created by e.g. specific procurement systems, together with training-schedules, for getting people locally suitable for a more developed construction industry. These issues may assist in helping to overcome existing barriers of technology-transfer.

Keywords: Construction-industry, Culture, Emerging regions, Technology-transformation.

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Introduction

Searching for the best solutions for problems occurring in general is a quite often used approach in problem-solving. One wants to have the possibilities to get and use e.g. state-of-the-art technology, expecting that it will give the best solutions for problems occurring; or at leat one thinks it will give the best *chance* for reaching the solution of the problems.

But what to do in underdeveloped and/or emerging regions? Does this same search for state-of-the-art technology apply logically to be succesful in such areas? That is an interesting issue; it is generally known that to improve the need for e.g. food somewhere, the approach of giving just food isn't the right one anymore: One should also and especially focus on giving (agricultural) tools and technologies how grow their own food succesfully, and not to forget in the meantime that they also still need food at first, to stay able to work at all. But in general, by giving tools and technologies to local people, it is not just a question of obtaining it, but moreover to maintain it!

The above described situation can also be applied in construction industry nowadays: To transfer technology with the goal to improve local circumstances of underdeveloped or emerging regions, one should focus especially on a main important issue: What possible barriers do local people possibly see to adapt the 'gifts' quite easily? Not only for a short-term but especially for reaching a long-term improvement and growth of the areas focussed at.
This paper mainly focusses on some of the barriers one can encounter, and especially on the strategies to overcome them.

Globalization in Construction: Threats and Opportunities

Introduction

Within the scope of transferring technologies, one can distinguish opportuinities and thereats. However, opposite to that sequence as e.g. also Porter uses [Porter, 1985] , the title of this paragraph ends-up just with *opportunities*; and that is what one should focus at. However, to gain maximum potential of the opportunities, one should also be aware of the *threats*.

Some Serious Threats

In general, as being part of serious threats to local and international construction activities, one can diswtinguish e.g. the following 'lacks':
Lack of money;
Lack of skilled professionals.

Lack of money

As global (and local!) construction-industry is about projects like e.g. infrastructure, housing, offices, etc., it strongly depends on the shift of investments around the world. Basic economic conditions have to be good for creating the need for projects, resulting into attractive *opportunities* for *investors*, thus making construction business going.

Lack of motivated and skilled professionals

Although parties in construction industry can be small, mid-sized or even very large (stock-listed) companies, they all have to rely on a very important issue: The availability of motivated and skilled professionals, giving opportunities for delivering good products, creating stakeholder's and shareholder's value [SVB, 1996]. And that's an international issue, not only for specific areas [Tijhuis, 1998]. Looking e.g. to present situation in Western European regions, there is a lack of *motivated* and *skilled* employees, although it has to do with the spread of activities over certain areas of e.g. the EU.

The above mentioned issues will be used to get a direction for possible opportunities for improving construction activities in local emerging regions.

Some Serious Opportunities

Looking to the above mentioned threats, influencing local and international construction industry, one could define the solutions for the problems described more specifically by focussing on 'serious opportunities'. Doing so results into the following shortlist:

- Creating an investment-friendly policy;
- Improving skills and professional attitudes of employees.

Creating an investment-friendly policy

This issue is a political one, which has a lot to do with the local situation into regions and countries. As may be clear, 'trust' into people or areas or projects does not exist 'automatically'; one needs to work on it, looking to all these dimensions, leading to attraction of investments or not. Pricing the construction risks in such situations is not only a 'fuzzy' decision [Moselhi, 1995], but also an issue, based on the impact of e.g. political issues [Wells & Gleason, 1995]. As these issues are mainly related to politics, they will not be analyzed further into detail. However, they play a very important role as one of the 'drivers' for improving and stimulating emerging markets.

Improving skills and professional attitudes of employees.

This issue has especially to do with people: In the offices and on the sites, not only from e.g. a contractor's viewpoint but also from a client's viewpoint. It needs professional attitudes at 'both sides' of a project. Not only to reach for the best results, but in that process to overcome the problems occurring, taking care for (cultural) differences and /or different goals into projects. E.g. 'looking for solutions' instead of 'looking for who's guilty' [Felstiner, Abel & Sarat, 1980; Tijhuis, 1996], taking care of local habits.

Resume

From the issues, described in the section above, it should be clear that both serious opportunities mentioned will have their impact on improving construction activities in local emerging regions. Therefore, there has been derived a central question, regarded here as the important one to take up within the scope of transferring technologies:

- *How to get local people motivated and skilled, so that they can be productive into their own construction industry?*

Answering this question will be focussed at more closely in the following part of this paper.

Transferring Or Transformation Of Technologies?

Introduction

When one wants to become more productive, thus generating profit with a spin-off to possible income, there should be available at least the following:

- *The right people (motivated, creative, etc.);*
- *The right tools (useful, maintainable, etc.).*

It should be clear that there could be a lack of these issues in certain areas, but nevertheless it always starts with *people*! When there are good people within the areas, they do have the possibilities for creating and/or improving their living-environment, leading to activities, making possible investors interested for funding, etc. Thus leading to a very important issue, that improving local developments in construction-industry in suffering and/or emerging areas should consist not only of investments, but also and especially consist of implementing technology there, combined with labour-generating efforts [World Bank, 1996]. And then taking into account the *believe* and *trust* that the local people do have the abilities to work by themselves, which are of course important basic criteria to start-up development-schemes in those emerging or under-developed areas.

The reflections, described in this introduction-part of this paragraph, more or less lead to a strong focus on:

- *transformation* (e.g. 'searching for best of both worlds')

...instead of just using:

- *transferring* (e.g. 'forcing one world into another')

...technology and its impacts. These both viewpoints can cause a dilemma for the choice to be made: As e.g. introducing a serious need, willingness and motivation for collaboration in case of transformation, and e.g. introducing a serious threat of not-fit-for-purpose-solutions in case of transferring. In figure 1 this dilemma is represented more schematically.

However, as from a viewpoint of 'people' and its (cultural) differences nowadays as a central productivity-factor of international construction business still since e.g. the construction of the 'Tower of Babylon' and other ancient projects [Holy Bible, 1618 and 1619; Warszawski and Peretz, 1992], the focus in this paper will be set on *transformation* of technologies and its impacts on the people involved.

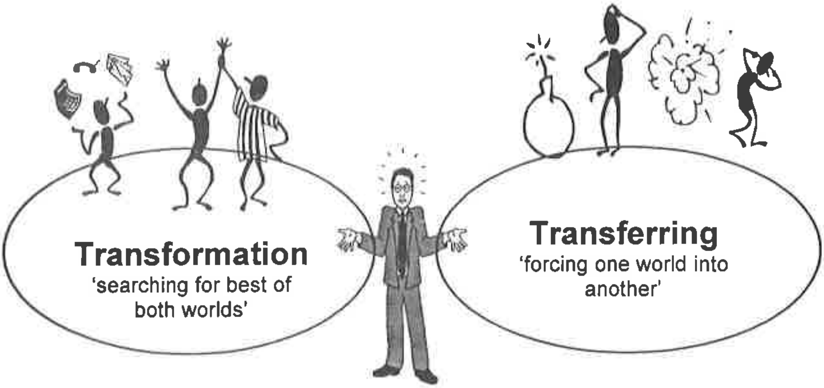

Figure 1: The dilemma of choosing between transformation and transferring of technology

Choosing Levels Of Technology Adapted

Transformation of technology, combined with labour-generating efforts, needs a sound climate for good understanding of both parties: Both for the 'delivering' (international?) party as well as for the 'receiving' (national/local) party. They should be aware of relevant issues in the transformation-process. And that just indicates more or less a serious *dilemma*:

- *Should one focus on getting as much people as possible to work? (thus maybe introducing a very strong focus on labour-intensified working-methods);*

Or the other way:

- *Should one try to improve the working-methods as best as possible, using the most modern tools? (thus maybe leading to less need for labour and employees).*

In fact the dilemma represents the discussion of 'which road leads to success as quick as possible?': *Just creating a high need for human labour by using as less as equipment as possible?* (in fact 'employment' is leading then); or: *Simply* *using the most modern equipment locally, thus reducing the need for human labour* (in fact 'technology' is leading then). However, both 'roads' need a safe, healthy and good managed process. In figure 2 these two strategies with their 'roads to success' are represented schematically.

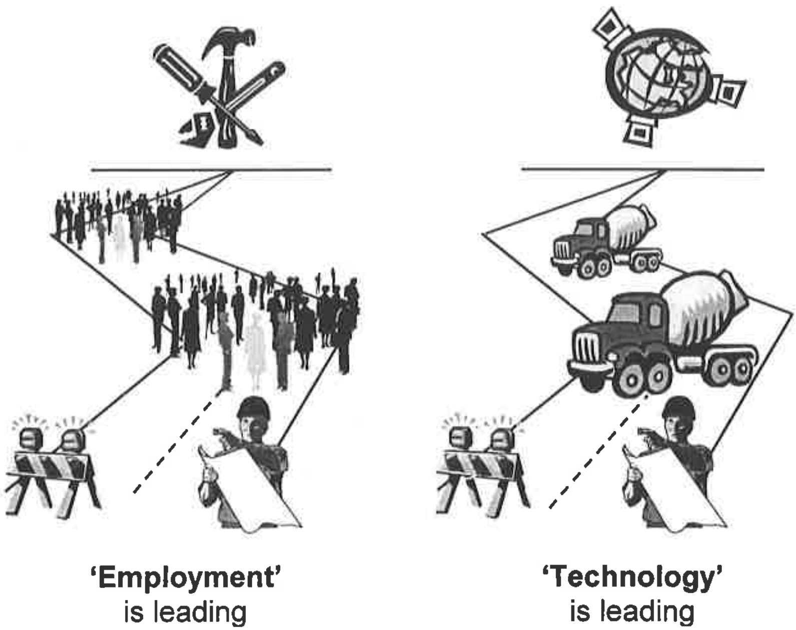

Figure 2: Two main strategies with their roads to success in regional development

Although both roads can lead to the success of reaching the 'developed status' for the specific regions, it has different impacts on its environment, depending of how to deal with the local people and their culture (values, etc.). But choices have to be made, consisting of (combinations of) clear strategies.

Resume

In several programmes, based in rural areas, there can be seen a trend toward the use of labour-based technologies, e.g. promoted by the ASIST-Programme, a worldwide spread stimulation-programme for labour-based technologies in developing areas, as part of the ILO. Not saying this is the only right approach, it at least indicates the importance and the need for it worldwide. Especially while it focuses not only on solving local lack of employment and lack of infrastructure, it also generates an important 'need for maintenance': Thus creating not only the initial projects in the construction-phase, but also and especially the long-term based employment in the maintenance-phase [Veen de, 2000]. Although one could suggest that it should then be worth thinking of using ultra maintenance-free technologies (with potentially higher initial investments), there is a barrier for it: Not the issue of *how* to get people at work, but more how to *keep* them at work in the future?! The ILO more specifically focuses on this last issue.

Nevertheless it still should be actual to search for technologies, suitable for local circumstances. But especially then it is important to hang on to local habits, values, etc. represented in its *culture*: What is seen as acceptable or valuable by the local *people* in their local *situation*, so leading to the best local 'curing' method for solving local problems, as e.g. also is being recognized by the medical sector [Morley & Wallis, 1979]. Although it here just focuses on 'developing' areas, also the 'western' construction sites do need a focus on local culture, despite of an enormous flow of technologically driven tools like e.g. 'E-sites' etc. [Tijhuis, 2001a]. But construction is still a people's business, like also the medical sector is, and related to that aspect these technologies like e.g. modern electronic communication do have a lot of assumed benefits, but still with a difficulty to prove these benefits exactly [Kam van der, 2001].

However, the people involved need training, but also a stimulating, good and healthy environment for professional and private life. In the following parts these issues will be illustrated more in detail.

Culture's Influence And Procurement Strategy

Introduction

The issue of getting and keeping people at work now and in the near future doesn't need thinking into capacity but more into creativity: What kind of transformation do technologies need for getting them accepted and adapted into the local culture and environment? Focussing on actual themes can be an important issue then, within the background of lack of labour, knowledge, experiences, etc. And procurement can be a useful tool, being the first stage of getting construction projects 'into the market'. So, by using procurement as a '*carrier*' inside local markets with respect to their own culture, there can be reached successful results within the scope of reaching a strengthening of the developing region. But that means especially involvement of 'new ' groups of (local) people, complete with their cultures [Tijhuis, 2001b].
The following two recent case-studies give examples of actual approaches for improving local developing markets.

A Case Study: An Eco-Building Training Course

Description

The South African city of Midrand is a fast growing area, in which sustainability of the environment is still a difficult problem to solve. As sustainability is of growing importance worldwide, also this region focusses more on this issue as a main problem in her built environment. And its especially a problem while the local construction-employees do not have enough knowledge and experience in this way of thinking and building. Therefore, a training-schedule has been set up within a special project, called 'Eco-City', managed by a special Sustainable Development Unit, founded by the the local council of Midrand.

The flagship-project is the development of an eco-village in a local black township. This project is carried out in order to demonstrate the potential that can be achieved in the governmental housing programme if lateral thinking is applied to this issue. It focusses on demonstrating alternative building practices, planning systems, sanitation and energy systems, etc. As part of an internship, three of our students particpated in this project on the site, supervised locally by the Research Center for Employment Creation in Construction, based in Witwatersrand [Geurtsen, Jongeling & Van der Pal, 2000].

Scope

Important central scope within this project is the fact that one is convinced that reaching the goals set is only possible when training the local employees in the construction industry.

Problem was e.g. the differences of skills between several local groups of people. Solving this issue meant that there was a focus on the diversified skills available, and transforming them on those aspects which were different within the focus of 'sustainable construction'. In the same time it also created the chance to train the people involved also into extra knowledge and experience of aspects of e.g. modern business management skills, how to keep the environment clean and healthy, how to secure the lives of the people from diseases, etc.

This is also indicated by the CIB, which also put sustainable construction on its '*Agenda 21*' [CIB, 1999]. Important issue for challenges of sustainable construction (not only technological, but also related to e.g. social, cultural and economic issues) is its role of contribution to poverty alleviation and to a safe and healthy environment.

Some results

So, by focussing on a general accepted issue of 'sustainable environment', the training programme resulted into the adaptation and use of a broad scope of 'help for a better life'. This means in fact that:

- *training on the job;*

...is a very important tool but, if possible, it should be:

- *combined with focussing on improvement of local (private) circumstances.*

Especially then it could stengthen the impact of change (= transformation), keeping respect for local culture.

A Case Study: Affirmative Procurement in South African Construction Industry

Description

Another project in the South African area is the present programme on alternatives in development (SANPAD). One of the actual projects is a research in the field of construction project procurement selection for poverty-focused development [Rwelamila, Hindle, Tijhuis et al, 2000]. Although this is based on developing a theoretical framework for a new policy, aiming to create and implement a so called *Affirmative Procurement Practice* (APP), it especially focusses on results for industrial practice: Both for local small, medium and micro enterprises (SMME's) in construction industry to train and to improve their business skills in the competitive market. Thus reaching for the main goal: To use the industry as *vehicles* towards adressing past *imbalances* through on-the-job training and implementing the APP by creating an enabling environment for the SMME's.

Scope

Especially the development and implementation of APP gives the several disabled parties in the present construction industry in developing regions such as e.g. South Africa positive chances for growing and adapting to equal business chances and opportunities in the (local) markets. And that is of great importance: For creating a local economy, one needs well trained and able local parties. Not specifically run and/or owned by the big national or international companies, but especially run and when possible also owned by local people. That stimulates a good local balanced network of steady and strong parties like e.g. (sub)contractors, being able to compete in an honest way with others.
An extra spin-off of the research-part within this project is reached by the fact that the excellent local universities involved are incorporating also local research-trainees, to improve their research and project management experience.

Some results

So, when trying to keep a steady and stable growth of local developing markets, one needs especially and environment which:

- *Stimulates entrepreneurship;*
- *Motivates people to improve their (business)skills.*

But growing towards improved skills and strenghtened business attitude for the disabled parties needs also more or less:

- *a 'protecting' environment.*

Especially the public clients should give opportunities for such an approach, by adapting their national/local procurement systems in such a way that they give chance for the (in general still) weak local parties to improve themselves, gradually growing towards the more 'tough' daily situation.

Resume

The focus on training skills and stimulating the professional and private environment, are key-factors for the improvement of developing regions. And in fact these factors do apply worldwide: While construction is not only a people's business but also and especially a global activity, although local business. Therefore one needs a 'glocalized' focus on these issues.

Conclusions and Recommendations: Rethinking Construction Procurement?

Conclusions and Recommendations

In general, there can be distinguished some main conclusions, which are described below, together with some reflections.

(1) Instead of aiming on 'transferring' technology, there should be more focus of 'transformation' of technology.
This has specifically to do with the fact of the recognition and acceptance or not of local used skills, technologies, etc.

(2) Before starting with the improvement of local construction markets, one should define very carefully the road along which this will happen: Or 'technology-driven', or 'employment-driven', or a certain balance between these two strategies.
Although local technologies may need a very strong modernization, one should not pass completely the opportunities or threats these modernization may have on the local level of employment.

(3) Involvement of 'culture'-issues is essential for getting the right results in the transformation of local construction processes and markets towards a more developed status.
As may seem not everytime the issue, the local situation should always be the starting point for creating a movement of

change. Especially this is essential when discussions about the level of development are actual. E.g. what is 'development'? Should a 'western' model be the only ideal focus and goal for local parties to work for? Although this question is quite difficult to answer, and differs from situation to situation, it at least indicates the main thing: Be aware of local culture, and try to balance interests for the short and the long term.

(4) Continuously training and improving skills for local people in (developing) markets is essential for strengthening the local situation.

And combining these efforts with focussing on a *balanced* and *healthy professional* and *private environment* is essential for doing the right business, but also for doing the business right (which may not be the same…). This part is applicable everywhere, *without offending (inter)national and/or local regulations.*

(5) Creating a 'protecting' environment by the adaptation of specific procurement-systems during a certain period is essential for local parties to strengthen themselves. However, the search for a 'protecting' environment (which may be seriously necessary in unbalanced situations with a lot of disabled parties in construction industry) may conflict with national and/or international trading regulations

Like e.g. the present regulations in European Community (EC) say in general that every European party should be able to have equal business opportunities in the European market; A well balanced and competition-supporting principle [EC, 1993]. But when there is a group of strong parties (not just that strong for creating e.g. a cartel) they still can be very powerful to push aside the newly weak companies. And in such situations e.g. new (weaker) member countries may be confronted with competition difficulties. Therefore, there should be especially control about the *duration* of this period of protection: It should only be used during the first few (e.g. five) years of growth of the specific developing market.

Resume

In general, it should be clear that rethinking the choice of which procurement-strategy suits best for local developing regions is necessary. But, one should be honest: Starting to think is only one part of the puzzle; one has start to act! Together with local experiences there can be expected growing re-actions then, which can improve the situations. And in several cases it may be better to act at least, instead of waiting too long! However, thinking before starting is better than only thinking after starting, or worse, only thinking when the critical issues arise. Or, to say with a Dutch statement: '*Voordenken*' instead of '*Nadenken*'.

References

CIB (1999) *Agenda 21 on Sustainable Construction*; CIB-report Publication no. 237; Rotterdam.

EC (1993) *European Directives Nr. EC/93/96 – EC/93/97 – EC/93/98*; 14th June 1993; Publication Office of the European Commission; Luxembourg.

Felstiner L.F., R.L.Abel & A.Sarat (1980) *The Emergence and Transformation of Disputes; Naming, Blaming, Claiming*; article in: 'Law & Society Review'; Journal; Vol.15, Number 3-4 (1980-1981), pp.631-654; USA.

Geurtsen T, R.P.M.Jongeling & A.van der Pal (2000) *Midrand Eco-Building Training Course*; Internal report of internship; University of Twente (Dr.ir.W.Tijhuis) and University of Witwatersrand (Ir.F.Taylor-Parkins); Enschede, Witwatersrand.

Holy Bible (1618 and 1619) *Genesys 11:1-8*; Dutch translation from Synode of Dordrecht: 'Statenvertaling'; Jongbloed; Leeuwarden.

Kam van der W.J. (2001) *Effects of Electronic Communication in General Practice*; Ph.D-report; EC 4th Framework

Health Telematics Programme; Erasmus University, Rotterdam.

Morley P. & R.Wallis (1979) *Culture and Curing – Anthropological Perspectives on Traditional Medical Beliefs and Practices*; Contemporary Community Health Series; University of Pittsburgh Press; Pittsburgh.

Moselhi O. (1995) *Pricing Construction Risk: Fuzzy Set Application – Discussion*; article in: 'Journal of Construction Engineering and Management'; Vol.121, No.1; March 1995; pp.163-164; American Society of Civil Engineers (ASCE); New York.

Porter M.E. (1985) *Competitive Advantage*; The Free Press; New York.

Rwelamila P.D., B.Hindle, W.Tijhuis et al (2000) *Construction Project Procurement Selection for Poverty-Focused Development*; SANPAD-project; March 2000; University of Cape Town, Peninsula Technikon and WT/Consult BV; Cape Town (South Africa) and Rijssen (The Netherlands).

SVB (1996) *Betrokkenheid is heel belangrijk voor de Bouw*; article in: 'Peil'; magazine for training and education in Dutch construction industry; Vol.30, Nr.2; May 1996; pp.20-21; Stichting Vakopleiding Bouwbedrijf (SVB); Zoetermeer.

Tijhuis W. (1996) *Contractors at work or in conflict? - Lessons from international collaboration* (published as a book in Dutch: *Bouwers aan de slag of in de slag? - Lessen uit internationale samenwerking*); Ph.D-thesis; Eindhoven University of Technology, Eindhoven; Kondor Wessels Berlin GmbH, Berlin; WT/Consult BV, Rijssen, The Netherlands.

Tijhuis W. (1998) *Connecting Marketing to Construction Process: The Impact of Internationalization*; paper; University of Twente, Enschede and WT/Consult BV, Rijssen, The Netherlands; presented and published in proceedings of conference "The 1st International Construction Marketing Conference – Opportunities and Strategies in a global Marketplace"; pp.141-148; Ed.:

Chr.N.Preece, University of Leeds; Leeds.

Tijhuis W. (2001a) *Improving the Multicultural Construction Site: The Human Role in a Technology-Driven Environment*; paper on CD-ROM: 'International Status Report on Aspects of FutureSite'; electronic proceedings of workshop CIB-TG27; Wellington; Edited by: Prof.ir.Ger Maas & Ir.Frans van Gassel; publication nr.265; CIB, Rotterdam; Eindhoven University of Technology, Eindhoven.

Tijhuis W. (2001b) *Culture in Construction – Part of the Deal?*; proceedings of workshop; CIB-TG23, 'Culture in Construction'; Edited by: Dr.ir.Wilco Tijhuis; 22nd and 23rd May 2000; Published January 2001; publication nr.255; CIB, Rotterdam; University of Twente, Enschede.

Veen de J. (2000) *ASIST: How it began, what it is now and where it is going*; article; ASIST (Advisory Support Information Services and Training for Labour-based Practitioners); EMP/INVEST, ILO; Bulletin no.11; pp.3-4; July 2000.

Warszawski A. and W.Peretz (1992) *Organization and construction of Ancient Projects – The Case of the Temple Mount Compound*; National Building Research Institute (NBRI); Technion I.I.T., Haifa; Israël; Building and Environment, Vol.27, Nr.4, pp.399-412; Pergamon Press Ltd.

Wells L.T. & E.S.Gleason (1995) *Is foreign infrastructure investment still risky? – Developing countries are courting investors. Is it safe to say yes?*; article in: 'Harvard Business Review'; journal; September – October 1995; pp.44-55; Boston.

World Bank (1996) *Expanding Labour-based Methods for Road-works in Africa*; Technical Paper, no.347; Washington DC.

Global Cultures: Convergent Divergence?

Richard Fellows & Anita Liu

Abstract

The various forces which fuel the concept of a 'shrinking planet' have also generated the *convergence hypothesis*. As societies become ever more readily and closely in contact and linked - through communications, travel and economics - the hypothesis suggests that differences diminish, resulting, eventually, in a common, global society. However, that hypothesis' realisation is founded on a number of important assumptions, including commonality of basic desires. Some of those assumptions are, at least, questionable. The *divergence hypothesis* maintains that social (etc.) diversities will persist and may even be enhanced through the 'shrinking planet' forces as communities increase their awareness of uniqueness and desire its maintenance. Such preservations of uniqueness foster group identities and, from other perspectives, can be viewed as 'niching' and as components of a (power) struggle for self-determination. Manifestations of the realisation of elements of both hypotheses can be observed in the globally common 'shopping mall' (should that be pronounced "maul"?) and in the preservation of buildings of significant vernacular architecture. This paper investigates the two hypotheses in the context of evidence of their manifestations and proceeds to examine the consequences for the construction industry from a culturally-oriented perspective.

Keywords: Construction, Convergence, Culture, Divergence, Globalisation.

Introduction: Convergence - Divergence

The convergence hypothesis asserts that, over time and due to a variety of forces, organisations and societies will become progressively similar. The basis for the hypothesis lies in theories of competition wherein market structures and constituents strive for efficiency – commonly measured through profitability – as the imperative for survival; the less the imperfections, the greater and more immediate are the effects of competitive forces. Thus, in the modern world of increasingly ubiquitous data and information (if not knowledge!), more rapid communication etc. with the consequent breaking down of barriers (protection devices) and control mechanisms, the requirement to improve efficiency by reducing costs, including transaction costs, and enhancing revenue is magnified. The ultimate of perfect competition theory is that only those which maximise profits exist – retribution for the inefficient is absolute and instantaneous!

However, it is also clear that, despite the, often politically-aligned, rhetoric of many organisations in capitalist market economies to advocate competition, the actions taken by firms (which, over time, indicate pursuance of strategy) are geared to isolate them from competitive forces and to secure market dominance.

Divergence, therefore, may be encouraged by market-power oriented actions. Further differences are preserved by government interventions in the international (global) economy to secure advantages for the domestic economy and its participants. Basic theory of international trade is founded upon divergence – in endowments of resources, climate etc. and, of course, location – as the theory of comparative advantage. If convergence applied to the ultimate such that comparative advantages were removed, location of economic activity would be random!

Examination of recent changes in politico-economic (and social) systems suggests, superficially, that convergence towards "democratic", market systems is occurring – such as in the former Soviet Union and in China. However, whilst that may be the rhetoric and behaviour, it is also clear that significant differences persist. The depth of such differences is evidenced by contrasts in behaviour, attitudes etc. between

Mainland China, Taiwan and Hong Kong SAR – just three examples of significantly different 'Chinese' societies! Such examinations lead to the proposition that convergence and divergence coexist and operate continuously yielding, at any location and time, degrees of commonality and of difference (UK society bears witness too). Boyer (1996: 30) notes that there is, '…no clear trend to convergence or divergence…' and that, in part, the situation is explained by the '…coexistence and competition of various kinds of capitalism.' Capitalism, in its various forms, although increasingly dominant as the world's generic economic system, exists alongside substantial elements of command economies – most notably, in mainland China.

Globalisation

Globalisation, as envisioned by Kenichi Ohmae (Ohmae, 1999), comprises five, progressive stages – exporting; localisation of sales and marketing; localisation of production etc.; localisation of headquarters activities – personnel, financing etc. (insiderisation); complete globalisation to give overall identification to the total firm (activities such as financing re-coagulated to the 'central' office). The globalised result comprises world-wide branding, coupled with logically centralised functions, together with locally-specialised features. Thus, globalisation results in combinations of common and diverse elements.

In any organisation, operating objectives reflect the environment through performance requirements of major participants – owners, managers, regulators etc. Thus, the extending market capitalist oriented economies give rise to local, international and global organisations having to perform to accord with the performance imperatives of, particularly, profitability and turnover to ensure survival. However, even given such apparently universal criteria, their applications differ between societies in reflection of prevailing cultural differences. So, Western organisations are forced to pursue continual dividend growth to accord with the financial performance dictats of the domestic stock markets (the collectivity of, progressively institutional, owners) – emphasising short term operating results. Eastern based organisations have been able to adopt a longer term approach as reflected in investment perspectives, including R & D. (See, e.g., Hutton, 1996.) However, restructuring following the regional crisis of 1997, has instigated a variety of changes, usually towards more 'Western' procedures.

Traditional economic theory of international trade suggests that if convergence were to operate to the extreme, comparative advantage would vanish and, hence, so would international trade!! However, extremes aside, '...to invest abroad, firms must find it more profitable, or strategically worthwhile, to engage in foreign rather than domestic production', (Dunning, 1993). Dunning's analysis of the globalisation of business employs the framework of Ownership (competitive) advantages, Locational (country-specific competitive) advantages and market Internalisation opportunities as the categories of variables for analysis (OLI framework). Analyses include 'strategic alliances' between organisations, the value of which are depicted in figure 1. However, as noted by various authors – e.g. Norman (1998) – a major issue is enforcement of (contractual) arrangements; difficult enough in the domestic arena but complicated exponentially in the international one. The variety of legal systems exhibits divergence despite, often, common 'colonial' origins. In many societies, accord with 'understood' business arrangements, as well as those expressed, is an imperative of behaviour to the extent that contracts are superfluous.

Dunning (1993) further analyses the changes in cross-border organisation of production in respect of a triad of organising mechanisms – governments, privately owned commercial hierarchies and markets – see figure 2. Changes in relative

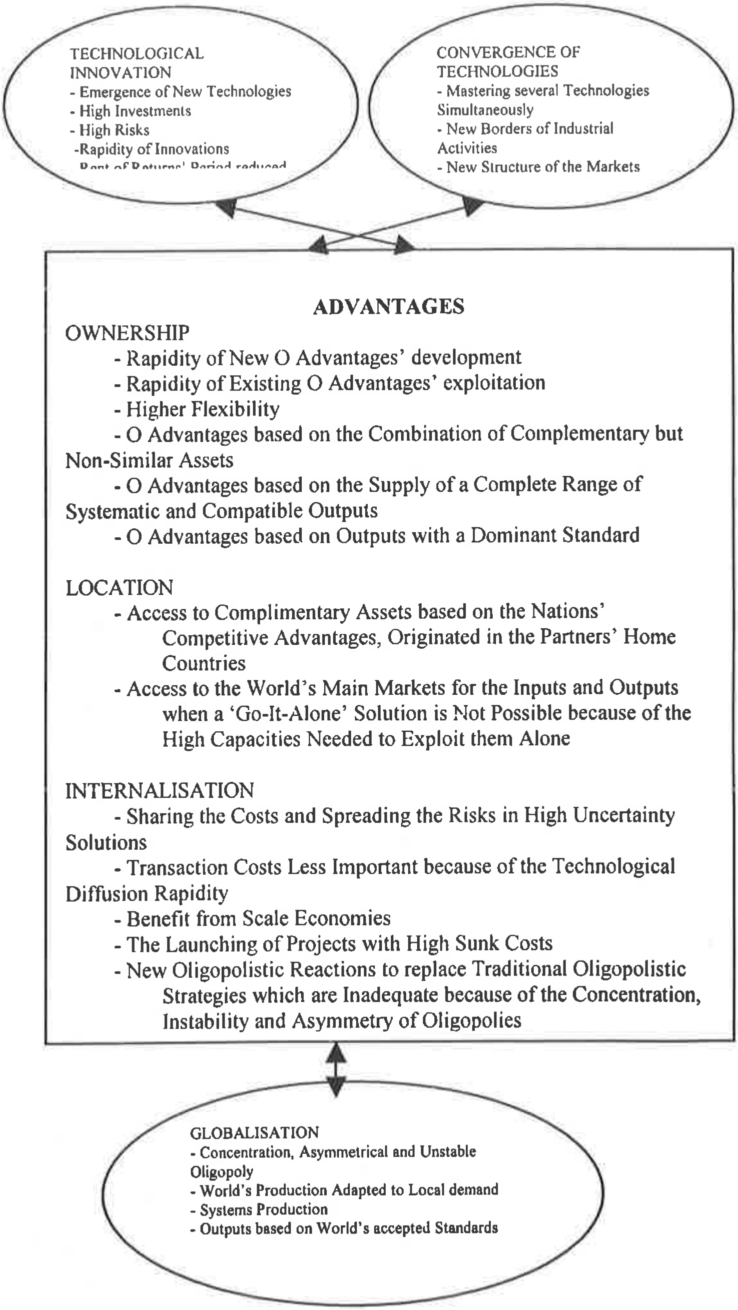

Figure 1: The value of strategic alliances
Source: Dunning (1993)

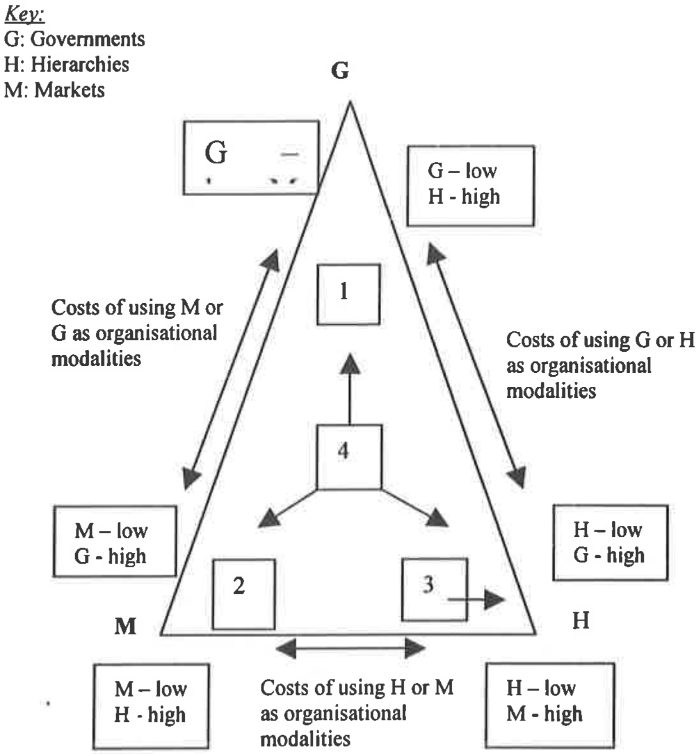

Figure 2: Triad of Organisational Mechanisms (Source: Dunning, 1993)

modalities are believed to reflect relative changes in cost-benefit of the structures, notably, due to the (macro-) governance aspects of transaction costs. System1 depicts a command/state capitalist economy; 2 is a market economy; 3 is a capitalist economy with dominant firms and 4 depicts a mixed economy. The model notes the levels of transaction costs which impact on the configuration and operation of the economic system. However, as noted by Dietrich, (1994), internal costs and the array of benefits must also be evaluated when examining the most appropriate form for economic governance.

Cultural Aspects

There is apparent correlation between behaviour enforcement orientation, cultural dimensions and linguistic characteristics. Legalistic enforcement orientation relates to individualism, low power-distance, short–term and achievement orientation in which high content languages are used. Such contexts tend to engender greater behavioural rigidity. In high context societies, everyday existence requires more flexibility, including reflection on the unspecified and consequent action to accommodate the implicit (legitimate) desires of others. The high content – high context spectrum may lead to very different understandings from any behaviour, linguistic exchange etc. That is in addition to the differences in understanding within a society which are indexical upon socialisation, education, training etc (see, e.g., Clegg, 1992).

Child (1999) notes the general acceptance of the depth and persistence of values in a culture and that such values differ between cultures. Such perspectives are likely to be reflected in how information is interpreted – social indexicality – and, consequently, the forms of governance adopted for economic transactions – whether devised to protect the community or the individual and, thereby, expressing normative social priorities.

Ralston et al. (1999) found that external influences do engender different value structures, although such changes may occur only over considerable time (as between generations). However, behavioural modification is acknowledged to be speedier but, often, shallower than real cultural change which, of course, does not detract from the power of enduring external influences, especially if offering convincing, tangible benefits.

In considering issues of the objectives and regulation of international trade, Dore (1996: 371) notes '…the need for mutual recognition of different definitions of the public interest, deriving from different value concepts of what life is about'. That perspective has far-reaching importance as international trade usually occurs across cultural boundaries and so, must address moral issues.

Discussion

Boyer (1996) discusses three typologies of convergence – *Economic*, concerning productivity and living standards; *Development*, concerning democracy and markets and *Institutional/Regulatory*. He continues, '...for the new growth theorists, technological change is endogenous, that is, the equilibrium growth path depends on past efforts in research and development, education, and product differentiation. Thus rates of productivity growth are likely to vary from one country to another...' (Boyer, 1996: 35). That perspective is in contrast with the 'catch-up hypothesis' which emphasises *potential* for rapid advance in less developed economies due to their lower starting point.

The World Bank (2001) stated that 'Inequality both among and within countries appears to have risen, in part as the result of technological progress'.

For international projects the issue of sustainability, commonly through use of 'appropriate technology' is second only to the financing concerns. Construction, as a major provider of projects and consumer of resources (many of which are non- or inadequately renewable) has a critical role. Problems of working beyond domestic borders are well known but may not be well understood, given widespread task orientation of the industry's personnel. Project sites may, often, be likened to historic colonial enclaves where groups work to complete the total product but further 'integration' is absent. Consequently, exporting internationalisation is practiced, rather than globalisation.

Design and standards further the concepts of superiority of certain technologies, production processes and all that underpins them. Familiarity with the domestic requirements and procedures hampers flexibility and adaptability and tends to be reinforced by pricing consequences of risk aversion. Thus, technologies tend to be imposed from the domestic environments of designers onto project host locations – again, international financing bodies tend to reinforce the pattern. Such impositions may be disguised under the cloak of 'technology transfer' but even where such transfers are appropriate and desired, mechanisms to effect transfers tend to be quite ineffective, perhaps to protect the market of the 'transferor'.

Conclusions

Given that the evidence may be and has been interpreted variously and that different data do not yield consistent results, it is apparent that both convergence and divergence are occurring in parallel – probably the paces, forms and degrees vary between locations and times, in part due to political controls. However, a major trend is towards more widespread adoption of market economics, and in so doing, also extending the variants of capitalism.

As both domestic and international power structures shift, the historic ability of supplier nations (of construction) to impose technology, procedure etc on host nations seems likely to diminish as well as change in pattern. The message seems clear, sensitivity to engender flexibility and adaptability are required for success for sustainability of organisations as well as their outputs.

References

Boyer, R. (1996) The Convergence Hypothesis Revisited: Globalisation but still the century of Nations, In Berger, S., Dore, R. (Eds.), *National Diversity and Global Capitalism*, Ithaca: Cornell University Press.

Clegg, S.R. (1992) Contracts Cause Conflict, In Fenn, P., Gameson, R. (Eds.), *Construction Conflict Management and Resolution*, London: E&FN Spon.

Dietrich, M. (1994) *Transaction Cost Economics and Beyond: towards a new economics of the firm*, London: Routledge.

Dore, R. (1996) Convergence in Whose Interest?, In Berger, S., Dore, R. (Eds.), *National Diversity and Global Capitalism*, Ithaca: Cornell University Press.

Dunning, J.H. (1993) *The Globalisation of Business*, London: Routledge.

Hutton, W. (1996) *The State We're In*, 2nd Edn. London: Vintage.

Norman, G. (1998) Foreign Direct Investment and International Trade: a Review, *Discussion Paper 98-10 Department of Economics, Tufts University*, (Unpublished).

Ohmae, K. (1999) *The Borderless World: Power and Strategy in the Interlinked Economy*, New York: Harper Business.

Ralston, D.A., Egri, C.P., Stewart, S., Terpstra, R.H., Yu, K. (1999) Doing business in the 21st century with the new generation of Chinese managers: A study of generational shifts in work values in China, *Journal of International Business Studies*, 30, 415-427.

Schuster, C., Copeland, M. (1996) *Global Business: planning for sales and negotiations*, Fort Worth: The Dryden Press.

World Bank m(2001) *Global Economic Prospects and the Developing Countries 2001*, http://www.worldbank.org/prospects/gep2001/sumeng.htm, 17 May 2001.

Strength from Within
Relative Importance of Factors Influencing Development of Local Construction Enterprises in Singapore

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Abstract

Many factors are instrumental in influencing the growth and development of construction enterprises. Studies tend to concentrate on one or a few of these factors, such as technology transfer from foreign construction companies. Thus, they fail to explore the relevant issues in a comprehensive manner. This partial approach leads to proposals for improvement in industry performance with wide gaps within them.

This questionnaire-based study first assesses the extent to which local contractors in Singapore have grown. It then considers a broad range of factors which have had an impact on the development of these firms, and examines their relative importance. It is found that government's action, clients' initiatives, and measures taken by the companies themselves are all relevant factors which have influenced the growth and development of Singapore contractors. It is recommended that appropriate targeted action be taken by this range of actors.

Keywords: questionnaire, development of firms, Singapore, contractors

Introduction

Background

Efforts have been made to develop Singapore's construction industry and its constituent companies since the 1960s. Much of these have been government initiated, supported or led. The

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first steps in these regards followed the major study by a Commission of Inquiry (1961) appointed by the government to study the ability of the construction industry to meet the demands of a planned programme of industrialization, mass housing and school building.

The continuous development of the industry of Singapore has been administered by the Construction Industry Development Board (CIDB), formed in 1984, which became the Building and Construction Authority (BCA) in 1999 after the restructuring of government organizations relating to the construction industry. The achievements and challenges of the CIDB/BCA have been studied by many authors (see Chow, 1990; Ofori, 1993; CIDB, 1994).

Other government organizations which have been involved in the efforts to develop the construction industry include the Housing and Development Board which offered incentive schemes to support the purchasing of equipment, and assisted firms with resource and project management (Wong and Yeh, 1985; Chionh, 1999). The private sector's involvement in industry development has mainly been through the activities of the Singapore Contractors' Association Ltd. (SCAL) (SCAL, 1997a).

Previous studies have investigated the factors which have contributed to the development of Singapore's construction industry. Low and Tan (1993) examined the relationship between government measures and the growth of construction capacity. Ofori and Chan (2000) studied the involvement of foreign contractors in the development of local firms, and Ofori et al. (2001) considered local-foreign joint ventures. Knowledge about these determinant factors would helping in the development of appropriate initiatives.

Research Objectives and Methodology

This study has the following objectives:

1. to examine whether local contractors in Singapore have grown over the past decade
2. to consider the broad range of factors which have had an impact on the development of local contractors in Singapore
3. to examine the relative importance of these factors
4. to propose measures for improving the performance of the local firms, with the view to enhancing their competitiveness and performance.

Field Study

Research Design

A postal questionnaire-based survey of three groups of target respondents was undertaken. These were: (i) local contractors (LC) in the top three registration categories; (ii) foreign contractors (FC) operating in Singapore; and (iii) clients and consultants (CC).

The first part of the questionnaire sought details of responding organizations and persons. The second part of the questionnaire posed "Yes" / "No" questions concerning the growth of local construction firms. The third part related to the factors which have contributed to the development of local firms. In this section, respondents were requested to indicate, for each attribute under each question, the extent to which they agreed, on a scale of 1 to 5, where: 5 = "Strongly Agree"; 4 = "Agree"; 3 = "Neither Agree Nor Disagree"; 2 = "Disagree"; 1 = "Totally Disagree". The ten-year period 1987-97 was adopted as the frame of reference because existing data showed that local firms had improved in size most significantly during this period (Ofori and Chan, 2001).

The addresses of all 178 local contractors in the top three registration categories and all 44 foreign contractors were obtained from the *Register of Contractors and Suppliers 1997/98* (CIDB, 1997); the names of possible contact persons were taken from the *Singapore Contractors' Association Ltd Yearbook 1997* (SCAL, 1997b). Addresses of developers were drawn from the *REDAS Directory 1997* (Real Estate Developers' Association Ltd, 1997); and those of consultants from the institutes' directories such as the *Singapore Institution of Architects Yearbook* (Singapore Institute of Architects, 1997).

Response Rate and Respondents

The overall response rate was about 26% (263 questionnaires sent, 68 returned). Local contractors formed 41% of the respondents; foreign contractors 13%; and clients and consultants 46%. The response rate for local contractors was 16% (178 questionnaires sent, 28 returned), whereas that for foreign contractors was 21% (44 questionnaires sent, 9 returned), and for clients and consultants, 76% (41 questionnaires sent, 31 returned).

Despite the relatively low response rate, the results of the survey will provide a good basis for analyzing issues relating to the growth of local construction companies as the targeted group included all organizations which had become large in the past decade.

The questionnaires were completed by senior persons – 18% of them were Directors or Deputy Directors, 27% were Chief Executive Officers, Managing Directors, General Managers, Deputy General Managers or Partners; 24% were Managers or Assistant Managers; and the rest were professionals.

Forty-six percent of responding contractors were in the top registration category, and a cumulative 70% in the top two categories. Of these, 31% were foreign contractors. Sixty-four percent of local contractors were in the top two categories. Forty-nine percent of responding firms specialised in Building, and 22% in Civil Engineering. Nineteen percent of contractors 'specialised' in "Building and Civil Engineering". Forty-seven percent of local-contractor respondents specialised in building and 25% in civil engineering, whereas 14% of local firms did not indicate their area of specialization.

By Singapore standards, the responding contractors were large. Their mean annual turnover in 1995 was S$90 million, and the maximum was S$500 million. The average number of professionals employed by responding contractors was 43, the minimum was 4, and the maximum, 375. The contractors were also quite experienced – the mean age of companies was 25 years and the oldest firm was 51 years old.

Growth of Local Firms

Almost all the respondents (96%) believed that the capacity and capability of Singapore construction companies have increased considerably since 1980. Seventy-seven percent of the respondents felt foreign construction companies operating in Singapore have helped their local counterparts to develop.

Factors Influencing Development of Local Firms

Factors which have contributed to the development of local construction companies were explored in the study. The results on the main factors are now presented.

Influence of Foreign Contractors

Table 1 shows the respondents' mean scores on the vehicles through which foreign contractors have influenced local construction companies generally. The overall mean scores ranging from 3.15 to 3.35 are quite low. This accords with the finding by Ofori and Chan (2000) that foreign firms have not been among the key factors which have influenced the development of their local counterparts. Two vehicles are jointly ranked as the most effective. These are "transfer of construction techniques", and "transfer of managerial skills and systems". The three categories of respondents did not agree on the most important vehicle. Clients and consultants rated "transfer of managerial skills and systems" at the top, whereas foreign firms chose "transfer of corporate policies and attitudes" and local contractors gave the highest score to "targets for corporate benchmarking", followed by "transfer of construction techniques", and "transfer of managerial skills and systems".

It worth noting that "offering of competition" received the lowest overall score, and was given a score below 3 by local contractors and was not ranked highly by any other respondent category, although it has often been identified as being important (see *The Straits Times*, 1993). It is also worth observing that "targets for corporate benchmarking" received relatively high scores from local and foreign contractors.

Table 1 Mean score of respondents' views on vehicles through which foreign contractors influenced their local counterparts (in general)

Factors	*Overall Mean*	*CC*	*FC*	*LC*	*F value*	*P > F*
Inspiration as role models	3.24	3.29	3.44	3.11	0.51	0.6045
Targets for corporate benchmarking	3.34	3.29	3.67	3.29	0.67	0.5143
Transfer of construction techniques	3.35	3.35	3.67	3.25	0.42	0.6615
Transfer of managerial skills and systems	3.35	3.39	3.56	3.25	0.18	0.8367
Transfer of corporate policies and attitudes	3.15	3.00	3.78	3.11	1.96	0.1488
Demonstration of construction techniques	3.32	3.42	3.56	3.14	0.65	0.5245
Offering of competition	3.15	3.31	3.56	2.85	2.61	0.0819**

Government Incentives

Table 2 shows the respondents' mean scores on the types of government incentive schemes which have helped local contractors to upgrade and expand. The overall mean scores are between 3.06 and 3.35. "Financial incentives" received the highest overall score, as well as the highest from both local and foreign contractors. Clients and consultants rated human resource development highly. They gave the highest score to "short courses for professionals and technicians", followed by "training of site supervisors". Local contractors gave the lowest score to "national awards", despite their motivational properties which are often claimed (see Construction 21 Steering Committee, 1999).

Table 2 Mean score of respondents' views on how government incentive and support schemes have helped local firms to upgrade

Factors	*Overall Mean*	*CC*	*FC*	*LC*	*F value*	*P > F*
Financial incentives	3.35	3.46	3.67	3.17	1.09	0.3428
Advisory services	3.03	3.16	3.22	2.82	1.55	0.2210
Market information	3.25	3.26	3.44	3.17	0.51	0.6045
Training of skilled workers	3.17	3.39	3.22	2.93	1.61	0.2072
Training of site supervisors	3.26	3.48	3.22	3.03	1.60	0.2090
Short courses for professionals and technicians	3.28	3.52	3.56	2.93	5.71	0.0052*
Seminars and workshops	3.13	3.32	3.11	2.93	1.96	0.1492
Improvement of business environment	3.28	3.42	3.22	3.14	0.70	0.5020
National awards	3.06	3.32	2.89	2.81	2.40	0.0993**

Government's Improvement of Operating Environment

Table 3 shows respondents' views on the extent to which specific measures adopted by the Singapore government to improve contractors' business environment have helped them to develop. The mean scores are relatively low, being between 3.17 and 3.39. "Registration and classification of contractors" receives the highest overall score, and is also rated at the top by clients and consultants. The CIDB/BCA also rates this aspect of its work very highly (CIDB, 1994). Foreign contractors ranked it second, giving the highest score to "market information". Presumably, foreign contractors believe that their local counterparts are privy to some government sources of market information which gives them a competitive edge. Local contractors gave the highest score to "contractual terms" and accorded all the remaining four measures the same average score (3.14). This top billing for contractual terms is not surprising as the local public client in Singapore is a good one, with fair contract terms and few bureaucratic procedures (Chow, 1990). However, foreign contractors gave it the lowest score.

Table 3 Mean scores of respondents' views on extent to which Singapore government measures to improve contractors' business environment has helped industry develop

Factors	*Overall Mean*	*CC*	*FC*	*LC*	*F value*	*P > F*
Procurement policies	3.20	3.23	3.33	3.14	0.11	0.8977
Contract documents	3.17	3.26	3.00	3.14	0.45	0.6391
Contractual terms	3.17	3.19	2.89	3.24	0.60	0.5516
Market information	3.26	3.26	3.67	3.14	1.49	0.2331
Registration and classification of firms	3.39	3.58	3.56	3.14	1.71	0.1895

Local Contractors' Initiatives

Table 4 shows the mean scores of respondents' views on the extent to which stated initiatives taken by local construction firms have helped them to upgrade. The overall mean scores are between 3.19 and 3.57. The measure given the highest score was "employment of professionally qualified persons"; it was also given the highest score by clients and consultants (followed by "establishment of better relations with clients"). Strategic alliances were rated very lowly, with "strategic alliances with other local contractors" receiving the third lowest overall score, "joint ventures with foreign companies" the second lowest, and "strategic alliances with firms outside construction" received the lowest overall score. Local contractors gave the lowest score (below 3) to "joint ventures with foreign contractors" and the highest score to "utilisation of information technology", followed by "strategic alliances with firms outside construction".

Table 4 Mean scores of respondents' views on how measures adopted by local firms have helped them to upgrade

Factors	*Overall Mean*	*CC*	*FC*	*LC*	*F value*	***P >F***
Employment of professionally qualified persons	3.57	3.90	3.56	3.21	2.65	0.0783 **
Adoption of human resource management policies	3.24	3.42	3.44	3.03	1.47	0.2394
Institution of quality management systems	3.36	3.58	3.33	3.14	1.57	0.2152
Joint ventures with foreign companies	3.21	3.35	3.56	2.93	1.86	0.1640
Strategic alliances with other local contractors	3.22	3.35	3.22	3.07	0.86	0.4295
Strategic alliances with firms outside construction	3.19	3.06	3.67	3.18	1.67	0.1959
Establishment of better relations with clients	3.43	3.61	3.11	3.34	1.15	0.3223
Utilisation of information technology	3.38	3.52	3.89	3.07	3.28	0.0440 *

Initiatives of Singapore Contractors' Association Ltd.

Table 5 shows the mean scores of respondents' views on how initiatives by the SCAL have helped local companies to improve their performance. The figures are quite low, ranging from 2.96 to 3.24. "Continuing professional development" was given the highest score overall, and also received the highest score from clients and consultants, which, again, were more impressed by human resource development (they gave equal highest score to "running training courses for contractors' personnel"), whereas both local and foreign contractors gave it the second highest score.

Table 5 Mean scores of respondents views on how initiatives by SCAL have helped local companies to improve upon their performance

Factors	*Overall Mean*	*CC*	*FC*	*LC*	*F value*	*P > F*
Running training courses for contractors' personnel	3.21	3.33	3.00	3.14	0.61	0.5462
Organising seminars for members	3.15	3.27	3.11	3.04	0.61	0.5480
Lobbying government on members' behalf	3.00	3.20	3.11	2.76	1.37	0.2604
Offering networking opportunities at home	2.96	3.00	3.44	2.75	2.57	0.0845**
Offering networking opportunities overseas	3.10	3.30	3.22	2.86	2.06	0.1361
Construction Industry Information Network	3.07	3.30	3.33	2.75	4.18	0.0198*
Continuing professional development	3.24	3.33	3.33	3.10	0.80	0.4522
Singapore List of Trade Subcontractors	2.96	3.20	2.78	2.76	2.46	0.0937**
Safety consultancy	3.00	3.23	2.89	2.79	2.26	0.1130

Foreign and local contractors had opposite views. The former accorded the highest score (only 3.14) to "offering networking opportunities at home", to which the latter the lowest score (jointly with "Construction Industry Information Network" which foreign firms ranked joint second). From their views of local contractors, the foreign firms scored SCAL's potential rather than its actual achievements. Local contractors are not impressed by their association: they gave the lowest scores under all the factors; they gave the highest score to "running training courses for contractors' personnel". They gave very low scores (below 3) to some initiatives which SCAL is proud about, including "lobbying government on members' behalf" and the Singapore List of Trade Subcontractors.

Clients' Initiatives

Table 6 presents mean scores of respondents' views on the extent to which each specified measure adopted by clients has helped local firms to improve upon their performance.

Table 6 Mean score of respondents views on how measures adopted by clients have helped local firms to improve upon their performance

Factors	*Overall Mean*	*CC*	*FC*	*LC*	*F value*	*P > F*
Shortlisting opportunities	3.24	3.32	2.89	3.25	0.67	0.5134
Alternative design possibility	3.36	3.45	3.67	3.17	1.14	0.3266
Favourable contractual terms	3.13	3.00	3.44	3.17	0.77	0.4665
Design and build opportunities	3.34	3.48	3.44	3.14	0.75	0.4753
Bonus for quality performance	3.49	3.61	3.44	3.36	0.56	0.5763
Timely payment	3.59	3.94	3.56	3.24	3.01	0.0563**

The highest overall score was given to "timely payment", followed by "bonus for quality performance". These two measures were also the top two selected by the clients and consultants surveyed. The top two scores of foreign contractors went to “alternative design possibility” and “timely payment”, whereas local contractors’ two highest scores went to “bonus for quality performance” and “shortlisting opportunities”.

Organisations Outside Construction Industry

Table 7 presents the mean scores of the respondents’ views on the extent to which specified types of organizations outside the construction industry had helped local contractors to develop. These organizations outside the construction industry received relatively high scores. There was overall agreement among the categories of respondents on the importance of the factors. Generally, the organizations were ranked in overall terms and by each of the categories of respondents as follows: (i) financial institutions; (ii) suppliers of materials; and (iii) manufacturers of materials and components.

Table 7 Mean scores of respondents’ views on how organisations outside construction industry have helped local contractors develop

Factors	*Overall Mean*	*CC*	*FC*	*LC*	*F value*	*P > F*
Financial institutions	3.58	3.58	3.67	3.55	0.11	0.8970
Manufacturers of materials and components	3.33	3.55	3.22	3.14	2.02	0.1415
Suppliers of materials	3.39	3.55	3.44	3.21	1.11	0.3346

Conclusion

The study shows that a broad range of measures are required, if the performance of Singapore’s construction industry is to be improved. These transcend governmental action which is usually stressed, and even go beyond the construction industry. Technology transfer from foreign firms was highlighted. The influence of government’s action received stronger endorsement, with the provision of financial incentives and setting of standards. The local firms can take action to help themselves, especially with regard to employing qualified personnel and appointing them to managerial positions. Attention to the financial aspects of clients' role, such as prompt payment would also help.

Acknowledgement

The authors gratefully acknowledge the grant provided by the National University of Singapore which made the research study possible.

References

Building and Construction Authority (2000) *Building Up: Inaugural annual report 2000*. Singapore.

Chionh C.K. (1999) The role of the Housing and Development Board in preparing Singapore's construction industry for the challenges of the new millennium. *Proceedings, Second International Conference on Construction Industry Development and First Conference of CIB TG29 on Construction in Developing Countries.* Singapore, 27-29 October, Vol. 1, pp. 1-8.

Chow, K.F. (1985) *Construction Joint Ventures in Singapore*. Butterworths, Singapore.

Commission of Inquiry Into the Construction Capacity of Singapore (1960) *Interim Report.* Government Printer, Singapore.

Construction 21 Steering Committee (1999) *Re-Inventing Construction*. Ministry of Manpower and Ministry of National Development, Singapore.

Construction Industry Development Board (1994) *10th Anniversary Commemorative Publication.* Singapore.

Construction Industry Development Board (1997) *CIDB Register of Contractors and Suppliers.* Singapore.

Lam, S.W. (1997) Construction Industry Development Into the 21st Century. *Proceedings, First International Conference on Construction Industry Development,* Singapore, 9-11

December, Vol. 1, pp. 11-13.

Lam, S.W. (1999) Preparing Singapore's construction industry for the new millennium. *Proceedings, Second International Conference on Construction Industry Development and First Conference of CIB TG29 on Construction in Developing Countries.* Singapore, 27-29 October, Vol. 2, pp. 1-7.

Low, S.P. and Tan, S.P. (1993) *The Relationship Between Construction, Marketing and Economic Development.* Royal Institution of Chartered Surveyors, London.

Ofori, G. (1993) *Managing Construction Industry Development: Lessons from Singapore's experience.* Singapore University Press, Singapore.

Ofori, G. (1996) International contractors and structural changes in host-country construction industries: Case of Singapore. *Engineering, Construction and Architectural Management*, Vol. 3, No. 4, pp. 271-288.

Ofori, G. and Chan, S.L. (2001) Factors influencing development of construction enterprises in Singapore. *Construction Management and Economics*, **19**, 145-154.

Ofori, G., Teo, P. and Leong, C. (2001) Effectiveness of joint ventures as construction technology transfer vehicles: the case of Singapore. *Journal of Construction Research*, in press.

Real Estate Developers' Association of Singapore (1997) *REDAS Directory 1997.* Singapore.

Singapore Contractors' Association Ltd. (SCAL) (1997a) *Foundations of Success: Celebrating 60 years of building our nation.* Singapore.

Singapore Contractors' Association Ltd. (1997b) *Singapore Contractors' Association Ltd. Yearbook 1997.* Singapore.

Singapore Institute of Architects (1997) *Singapore Institute of Architects Yearbook 1997.* Singapore.

The Straits Times (1993b) Construction firms benefit from govt's open-door policy. Singapore, September 18, p. 47.

Wong, A and Yeh, S.H.K. (1985) *Housing a Nation: 25 years of public housing in Singapore*. Maruzen Asia, Singapore.

Knowledge Sharing: A Softly-Softly Approach.

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Abstract

Knowledge sharing has been on the UK construction research agenda since the early 1980s. Benchmarking as a method of knowledge capture and transfer to improve organisational performance is an early example of this. The purpose of benchmarking is to understand both performance and the contributing factors (knowledge) that dictate performance. Continuing this theme, the Egan report in 1998 (DETR, 1998) detailed the problems of the UK construction industry and proposed that knowledge required to resolve these problems was embedded in the managerial practices of other industry sectors. His challenge to the construction industry was to capture and transfer knowledge between organisations in different industry sectors. However, despite the compelling arguments for the use of knowledge transfer within construction, efforts to develop and implement an appropriate method are curiously absent. This paper explores the notion of knowledge sharing and highlights the pitfalls that may befall potential methodologies that adopt a simplistic approach. Knowledge sharing is argued to be a complex social process that involves eliciting both explicit and tacit knowledge. The process is further complicated by the need to fully understand and consider the context within which the knowledge is embedded. This paper proposes a structured approach for knowledge sharing that considers the embedded and contextual nature of tacit knowledge. Specifically, the paper reports on the initial application of a knowledge sharing method to organisations within the aerospace and construction sector. The research is sponsored by the UK Government through the Engineering and Physical Sciences Research Council (EPSRC), and subsequently benefits from a high level of collaboration between industrial

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organisations and academic researchers.

Keywords: benchmarking, context, industry sectors, knowledge sharing.

The Need for a Knowledge Sharing Method

The notion that industry sectors or economic clusters are characterised by varying propensities to import, export, or produce knowledge for themselves is argued by Gavigan et al (1999). Specifically, it is noted that the construction economic cluster (sector) appears to be a net importer of knowledge. If this analysis is taken to be accurate, the need for an effective knowledge sharing method within the construction sector becomes paramount.

An assumption that improved productivity can be achieved by learning and adopting alternative approaches from other industry sectors is central to the findings of the 'Rethinking Construction' report (DETR, 1998). This report, authored by the Construction Task Force (a UK forum consisting of the industry's major clients such as BAA) sets out the scope for improving quality and efficiency in the UK construction sector. Whilst conceding that the UK construction industry is *excellent at its best*, the report focuses on its shortcomings. One of the conclusions seemed to be that using particular management approaches from other industry sectors would solve many of these shortcomings. This is encapsulated specifically within a section of the report that analyses and highlights the drivers for change in other industries as a basis for change in the UK construction sector (pp 14-17) and, in the penultimate sentence of the report:

"We wish to see, within five years, the construction industry deliver its products to its customers in the same way as the best consumer-lead manufacturing and service industries" (DETR, 1998, pp 40)

However, the report falls short of outlining how such learning can occur which, tends to understate the complexity of cross-sectoral learning.

Benchmarking is widely advocated within the construction sector as a way to interact with and learn from organisations within and outwith the sector (Pickrell et al, 1997). There is also a plethora of government supported and independent organisations and initiatives freely available to assist the novice benchmarker such as the Agile Construction Initiative, Construction Benchmarking Centre, Government Construction Clients' Panel Benchmarking Group, Construction Best Practice Programme, Movement for Innovation, National Construction Benchmarking Forum, ECI/CII Benchmarking. Most of these seem to be positioned as a response to the findings of the 'Rethinking Construction' report (DETR, 1998) regardless of their prior existence. However, to accept benchmarking as a 'knowledge sharing' panacea, without critical theoretical examination, would be to concede to the dominant orthodoxy within industry and reject a more pluralistic position (New, 1997).

The need for a knowledge sharing method is clear, and the acceptance of benchmarking as a widely advocated knowledge sharing method is evident within the construction sector. However, theoretical understanding of knowledge sharing and the potential conceptual limitations of benchmarking within the construction sector are not. A critical examination of both these aspects is required to credibly advocate benchmarking as the only knowledge sharing method, or to introduce, on the basis of necessity, alternatives approaches.

The Problematic Nature of Knowledge Sharing

Explicit and Tacit knowledge

Human knowledge can be divided into two components – explicit and tacit (Nonaka and Takeuchi, 1995). Explicit knowledge is that which can be easily shared, codified and stored, and is present in the documents and reports of organisations. Tacit knowledge, on the other hand, is difficult to codify since it is arguably held within peoples heads. Whilst codified explicit knowledge lends itself easily to sharing, tacit knowledge must go through a number of processes before any sharing can occur. These processes are argued to centre on socialisation, where participants interact within a shared environment (Nonaka and Takeuchi, 1995). Therefore any method concerned with capturing and benefiting from knowledge must consider how these various aspects of knowledge may be captured and understood within a specific environment or context. The importance of capturing or understanding the tacit aspects of knowledge is considered by Whitley (2000) who finds fault with the current discourse on knowledge management being directed to knowledge that can easily be formalised and held in data format within computers, i.e. explicit knowledge. The concentration on systems that seek to capture and manage only explicit knowledge is one of the most common criticisms of knowledge management within the literature (e.g. Scarborough et al 1999, Egbu, 2000; Whitley, 2000; Egbu and Sturges, 2001).

Context

The context within which knowledge is embedded cannot be divorced from any analysis or understanding of the application of that knowledge. For example: managerial processes in different sectors are influenced by disparate economic, social, technological, legal, environmental and structural factors (Pettigrew, 1997). From this perspective, an organisation is itself historically the product of its own environment. To understand any managerial practice or process it is necessary to understand its dependence upon the context within which it operates. As Nonaka and Takeuchi (1995) argue, little sense can be made of information if it is abstracted from the associated emotions and specific contexts in which it is embedded.

Historical events inevitably influence the development of both the current context within which knowledge is embedded and the knowledge itself. Taking a snapshot in time of both context and process, inherent in benchmarking, is therefore inadequate to provide a basis for understanding the nature of particular knowledge. The historical development of both context and process will be *carried forward in the human consciousness* (Pettigrew, 1997). Therefore, an insight into the historical events that have shaped both context and process will reveal a better understanding of the current process and thus its potential for transferability.

Knowledge sharing environment

The environment within which the knowledge sharing occurs between people will influence the extent to which tacit knowledge can be appropriated or shared. The forum or environment must seek to engender some form of shared experience that will allow knowledge (tacit and explicit) to be articulated and thus subject to reflection and interrogation.

Drawing on Nonaka and Takeuchi's (1995) model of a knowledge creation process shown in Figure 1, the social interaction between individuals acts as the initial catalyst for four permutations of knowledge conversion: socialisation (tacit - tacit), externalisation (tacit - explicit), combination (explicit – explicit), and internalisation (explicit – tacit). Further exploration of these processes displays the difficulty of accessing tacit knowledge. Socialisation (tacit - tacit) is concerned with generating shared or sympathised tacit knowledge within individuals through a shared experience. This new tacit knowledge takes the form of shared mental models or constructs – a shared cognitive platform from which to address the subject matter. To make this tacit knowledge explicit (externalisation) a process of dialogue and reflection is used. Codification of this knowledge occurs particularly through the use of metaphor and analogies, which allow for reflection. Combination (explicit – explicit) is simply concerned with the combination of discrete pieces of explicit knowledge to allow the generation of a new piece of explicit knowledge. Internalisation (explicit – tacit) of explicit knowledge to tacit knowledge flows from the experience gained through individuals using newly formed explicit knowledge. And so the cycle can begin again if necessary, building upon the existing field of knowledge.

The research project seeks to promote synergistic learning amongst industrial partners from the construction and aerospace sectors. Therefore, a high degree of importance is placed upon engaging practitioners from a diversity of different backgrounds, within the two sectors, in a highly socialised setting. Knowledge sharing methods must take into account these three key issues: (i) the distinction between 'explicit knowledge' and 'tacit knowledge', (ii) context, and (iii) the environment within which effective knowledge sharing takes place.

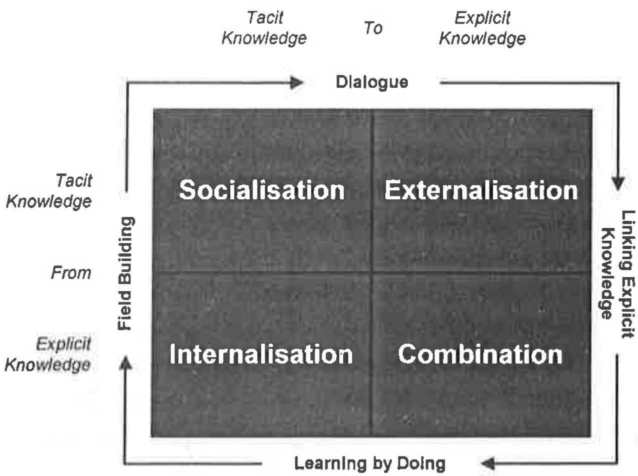

Figure 1: Knowledge Conversion (adapted from Nonaka and Takeuchi 1995)

Benchmarking as a Knowledge Sharing Method

Improving performance as a consequence of learning from others' experience is a central tenet of the practice of benchmarking (Camp, 1989, Codling, 1992, Watson 1993, Zairi 1992, Spendolini, 1992). This practice was first expressed and introduced to Western management practitioners by Camp (1989) as a structured process of comparison and learning between organisations. Camp's ten-step process was predicated on the ability to measure, analyse and understand why differences in performance occur. Essentially knowledge underpinning the application of processes in an environment reflects performance differentials. The use of this structured approach outlined by Camp (1989) and others (Codling, 1992, Watson 1993, Zairi 1992) is considered by Wolfram Cox et al (1997) to take the form of recipe knowledge (Sackmann, 1992). They identify the dominant literature on benchmarking to be prescriptive and pedagogical and that theory is insufficiently developed to support claims of the efficacy of one recipe against another.

Inherent in benchmarking is the assumption that important aspects of organisational performance can be codified, and that procedures or processes can be structured in such a way to make measurement achievable and also meaningful (Wolfram Cox et al, 1997, Bresnen, 1998). Yet, as noted above, not all that is important can be codified such as tacit knowledge. Notable benchmarking studies and initiatives in the UK construction sector include Pickrell et al, 1997, Male et al 1998a, 1998b, Madigan 1997 (Agile Construction Initiative) and the work of the European Construction Institute (ECI) (www.eci-online.org). These seem to draw heavily upon benchmarking recipes (Camp 1989, Codling, 1992, Spendolini, 1992, Watson, 1993, Zairi, 1992) and are consequently characterised, to varying degrees, by:

- The assumption of a need to measure
- Process as a 'unit of analysis'
- A dominant positivist paradigm

- A lack of attention to industrial contexts

These characteristics reveal various theoretical and practical limitations inherent within the 'use of' and 'process of' benchmarking as a knowledge sharing method.

Problems with measurement

It is recognised that aspects of possible outcomes from *one-of-a-kind strategic problems* may be resistant to quantification, although still crucial to an understanding of the problem (Rosenhead, 1989). Therefore important aspects of organisational and project performance can be extremely difficult to measure, and in some circumstances even defy attempts to be measured. Arguing the case for the determination and existence of an alternative paradigm in operational research (OR), Rosenhead (1989) indicates potential limitations and OR's over-reliance on traditional quantitative methods. Making a distinction between technical and practical problems, and 'tame' and 'wicked problems' highlights the need for the application of different analytic methods and the alternative OR paradigm (Ravetz, 1971, Ritell and Webber, 1973). A technical or tame problem is characterised by agreement of those involved on what the problem is, and the most appropriate way to address the problem. A wicked or practical problem is characterised by difficulties surrounding the definition of the problem itself and any subsequent solution. Technical and tame problems therefore lend themselves easily to the use of quantitative methods whereas practical and wicked problems cannot due to the difficulty in even defining the problem that needs to be measured. For Rosenhead (1989), these distinctions are analogous with tactical and strategic problems and the adoption of the traditional or alternative OR paradigm respectively.

It is indicated by Bresnen (1999), that a propensity to concentrate only on *easily measurable and quantifiable* *aspects of performance* is a potential drawback for benchmarking practitioners. Whilst this may be explained by the dominant empiricists view that *a concept attains status and legitimacy if it can be counted or measured* (Wolfram Cox et al, 1997), it does not therefore lend itself easily to addressing difficult or immeasurable practical, wicked or strategic problems. Within the realm of OR research, benchmarking can therefore be described as falling within the traditional paradigm characterised by a reliance on quantitative methods and the need for measurement.

The propensity described by Bresnen (1999) also appears to have been captured and explained much earlier by Schön (1983), and also the lost opportunity to those who concede to this propensity:
"In the swampy lowland, messy, confusing problems defy technical solution. The irony of this situation is that the problems of the high ground tend to be relatively unimportant to individuals or society at large, however great their technical interest may be, while in the swamp lie the problems of greatest human concern. The practitioner must choose. Shall he remain on the high ground where he can solve relatively unimportant problems according to prevailing standards of rigour, or shall he descend to the swamp of important problems and non-rigorous inquiry?"

Traditional quantitative methods are of limited use within the 'swamp' yet the 'comfort blanket' of rigour associated with this method represents a major hurdle to the acceptance of non-quantitative methods by practitioners. Benchmarking practitioners are therefore perhaps unwilling to enter the 'swamp'. The dominant use of benchmarking, as a quantitative analytic method, is inadequate for use in this swamp and therefore acts to exclude benchmarking *per se* from entry.

However, what must be guarded against is the acceptance of one method over another. Therefore, what this does not do is demonstrate benchmarking to be invalid as a method for knowledge sharing, only that it may be limited to particular problems such as technical, tame and tactical.

Inability to deal with complexity

The scientific tradition of reductionism (Pritchard, 1968) seems to be inherent in benchmarking methods. Reductionism seeks to reduce a problem to its constituent parts. Through experimenting with and understanding these parts it is considered that an explanation of the 'whole' can be developed. This is evidenced in benchmarking by the need to reduce activity to a level of process that is ultimately measurable.

However, the inability of the scientific approach to address complex social problem situations has led to the emergence of systems thinking (Checkland, 1993). This systems view reveals a further limitation in using benchmarking as a knowledge sharing mechanism. In essence, what is conceded by the dominant reductionism approach to benchmarking is an inability to address problem situations characterised by high levels of complexity. Generally, problem situations grounded in or highly dependent on human activity, are complex and problematic. Thus, complex processes and practices such as design, a complex situation described as a 'mess' by Ackoff (1979), remain outwith the imposed limitations of benchmarking as a useful knowledge sharing method.

Epistemological barriers

Garnett and Pickrell (2000) note that benchmarking should be an interactive social process, which distinguishes it from a positivist epistemology of measurement and observation to that of social constructivism. Benefits to be gained from the latter are outlined by Garnett and Pickrell (2000), however they suggest that benchmarking is still, within the construction industry, focused on the former. The struggle to understand and accept the limitations of positivism within the construction industry as a whole has been argued elsewhere in the construction management literature (Seymour and Rooke, 1995). However, the underlying positivist epistemology of the use of benchmarking in the construction sector is considered here to have profound consequences for the potential to develop an effective knowledge sharing method. The notion that 'we know more than we can tell' (Polanyi, 1966) highlights the need for social interaction to access and understand tacit knowledge and thus indicates a social constructivist epistemology. A positivist approach to benchmarking and knowledge sharing will therefore inevitably restrict the development of useful knowledge sharing methods that captures tacit as well as explicit knowledge.

Context stripping

In challenging the use of various competing paradigms as the basis of inquiry or research, a critique of problems associated with quantification reveal what is termed context stripping (Guba and Lincoln, 1998). This refers to the consequences arising from a research design that uses what is termed a *precise quantitative approach*. Such an approach focuses on a specific set of variables and excludes from the data collection and subsequent analysis the impact of other potentially influential contextual factors. More importantly however is the criticism surrounding the relevance of the findings from such a study to other contexts. Contextually stripping potentially important factors from a study limits the generalisability of the findings to other contexts. In the use of cross-industry benchmarking this criticism becomes crucial since the differences in context may be insurmountable.

Recontextualisation

Knowledge extracted from one context to be converted and adapted to another context is an aspect of knowledge transferability that is addressed and described as 'recontextualisation' by Gavigan et al (1999). They draw on Brannen et al's (1998) study of the transfer of Japanese technology from Japan to the US. What is proposed is an understanding of the need for high degrees of recontextualisation for tacit knowledge when transfer occurs between industrial sectors. It may also be argued that recontextualising knowledge is more akin to a process of knowledge creation (Nonaka and Takeuchi 1995). Adapting and altering knowledge (tacit or explicit) to other contexts alters the knowledge itself in such a way that it represents new knowledge and not necessarily 'tinkered old knowledge' in a new context. Whichever way this is viewed, the notion of the receiving context in knowledge sharing being independent from the knowledge itself must be questioned and addressed. Altering the context rather than the knowledge, whilst most likely improbable in most situations, must also not be overlooked by practitioners. Indeed in some cases this may be the easier of the options to generate the change required. However, the notion of comparing 'apples with apples' inherent in benchmarking seemingly pays little regard to processes or practices characterised and influenced by disparate industrial contexts.

An Alternative Process Of Knowledge Sharing

Based on the above, it is argued that any proposed knowledge sharing method must attempt to address:

- Access to and utilisation of tacit and explicit knowledge
- The inability to separate knowledge from its context(s)
    - Sectoral
    - Organisational
    - Departmental
- The socially embedded nature of knowledge
    - Political
    - Sociological
    - Environmental

  - Historical
- The environment in which sharing and learning takes place
- Complexity
- The dominant industry epistemological position - positivism

The research project 'Sharing Knowledge between Aerospace and Construction Sectors' sponsored by EPSRC at Reading University undertakes to address some or all of these issues. What is proposed is an alternative knowledge sharing method that builds upon the existing benchmarking method within a constructivist epistemology (see Figure 2). The method is informed by Soft Systems Methodology (SSM) (mode 2) (Checkland and Holwell, 1998) – a process of inquiry encouraging the immersion of the researchers into the problem environment. The research will also be conducted in accordance with the principles of *action research*, which aims to contribute both to the concerns of practitioners in a real situation and to the development of knowledge by joint collaboration within a mutually acceptable framework (Rapoport, 1970; Stringer, 1996; Whyte, 1991). As such the method is 'problem driven' in response to practitioners perception of where knowledge gaps exist between aerospace and construction. The action research approach is also intended for the purposes of 'sense-making' (Weick, 1995) rather than as a prescriptive guide to action. It is this emphasis on learning (from the 'means' and not the 'ends') that makes the method especially applicable to knowledge sharing within complex, multi-perspective contexts. The method is to be tested and validated during its iterative application over a period of two years and will be altered and adapted to suit as understanding of its application improves.

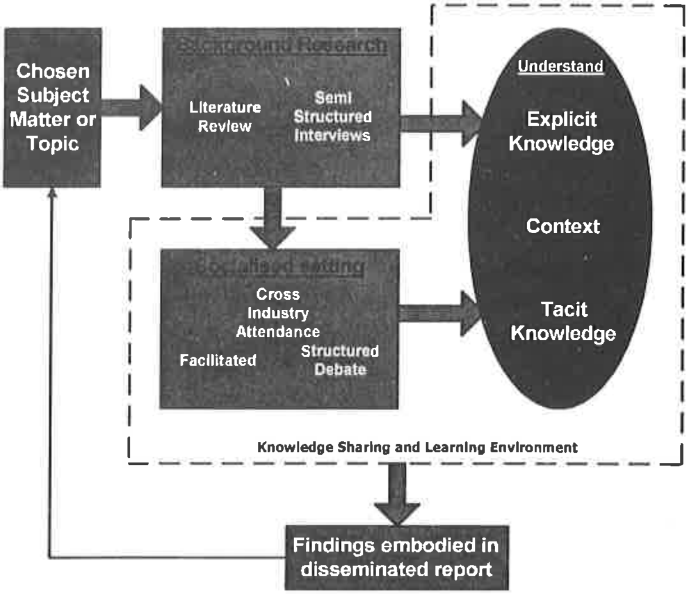

Figure 2: Knowledge Sharing Method

Addressing Context

The method explicitly seeks to avoid the problems associated with the separation of knowledge from its context. Firstly, through the findings in the literature review and the semi-structured interviews, an understanding of knowledge within a specific field is developed. The method goes further by using that information to allow a diverse range of workshop participants from either sector to reflect and debate this understanding in contrast to their own views. The emphasis within the method is to generate understanding through sense-making that acknowledges the socially constructed and culturally embedded nature of participants' perceptions of problems and solutions. Knowledge itself is therefore not artificially isolated from its embedded context.

Accessing Tacit Knowledge

As discussed, the importance of tacit knowledge is highlighted by the difficulty in accessing and sharing it; it is embedded knowledge, and as such is highly contextual. To gain an understanding of the context in which a person operates, it is necessary to access their tacit knowledge. Within our proposed knowledge sharing method this is achieved in three ways. Firstly, through semi-structured interviews we seek to help the interviewees to externalise their tacit understanding regarding the workings of their organisation. The interviews are also used to elicit and code explicit knowledge. Secondly, the workshop setting creates a knowledge-sharing environment in which the participants will use reflection and debate to create new shared and tacit knowledge. Thirdly, the process of generating and disseminating discussion documents throughout the knowledge sharing cycle allows for a further process of reflection and debate.

Creating the knowledge-sharing environment

The rationale behind the workshop setting is derived from Nonaka and Takeuchi's (1995) notion that through a shared environment participants from different contexts can share their knowledge. To share this knowledge, each participant must adopt similar mental models, influenced by the environment. Through debate and reflection, current tacit and explicit knowledge will be built upon to create new knowledge, which is shared. Socialisation therefore creates a shared context in which all participants undergo a shared experience and the workshop setting provides this context. Presentations by members of the research team generate the shared experience for the workshop participants. This shared experience creates shared mental models, which will set the parameters for communication. Communication occurs through debate, allowing for previously nonverbalised knowledge to be built upon and the resulting new knowledge to be made explicit, making it a process of externalisation. This externalised (explicit) knowledge will be captured and codified in the form of a report, prepared after the workshop for dissemination to all industrial partners. From this combination phase it is hoped internalisation will occur through the absorption of the report by the industrial partners, and by the potential implementation of any changes resulting from the cycle findings and workshop discussions. It is hoped that through practical application, internalisation will be achieved (Polanyi, 1966; Nonaka & Takeuchi, 1995).

Initial Application

The project is divided into six cycles, each exploring a topic relevant to both industries. Supply chain management (SCM) was chosen as the topic of this first cycle. Using Checkland's (1993) understanding of the inability to determine the efficacy of methodology *per se*, we find in the application of our knowledge sharing method a similar issue. However, as the premise of the method as a process of inquiry is to bring understanding and 'sense-making' to problem situations, the notion of quantifiable measures of success would be both subjective at best and impossible at worst. Bringing understanding and sense-making to a problem situation like supply chain management, it is argued, allows project participants to understand what actions can be taken and the possible consequences of those actions within context.

Findings

The initial findings from the first research cycle revealed many insights into knowledge sharing and supply chain management. It is not the authors' intentions to cite all of the findings here but to concentrate on one of the more general findings. This highlights the consequence of this 'sense-making' process of inquiry and the 'usefulness to participants' to be gained from the application of this alternative knowledge sharing method.

Evident within the literature is the notion of a split between the application of supply chain management on projects or in the context of strategic business. Support for this was found in the interviews, where a distinction between the sectors could be established such that construction relates supply chain management to projects, and aerospace takes a broader perspective that embraces both projects and strategic business management.

During debate and reflection in the workshop between the diverse range of participants from aerospace and construction it was noted that the structures of the aerospace and construction sector differed. They were described respectively as either 'tidy' or 'fragmented'. Tidy related to the limited number of players in the aerospace sector, which was perceived to positively impact on their ability to implement and operate a cohesive and generally widespread supply chain management philosophy. Fragmentation in the construction sector on the other hand, due to the large number of players and low barriers to entry, was viewed to be a barrier in this respect. It was considered that this fragmentation in the construction sector is due to short-term project mentality and/or the absence of consolidation and segmentation within the construction sector, which has been achieved within the aerospace sector. This cannot be wholly substantiated since it can equally be argued that short-term project mentality embedded within the construction sector supports a market in which there are low barriers to entry, large numbers of players and a high degree of fragmentation. Nonetheless, it is clearly evident that implementation and application of supply chain management in each sector is shaped and influenced by industry context and the related project or business perspective.

Conclusion

In this paper the authors have argued that the use of benchmarking to achieve cross-sectoral learning has specific limitations that require careful consideration by practitioners. Processes and practices developed within an industry or organisation are the product of their own environment, being influenced by economic, social, technological, legal, environmental and structural factors. As such, any knowledge of these practices must be viewed within the context in which they are developed. Furthermore, knowledge of these processes and practices will not only be present in documented, easily accessible and codifiable form. The unspoken, tacit understanding of how an organisation works can be accessed through the intervention of socialised processes. These processes occur within a shared environment, the complexity of which is not captured by current practice. Benchmarking's emphasis on measurement and reduction omits the use of such methods, and thus fails to capture and share this tacit knowledge.

Drawing on the limitations of benchmarking, a method for a contextually sensitive knowledge sharing method has been proposed and initially tested within the first cycle of a two-year research project. The findings support the authors' initial assumption of the role context plays in knowledge creation and sharing. This is partially evidenced by the workshop findings, which highlight some of the more critical contextual factors within which supply chain management knowledge is embedded. The findings also indicate within the domain of supply chain management that those in the construction sector need to be aware of their own industry sector context, and the limitations this places on the development of supply chain management.

This knowledge sharing method will be reviewed and subject to further testing over more research cycles. It is proposed that this insight will allow the generation and development of a robust knowledge sharing mechanism for use both across and within most industry sectors.

References

Ackoff, R.L. (1979) "The future of Operational Research is past", *Journal of Operational Research Society,* Vol. 30, pp189 - 199

Brannen, M.Y., Liker, J.K. & Fruin, W.M., (1998) "Recontextualisation and Factory-to-Factory Knowledge Transfer from Japan to the US.: The Case of NSK" in Liker, J., Fruin, M. Adler, P., (Eds) (1998) *Remade in America: Transplanting and Transforming Japanese Production Systems*, Oxford University Press, UK

Bresnen, M. (1999) "Linking Construction Research to Research and Innovation in Other Sectors: Institutional and cultural barriers to effective knowledge transfer", *CRISP publication*

Camp, R. C., (1989) *Benchmarking: The search for industry best practices that lead to superior performances*, American Society for Quality – Quality Press, Milwaukee, USA.

Checkland, P. & Holwell, S. (1998) *Information, Systems and Information Systems*, Wiley: Chichester.

Checkland, P. (1999) *Soft Systems Methodology a 30-year retrospective*, John Wiley & Sons, Ltd, London

Checkland, P., (1993) *Systems Thinking, Systems Practice*, John Wiley & Sons, Ltd, London

Codling, S., (1992) *Best Practice Benchmarking: The management guide to successful implementation*, Industrial Newsletters Ltd, Toddington, UK.

DETR (1998). *Rethinking Construction*. Department of Environment Transport and the Regions.

Egbu, C. & Sturges, J. (2001) "Knowledge management in small and medium enterprises in the construction industry: challenges and opportunities", Paper presented at *Managing Knowledge Conference*, University of Leicester, 2001.

Egbu, C. O. (2000) The role of information technology in strategic knowledge management and its potential in the construction industry. Proceedings of UK National

Conference on Objects and Integration for Architecture, Engineering and Construction, BRE, Watford, UK, 13-14 March, pp106-114.

Fernie, S, Weller, S., Green, S., Newcombe, R. & Williams, M. (2001) "Learning across business sectors: context, embeddedness and conceptual chasms" *ARCOM Annual Conference proceedings*, Salford, UK

Garnett, N. & Pickrell, S. (2000) "Benchmarking for Construction: Theory and practice", *Construction Management and Economics*, Vol.18, No.1, pp 55-63.

Gavigan, J.P., Ottitsch, M. & Mahroum, S, (1999) "The Futures Project, Knowledge and Learning: Towards a learning Europe", *European Commission Directorate – General JRC Joint Research Centre, Institute for prospective technological studies, TECS Futures programme*

Guba, E.G. & Lincoln, Y.S., (1998) "Competing Paradigms in Qualitative Research" in Denzin, D.K., Lincoln, Y.S., (Eds) (1998) *The Landscape of Qualitative Research: Theories and Issues*, Sage Publications, California, US

Latham, M. (1994). *Constructing the Team: Joint Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry*. HMSO, London.

Madigan, D. (1997) "Benchmark Method", *Agile Construction Institute*, University of Bath, Bath.

Male, S., Kelly, J., Fernie, S., Gronqvist, M. & Bowles, G. (1998a) *The value management benchmark: A good practice framework for clients and practitioners*, Thomas Telford, London.

Male, S., Kelly, J., Fernie, S., Gronqvist, M. & Bowles, G. (1998b) *The value management benchmark: Research results of an international benchmarking study*, Thomas Telford, London.

New, Stephen J., (1997), "The scope of supply chain management research", *Supply Chain Management*, Vol.2, Issue 1, ISSN 1359-8546

Nonaka, I. & Takeuchi, H. (1995) *The Knowledge-Creating*

Company, Oxford University Press: UK.

Pettigrew, A. M. (1997) "What is a processual analysis?", *Scandinavian Journal of Management*, **13** (4), pp.337-348.

Pickrell, S., Garnett, N. & Baldwin, J (1997) *Measuring up: A practical guide to benchmarking in construction*, Construction Research Communications Ltd: Herts, UK.

Polanyi, M. (1966) *The Tacit Dimension,* Routledge & Kegan Paul Ltd: London, UK.

Pritchard, H.A., (1968) "Descartes' "Mediations" " in Doney, W. (Ed.) (1968) *Descartes: A Collection of Critical Essays*, London, Macmillan

Rapoport, R. N. (1970) Three dilemmas in action research, *Human Relations*, **23**, 499-513.

Ravetz, J.R. (1971) *Scientific Knowledge and its Social problems*, Oxford University Press, Oxford,

Ritell, H.W.J. & Webber, M.M. (1973) "Dilemmas in a general theory of planning", Policy Science, Vol. 4, pp155 – 169

Rosenhead, J. (1989) "Introduction: old and new paradigms of analysis", in Rosenhead, J. (Ed.)(1989) *Rational Analysis for a Problematic World: Problem Structuring Methods for Complexity, Uncertainty and Conflict*, John Wiley and Sons, Chichester, pp1 – 20

Sackmann, S.A. (1992) "Culture and subcultures: an analysis of organisational knowledge", Administrative Science Quarterly, Vol. 37, No. 1, pp140 – 161

Scarborough, H., Swan, J. & Preston, J. (1999) *Knowledge Management and the Learning Organisation*, London: IPD

Schön, D.A. (1983) *The Reflective Practitioner: How professionals think in action*, Basic Books, Inc.

Seymour, D. & Rooke, J. (1995) "The culture of the industry and the culture of research", *Construction Management and Economics*, 13, pp 511-523

Spendolini, M.J. (1992) *The Benchmarking Book*, New York, AMACOM

Stringer, E. T. (1996) *Action Research: A Handbook for Practitioners*, London: Sage.

Watson, G.H., (1993) *Strategic Benchmarking: How to rate* *your company's performance against the worlds best*, John Wiley and Sons, London.

Weick, K.E. (1995) *Sense-making in Organisations*, Sage Publications, California

Whitley, E. A. (2000) "Tacit and Explicit Knowledge: Conceptual Confusion around the Commodification of Knowledge", Paper presented at the *Knowledge Management: Concepts and Controversies conference*, University of Warwick, February 2000.

Whyte, W. (ed) (1991) *Participatory Action Research*, Newbury Park, CA.

Wolfram Cox, J. R., Mann, L. & Samson, D. (1997) "Benchmarking as a mixed metaphor: Disentangling assumptions of competition and collaboration", *Journal of Management Studies*, Vol. 34, Issue 2, pp285 - 314

Zairi, M., (1992) *Competitive Benchmarking: An executive guide*, Technical communications (publishing) Ltd.

Optimal Sequencing of Information Flow on Fast-Track Projects

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Abstract

The sequencing of design and construction activities on a fast-track project is a challenging task as the two phases overlap. The design structure matrix (DSM) technique is a structured approach that has been used sequence activities in a number of engineering disciplines. This work extends the conventional design structure matrix by quantifying the precedence relationships between documents. The factors identified for quantification of the precedence relationship are criticality of information, accuracy of estimate, sensitivity to change and change propagation potential. The quantified relationships are used as an input for sequence optimization. The optimization is done using a permutation based genetic algorithm. It was found that the numerous options can be used for the quantification process and it should be finalized based on user requirements. Once the precedence relationship is quantified appropriately, the genetic algorithm approach was able to generate the optimal sequences very rapidly.

Keywords: information flow, fast-track, precedence relationships, sequence optimization, genetic algorithm

Introduction

The reduction of project duration is one of the primary objectives of project management. One of the strategies used to achieve this objective is to execute projects using the fast-track concept where, project duration is shortened by overlapping

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the design and construction phases. In the conventional type of projects, design is complete before construction starts. On fast-track projects the construction begins when design is 55% - 70 % complete. This poses numerous management challenges[5].

One of the key challenges is that the sequence of flow of deliverables between the Engineering, Procurement and Construction activities have to be synchronised. However, as the designer, vendor and contractor view the projects differently, it has been found that the natural sequence of executing the work activities are different in each of these phases. As a result of differing natural sequences in each phase and inherent uncertainty in the fast-track concept, it has been found that on numerous projects items to be installed as per the construction schedule items might be still undergoing design or fabrication. In contrast, items scheduled later in the construction phase might have been delivered and will be taking up storage space at the site. Thus there is a need for a tool which can assist in the coordination of deliverable flows within and between the phases.

A tool which has been applied for scientifically managing the sequencing task is the Design Structure Matrix (DSM) developed by Steward [4]. In the conventional application of this tool, the suitability of a particular sequence is evaluated based on the number of violations of precedence relationship between the different tasks. In reality, there are numerous other factors govern the suitability of a sequence. Work done by VTT Building Technology Group in Finland [3] and Department of Civil Engineering, Loughborough University, U.K [1] extended the DSM techniques by considering factors relevant to construction design projects.

This paper further extends these concepts to cover other factors that can influence sequence suitability and outlines a methodology for suitability evaluation. The paper also describes a Genetic Algorithm approach to determine the optimum sequence of activities. A description of the implementation of the optimization technique in the Evolver environment and the results from sample cases is also presented.

Design Structure Matrix

The primary objective of the Design Structure Matrix is to determine a good sequence in which interdependent/iterative activities can be executed. The methodology primarily consists of the following steps:

1. Develop initial matrix and identify precedence relationships
2. Apply partitioning algorithms to minimize assumed inputs and identify iteration cycles
3. Perform matrix tearing to reduce risks of errors in assumed inputs

Figure 1 shows a sample design structure matrix. The rows and columns represent the activities to be performed and are arranged in the sequence of execution. Each cell of the matrix contains a binary value; one state (x) represents the presence of a precedence relationship between the activity on the column to the activity on the row. The second state represents no relationship. For the project represented in the Figure, activity B requires input from activity A. Further activity A & B has a cyclic relationship as A also requires input from B .

	A	B	C	D
A		X		
B	X		X	
C	X			
D		X	X	

a. Before Partitioning

	A	C	B	D
A			X	
C	X			
B	X	X		
D		X	X	

b. After Partitioning

Figure 1. Design Structure Matrix Representation

In such a representation, all relationships above the matrix diagonal will represent a precedence violation. The objective of the partitioning step is to re-sequence the activities such than a precedence violations are minimized. If there are cyclic relationships in the project, it will be impossible to re-sequence without violating precedence. The tearing step identifies the precedence relationships that can be retained above the diagonal while identifying cyclic blocks of activities which need to be done iteratively.

A key limitation in the conventional approach is that the strength of the precedence relationships is not quantified. In the tearing step the planner is expected to identify tearing locations based on a subjective quantification, but the overall methodology does not rely on quantified inputs.

To overcome this limitation Austin et al. proposed classifying the precedence relationship into 3 classes A,B & C based on the criticality of input [1]. The classes are defined as follows:

Class A It is essential to a task that class A information is available before its commencement.

Class B It is not essential to a task that Class B information is available before its commencement but it would be preferable.

Class C It is not essential that Class C information is available before its commencement.

Extensions

In this work, in addition to criticality of input, the following three factors that influence the precedence relationship have been modeled.

1. Accuracy of estimate of input
2. Sensitivity to change in input values

3. Change propagation potential of input values

The accuracy of the estimate models the degree to which an assumed value is likely to be close to the final value used for design. This factor can be either estimated based on the designer's experience or using a historical database. The extremes values for this factor are (i) the assumed input values is likely to be close to actual value. (ii) The assumed is very unlikely to be close to the actual value. Intermediate values to represent the expected degree of closeness can also be modeled but was not considered for this study.

The sensitivity variable models how sensitive the design process is to a change in the value being assumed. In a two point rating, one extreme would be the downstream design is very sensitive to any change in input values and the other extreme that the design is insensitive to any change in input values. For this factor too, intermediate values can be modeled but only the two extreme values were considered.

Change propagation potential is the degree to which change in an input value can cause change across documents in the overall design process. While the earlier factor models the sensitivity to change, this factor models the extent to which the change can influence the design process. The extreme values for this factor vary between changes only to the immediate successor document, and change in documents even in the construction phase.

Using this approach if a precedence relationship has to be violated by assuming the input values, an estimate of the above factors and criticality should be made. As discussed earlier, the scale to estimate the significance of each factor can be defined based on the users requirements. In this study a two-point scale was used for each of the variables. Thus a total of $2^4 = 16$ combinations on the nature of the input are possible. Each combination is assigned a numerical value based on the impact the assumed input will have on the design process.

For example, a non-critical input, which can be estimated accurately, and has a little sensitivity and error propagation potential will have a low numerical rating. While a critical input, which cannot be estimated accurately, and is sensitive and has a high error propagation potential will have a high numerical rating. The rating system used for this study is a simplistic approach. It was deliberately chosen for this initial exploratory study. More sophisticated rating systems based of a Fuzzy Logic approach utilizing linguistic inputs can also be explored.

Genetic Algorithms

Genetic algorithms are a stochastic search approach for optimization based on evolutionary concepts. The method has been widely used in a number of problem domains and has been proven to yield near-optimal solutions although it searches only a small fraction of the total solution space. The basic issues in designing and implementing a genetic algorithm are encoding strategy and fitness evaluation. A simple genetic algorithm converges to the best solution by iteratively executing the following three steps: selection (Reproduction), cross-over and mutation.

Encoding strategy involves the representation of the solution values in a string format. The encoding in a string format enables the operations such as crossovers and mutation to be performed. For example, the integer 50 can be represented as a binary string 110010. The string is equivalent to a chromosome and each of the digits are equivalent to the genes. The normal method for conversion to binary and converting back can be used for the encoding and decoding purpose. For the current problem a solution string can be represented as a string containing the activity numbers in the sequence in which they are to be performed. This is commonly referred to as the permutation problem.

The fitness evaluation approach is based on the problem domain. The decoded value of a solution string is evaluated to determine the goodness of the solution and this is a relative indicator of the performance of this solution string compared to the others. The strings with a better values of fitness are considered to be closer to the optimal solution. For the current problem, a specific sequence is evaluated in terms of the disruption the out of sequence (above diagonal) relationships will cause to the project. The fitness is basically calculated as the sum of the numerical values of the violated precedences. In addition weightage is also given to minimize the size of the iteration loops within the design process.

The iterative steps in the genetic algorithm process are fairly standard. This process is shown in Figure 2. Reproduction is a process in which strings are duplicated according to their fitness. In each generation of the GA process, the strings (solutions) with higher fitness are retained based on a stochastic selection process.

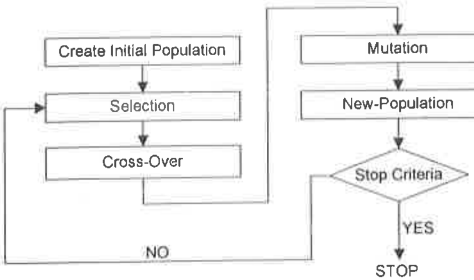

Figure 2. Simple GA Process

Parent-1 110 011	*Offspring-1* 110 010
⇕	
Parent-2 101 010	*Offspring*-1 101 011

Figure 3. Crossover Operation

These selected strings have the opportunity to exchange genes (bits strings) with other selected strings in the crossover operation. In a simple cross-over operation, two strings are selected and corresponding location for crossover is randomly selected and the genes are swapped as shown in Figure 3. The resulting set of strings form the new generation of solutions. A few individuals in this group are subject to random mutation where one of the bits is switched from 0 to 1 or 1 to 0. This new generation of solutions is subject to the selection, crossover and mutation operators in an iterative manner. The process is stopped when the improvement in fitness over successive generation is less than a stipulated value or the iterations have been run for a specified number of generations.

Only a basic concepts and operators of the simple genetic algorithm have been discussed in this section. The sequencing problem falls into the category of permutation problems that have a specialized set of crossover operator options, these are implemented in the Evolver software package and the concepts are covered in detail by Goldberg [2].

Evolver Features

Evolver is a spreadsheet based genetic algorithm solver. Initially, basic spreadsheet features are used to define the optimization problem in a format readable by Evolver. Next, the different options available in Evolver are utilized to select the GA operators to be utilized and the functions of Evolver are invoked to solve the problem.

In the spreadsheet, the Design Structure Matrix is represented spreadsheet cells. By selecting the permutation option in Evolver, the sequence of the activities is defined to be the variable for optimization. The fitness of a sequence is based on the total sum of the penalties due to out of sequence relationships i.e. relationships above the diagonal of the matrix. The penalty values are calculated based on the logic

discussed in Section 3.
When the GA is run, the average fitness of the population at each generation and the maximum fitness encountered is tracked. The GA iterations are stopped based on specified criteria and the best sequence generated until then is written back to the spreadsheet.

Case-Study & Results

The modified DSM approach was applied to a sample problem. This example is based on a problem that was initially formulated by Austin et al[1]. It consists of the design activities for a plant room. The different activities are shown the Table 1.

ID	Activity·
A	G.F. Calculations
B	G.F. Drawings.
C	Found. Calculations
D	Found. Drawings
E	Col Case Drawings
F	AHU Drawings
G	Duct Drawings
H	AHU/Duct Calculations
I	Mezzan. Slab Calculations
J	Mezzan. Slab Drawings
K	Mezzan. Steel Calculations
L	Column Size Calculations
M	Brick Wall Detail Drawings
N	Steelwork Plan Drawings
O	Steelwork Detail Drawings.
P	Elec. Switchgear Calc.
Q	Elec. Switchgear Drawings.

Table 1. Activities Considered for Case Study [1]

The penalty for violating the predecessor relationships are quantified based on the modified methodology. These values are summarized in the matrix shown in Figure 5a. The matrix

a. <u>Prior to Sequence Optimization</u>

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
A		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.90**	0.00	0.00	**0.88**	0.00
B	**0.99**		0.00	0.00	**0.61**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.97**	0.00	0.00	0.00	**0.73**
C	**0.97**	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.62**	0.00	0.00	0.00	0.00	0.00
D	0.00	0.00	**0.93**		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.79**	0.00	0.00
E	0.00	0.00	0.00	**0.76**		0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.71**	0.00	**0.69**	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00		0.00	**0.94**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G	0.00	0.00	0.00	0.00	0.00	**0.80**		**0.89**	0.00	0.00	0.00	0.00	0.00	**0.64**	0.00	0.00	0.00
H	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	**0.45**	0.00	0.00	**0.84**	0.00
I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.50**		0.00	**0.89**	0.00	0.00	0.00	0.00	0.00	0.00
J	0.00	0.00	0.00	0.00	0.00	**0.53**	**0.74**	0.00	**0.93**		0.00	0.00	0.00	**0.76**	0.00	0.00	0.00
K	0.00	0.00	0.00	0.00	0.00	**0.76**	0.00	**0.93**	**0.86**	0.00		0.00	0.00	0.00	0.00	0.00	0.00
L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.76**		0.00	0.00	0.00	0.00	0.00
M	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.72**	0.00	0.00	0.00	**0.84**		0.00	0.00	**0.82**	0.00
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.91**	**0.56**	0.00		0.00	0.00	0.00
O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.93**	**0.84**	0.00	**0.64**		0.00	0.00
P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.68**	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.93**	

b. After Sequence Optimization

	P	H	Q	F	K	L	N	I	M	G	A	C	O	D	E	J	B
P		**0.68**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H	*0.84*		0.00	0.00	0.00	0.00	0.00	0.00	**0.45**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q	*0.93*	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	*0.94*	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K	0.00	*0.93*	0.00	*0.76*		0.00	0.00	**0.86**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L	0.00	0.00	0.00	0.00	*0.76*		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	0.00	0.00	0.00	0.00	*0.91*	*0.56*		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I	0.00	*0.50*	0.00	0.00	0.89	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M	*0.82*	*0.72*	0.00	0.00	0.00	*0.84*	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G	0.00	*0.89*	0.00	*0.80*	0.00	0.00	*0.64*	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
A	*0.88*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.90*	0.00		0.00	0.00	0.00	0.00	0.00	0.00
C	0.00	0.00	0.00	0.00	0.00	*0.62*	0.00	0.00	0.00	0.00	*0.97*		0.00	0.00	0.00	0.00	0.00
O	0.00	0.00	0.00	0.00	*0.93*	*0.84*	*0.64*	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	*0.79*		0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.71*	0.00	0.00	0.00	*0.69*	*0.76*		0.00	0.00
J	0.00	0.00	0.00	*0.53*	0.00	0.00	*0.76*	*0.93*	0.00	*0.74*	0.00	0.00	0.00	0.00	0.00		0.00
B	0.00	0.00	*0.73*	0.00	0.00	0.00	0.00	0.00	*0.97*	0.00	*0.99*	0.00	0.00	0.00	*0.61*	0.00	

Figure 4. DSM for case study

after the genetic optimization is shown in Figure 5b. The solution space for this optimization consists of 17! = 3.55687E+14 possible outcomes. The genetic algorithm converged to the shown solution in a few seconds.

It can be seen that in the sequence generated, the overall impact of the values above the diagonal is minimal. This sequence gives a base from which further common sense based re-sequencing can be attempted if required. The sequence obtained here cannot be directly compared with that obtained by Austin et al.[1] as the input values are different.

Conclusions

This study investigated the extension of the Design Structure Matrix methodology by including a number of factors that influence the numerical estimates such as accuracy of estimate, sensitivity to change and change propagation potential. It was found that in order to quantify these factors either extensive detailed historical database is required or a reliable method of elicitation from experts. Further work is being done on investigating methods to assist with this quantification.

A second aspect of this study was the utilization of genetic algorithms approach to find the optimal sequence of activities. This approach was found to yield excellent results within a short time and it is recommended that this should be incorporated into conventional DSM methodology. As the GA is capable of generating multiple solutions the tools can be used to generate sequence options based on which further common sense based sequencing can be carried out.

References

Austin, S., Baldwin, A. and Newton, A. (1994). "Manipulating The Flow Of Design Information to Improve The

Programming Of Building Design", *Construction Management and Economics*, Vol. 12, No. 5, pp 445-455.

Goldberg, D.E. (1989) *Genetic Algorithms in Search, Optimization and Machine Learning*, Addison-Wesley Publishing Longman Inc.

Huovila, P., Koskela, L., Lautanala, M., Pietiläinen, K., Tanhuanpää, Veli-Pekka. (1995). "Use of the Design Structure Matrix in Construction" International Conference on Lean Construction, Albuquerque, October 16 - 17.

Steward, D. (1991). "*Using Information Flow to Manage the Design of Systems*", In IEEE, Portland International Conference on the Management of Engineering and Technology, New York, October, pp. 189-92.

Williams, G.V., 'Fast-track Pros and Cons: Considerations for Industrial Projects', *Journal of Management in Engineering*, Vol. 11, No. 5, 1995.

Evaluation Criteria for Business Process

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Abstract

It is important to develop a process evaluation framework for the Construction Industry, to enable organisations to objectively assess the 'value' of their current process, and to take the 'right' process improvement solutions prior to automation or major re-engineering exercises.

This paper discusses these issues in detail and proposes process evaluation criteria for effective improvements. Five criteria are discussed; *participant-participant interactions* in a project; the nature to which *controls* affect the project processes; *functional dependency* of preceding processes as information changes in processes, *output dependency* of successor processes as processes information revises; and the *iterative nature* by which project processes are completed. Each of the five evaluation criterion developed can be rated on a scale of 0 to 10 (which a process can obtain).

Keywords: Process improvements, process evaluation, evaluation criteria, business process models

Introduction

Information Technology (IT) has found an increasing role in the business practices of organisations, from the need to replace proximity to markets with more effective management of supply chains; to delivering products and services to markets with greater speed; and as a means of accountability and resource allocation, which was previously provided by more formalised structures (BT, 1998; Holtham, 1994; Prasad , 1999).

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The process approach is favoured in investigating efficiency and effectiveness as it provides descriptions of work activities, and places little emphasis on the vertical function boundaries of organisations. It also follows that processes can be mapped or modelled whilst describing the dynamic behaviour of work activities, such as with various views provided by process modelling techniques (functional, behavioural or structural) (Cichoki et al, 1998; Bhatt, 2000). The study detailed in this paper is one such example, set to investigate the efficiency and effectiveness of implementing IT in construction projects through the development of business models.

Business Modelling Techniques

Business modelling of construction practices requires investigation into issues of: information flows, goals, and regulations (such as those arising from statutes or contractual controls) used in the management and implementation of construction projects. The process modelling technique selected must provide sufficient descriptive elements to investigate these issues and, most importantly, allow the analyst to verify the 'correctness' of their information with domain experts and project specialists producing and managing these projects (in order to produce effective and accurate process models). Hence, modelling techniques focused within this study concentrated on Data Flow Diagrams (DFD), Role Activity Diagrams (RAD) and Integration Definition Function Modelling (IDEFØ). It also considered other factors, such as the review gate technique and progress fixity adopted from the Generic Design and Construction Process Protocol (GDCPP) model (Kagioglou et al, 1998) and colour patterns to illustrate project specialists responsible for co-coordinating process information.

The DFD approach models processes with input, output, and source information, but this does not sufficiently model the mechanisms and constraints of a process such as contractual agreements (De Marco, 1979). Furthermore, whilst the RAD technique is suitable for illustrating interactions within a process, this does not however adequately model input and output information necessary for completing a process, which also makes it unsuitable for the study (Ould, 1995). Finally, the IDEFØ technique can be used to identify input and output information together with mechanisms and constraints, and this would normally make it the most appropriate tool for modelling construction information (Ross, 1977; Ross and Schoman, 1977). In stating this however, the IDEFØ notation does not adequately model all aspects required for managing projects.

Thus, establishing the type of information produced and managed in a process is essential, as various types of information needs to be verified and managed in certain ways; for example, verification by an external enforcing body such as a Local Authority (DETR, 2000). In this context therefore, these process models fell short in numerous areas, especially in documenting levels of iterations within processes. This inadequacy could imply a shortfall in process support, but this is essential in order to avoid project specialists using superseded project information. Furthermore, changes in construction technology may also require new isolated sub-processes to enable completion of highly specialist content information in a project (Cox et al, 1999; Muir et al, 1995). In addition, the conventional process models do not accurately reflect the way in which controls influence process completion, such as notification notices to statutory bodies or submission of drawings. However, process models need to analyse issues of controls, especially with the concerns in construction industry vis-à-vis the high levels of conflicts, which reflect on project processes not meeting their controls. In addition, failure to document the level of inter-dependencies between processes means there is usually little or no support, as information is passed to preceding or succeeding processes as process information revises.

Successful IT implementation Issues

There is an increasing need to develop business models that bring about effective IT implementation into the management of projects in the construction industry. Yet, business models already developed, for example: Integrated Building Process Model IBPM (Sanvido, 1992); Concurrent Life-cycle Design and Construction (CLDC) process model (Anumba et al, 1997), have met with limited success. This lack of enabling has led to an increased pressure to produce business models which more accurately reflected the working practices found in the construction industry (Santoyridis et al, 1999; Yusuf, 1997). Thus, this study aimed to overcome these shortcomings by identifying the key enablers and constraints for effectively implementing IT in construction projects through an evaluation framework.

Development of the Evaluation Framework

Development of the evaluation methodology framework had to take into account the possibility of ever-changing management strategies associated with construction projects. Five key evaluation criteria were identified through a series of structured interviews with core specialists in project environments. This investigation was reinforced with domain experts, project stakeholders and an extensive literature review. The key attributes identified numerous issues, including: controls, such as statutes and contracts; and project information issues, such as interdependency and iteration (as these have to be created and verified in order to complete a project). This study identified five key criteria, specifically: *participant-participant interactions*; *controls*; *functional dependency*, *output dependency*; and the *iterative nature* by which project processes are completed.

Criterion 1: Participant-Participant Interactions

Construction players participate in different ways whilst performing in a process, the involvement of which can also change from the start of a project to the completion of a process. Evaluation of the interactions must thus identify the different types of project players interacting, and their importance to the process initiation and completion.

Research on interactions by organisational theorists tend to apply theoretical frameworks to describe these relationships, for example Complexity Theory (to define the richness in information resulting from the number of directly connected elements). The level and 'richness' of interactions can increase significantly from two interacting elements up to an upper limit of eight elements (McKelvey, 1999; Mitleton-Kelly, 1998), the details of which can be seen in Figure 1. In addition, further evidence by organisational theorists includes case studies undertaken on social networking (Rosenthal, 1997; Bodenhausen et al, 1987). These findings support the notion that construction project specialists do not always have direct connections due to the contractual nature of the industry (Ndekugri, 2000). Thus, the criterion itself should only be linked to project participants with 'direct' connections, such as those with direct contractual agreements with the client. Furthermore, whilst this criteria addresses such issues as complexity levels in interacting project players (with a component referred to as the complexity factor – as depicted in Figure 1), this can be scored on a range of 0.10 (for one participant interacting in a process) to a maximum value of 1.00 (for eight participants interacting in a process or more).

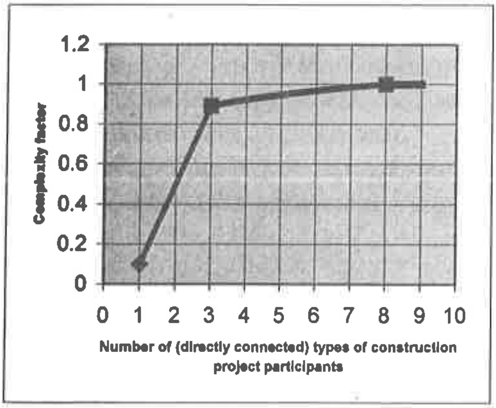
The *evaluation value* for this criterion can be seen as follows:
Initiation values + Completion values = Process criterion evaluation value

Where, the process *initiation* and *completion value* are obtained from averaging participants' involvement and differentiating this value with the complexity factor as illustrated.

$$\frac{\sum_{1}^{i} Z_i}{i} \quad \text{X} \quad \text{Complexity factor} = \textit{Value}$$

Where I = number of participants
Z_i = Participants involvement
Value = *Initiation values & Completion values*

An illustrative depiction of the values for Criterion 1 Participant-Participant Interactions can be seen in Table 1.



NUMBER OF PROJECT PARTICIPANTS	COMPLEXITY FACTOR
1	0.10
2	0.50
3	0.89
4	0.92
5	0.95
6	0.97
7	0.98
8-More Players	1.00

Figure 6 Scale Values for the Complexity Factor (adapted from McKelvey et al, 1999; Mitleton-Kelly, 1998)

Criterion 2: Controls

Construction information is often influenced by obligations arising from controls such as contractual and statutory controls (Uff, 1996). Furthermore, construction players must also try to meet their obligations by documenting information in order to avoid conflicts. Therefore, documenting these obligation *controls* or *constraints* is undertaken to various levels, depending on the process type (and whether these processes are starting or finishing). This criterion should therefore seek to give a value into the difficulty of obtaining this control. The level of difficulty can therefore have an impact on the management strategies employed in the construction project.

Process Name	Participants	Complexity Factor (From the number of players) Mini value for one participants = 0.10 Maxi value for eight or more participants =1.00.	Initialisation importance for each Participant Not Important = 1.0 Very Important= 5.0	Evaluation value for Initialisation of Participant	Completion Importance for each Participant Not Important = 1.0 Very Important= 5.0	Evaluation Value for Completion of Participant	Total Value
Process A	Participant X Participant Y Participant Z Participant K	0.92	5.00 2.00 1.00 2.00	2.30	1.00 5.00 1.00 5.00	2.76	5.06
Process B	Participant X Participant Y	0.50	5.00 5.00	2.50	5.00 5.00	2.50	5.00
Process C	Participant L Participant M Participant N Participant O Participant P Participant X Participant Y Participant Z	1.00	1.00 5.00 1.00 2.00 1.00 1.00 2.00 2.00	1.88	5.00 5.00 3.00 2.00 3.00 3.00 1.00 3.00	3.13	5.01

Table 1 Illustrative Values for Criterion 1 Participant-Participant Interactions

Combining the difficulty factor of obtaining control in process can thus provide a more indicative evaluation of how control can influence the process initiation or completion. For example, a process with important level of control and high levels of difficulty, may require different management strategies compared to processes where controls with a lower level of difficulty and process control.

An example of Criterion 2 can be seen as follows:
Initiation values + Completion values = Process criterion evaluation value

Where:
Process initiation values and completion values are derived from the highest control value obtained by differentiating the importance of a control with the difficulty of achieving the control, as illustrated:
(Control C X Difficulty of achieving control C) > (Control B X Difficulty of achieving Control B) > (Control A X Difficulty of achieving Control A)

Then:
Initiation Value or Completion values = (Control C X Difficulty of achieving Control C).

This can be represented in table format, the details of which are shown in Table 2.

Criterion 3: Functional Dependency

Managing project information in construction often involves making changes to previously completed process information. Most changes or revisions can normally be accommodated within the project scope; however, others may not. This criterion limits these concerns specifically to those within the project scope, since those outside this scope of the project are too numerous – for example, the contractor becoming bankrupt or war occurring (bringing about the necessity to revise succeeding or preceding processes). The amount of information revised depends invariably on the number of the preceding processes revised, which brings in the issues of *complexity* as discussed in Criterion 1 (due to the inter-relationships, interaction and inter-connectivity of the preceding processes and the processes concerned). The *link factor* addresses this complexity, the details of which can be seen in Table 3.

Process Name	Controls Documented	Importance of Documenting Controls for Process Initialisation Not Important = 1.0 Very Important= 5.0	Difficulty in Obtaining for Initialisation Not Difficult = 0.10 Very Difficult = 1.0	Total Value for Process Initialisation	Importance of Documenting Controls for Process Completion Not Important = 1.0 Very Important= 5.0	Difficulty in Obtaining for Completion Not Difficult = 0.10 Very Difficult = 1.0	Total for Process Completion	Total Evaluation Value for the Process
Process A	Contractual Agreements	3.00	1	3.00	-----	-----	-----	**3.00**
Process B	Approval by External H/S body Approval by L/A Planning Contractual Agreements	1.00 1.00 2.00	0.10 0.10 0.10	0.40	2.00 1.00 1.00	0.10 0.10 0.10	0.13	**0.26**
Process C	Approval by external body H/S	2.00	0.10	0.20	2.00	0.10	0.20	**0.40**

Table 2 Illustrative Values for Criterion 2- Controls

Process Name	Processes with Functional Dependencies	FUNCTIONAL Dependency importance to the Preceding process Not Important = 1.0 Very Important= 10.0	Link Factor Mini value for one Preceding process = 0.10 Maxi value for 8-more preceding process = 1.0	Total Evaluation Value For the Process
Process A	Process X	10.0	0.10	**1.00**
Process B	Process X Process Y Process T Process S	5.0 6.0 6.0 5.0	0.92	**5.06**
Process C	Process T Process S	9.0 8.0	0.50	**4.25**

Table 3 Illustrative Values for Criterion 3 – Function Dependency

Criterion 4: Output Dependency

Criterion 4 also addresses issues relating to process information changes and how these can affect other processes. This time however, it aims to address issues relating to the successor processes, where Criterion 3 addressed previously completed process information. Changes to forward processes can often arise from the same factors as identified for Criterion 3, but the *link* factor is replaced in this criterion by a *dissemination* factor, which again represents the richness levels brought about by the interactions of the processes. Even though Criterion 3 and Criterion 4 are interlinked, they are dissimilar and they must be addressed separately (Levitt, 1988; Austin et al, 1994).

Process Name	**Processes with Output Dependencies**	**OUTPUT Dependency importance to the Successor process** **Not Important = 1.0** **Very Important= 10.0**	**Dissemination Factor** **Mini value for one successor process = 0.10** **Maxi value for 8-more successor processes = 1.0**	**Total Evaluation Value For the Process**
Process A	Process X Process Y -	4.0 5.0	0.50	**2.25**
Process B	Process X Process Y Process T Process S	7.0 7.0 6.0 6.0	0.92	**5.98**
Process C	Process T Process S	9.0 8.0	0.50	**4.25**

Table 4 Illustrative Values for Criterion 4: Output Dependency

However, whilst evaluating construction processes consider interdependencies as part of the rationale of completing construction processes. The Criterion 4 Output Dependencies can be seen in Table 4.

Criterion 5: Iteration

This criterion concerns itself with the iterative nature of the processes. Iteration can be considered as ‘normal’ within a construction project and can be triggered by factors external to the project; but again, like Criterion 3 and 4, this limits itself to the iterations of processes within factors ‘normal’ to the construction project. Construction iterations are not dependent on the amount of information created, but on richness levels arising from the types of interactions necessary to complete the process. Processes having numerous types of persons creating their information, together with persons verifying information

for *correctness* (data *correctness* and co-ordination *correctness*) and ensuring *business value* of the project, will have high levels of iterations compared to those processes with one person completing the process.

Process Name	Partic. Types Interacting	INTERACTIONS OF THE PARTICIPANTS								Total Evaln. Value For the Process
		Creating Information Mini value for one participants = 0.50 Maxi value ten participants = 5.0.			Verifying Information Maxi value= 5.00					
		Creating Information (MAX 5)	Complexity factor Mini value – 1 participant = 0.10 Maxi value 10 participants = 1.	Evaln. value for creation info.	Verify correctness Evaluation Value= 1.00		Verify the business value Evaluation Value= 4.00		Evaln. Value For verifying Info.	
Process A	Partic. L	√		4.75					-----	4.75
	Partic. M	√	0.95							
	Partic. N	√								
	Partic. O	√								
	Partic P	√								
Process B	Partic. L	√		4.60		1.00		-----	1.00	5.60
	Partic. M	√	0.92							
	Partic. N	√								
	Partic. O	√								
	Partic. P				√					
Process C	Partic. L	√		4.45		1.00		4.00	9.45	9.45
	Partic. M	√	0.89							
	Partic. N	√								
	Partic. O				√					
	Partic. P						√			

Table 5 Illustrative Values for Criterion 5 –Iterations

A process with one person implies that information might not pass to others to *verify* its *correctness (*or perhaps to appraise the project *business value).* Thus, process iteration is dependent on the types of project specialists directly connected in creating and verifying their information. This criterion establishes the numbers of types of persons creating information. It also establishes whether further persons are needed to interact and verify the information *correctness* (data *correctness* and co-ordination *correctness*) and *business value* of the project, thereby placing a value to iterative levels in a process. A representation of this criterion can be seen in Table 5.

Conclusion

The paper details the importance of developing an evaluation methodology for business process. Whilst several modelling

techniques exist for modelling dynamic behavioural needs of organisations and business environments, it is evident that deficiencies still prevail.

This evaluation methodology was developed from key issues deemed important for managing construction projects using five criterion of *participant-participant interactions, Controls, Functional Dependency*, *Output Dependency* and Iterations. Benefits realised using this evaluation framework have enabled process prioritisation to occur within organisations, an example of which can help develop workflow specifications. Other important benefit realised include the 'sharing of process knowledge' to minimise process anomalies between project specialists, the implications of which can lead to reduced levels of litigation for example.

References

Anumba C.J, Evbuomwan N.F.O, (1997) Concurrent engineering in design –build projects, *Construction Management and Economics* (15), E & FN Spon, pp 271-281.

Austin S, Baldwin A, Newton A, (1994) Manipulating the flow of design to improve the programming of building design, *Construction Management and Economics*, Vol. 12 Number 5 September 1994 pp 445-455.

Bhatt G .D., (2000) An empirical examination of the effects of information systems integration on business process improvement, *Business Process Management Journal* Vol. 5 No 2, MCB University Press, pp 1331-1359.

Bodenhausen.V.G, Gaelick. L, Wyer. R, (1987) *Group thought and Intergroup relations 'Affective And Cognitive Factors In Intragroup and Intergroup Communication'*, Sage, USA.

BRITISH Telecommunications Plc (1998), Appendix 4-Electronic Commerce and a new business Model URL http://www.bt.com/regulate/otherresp/hmgothers/infoage/file6.htm [accessed on 4 February 2001]

Cichoki A, Helal A, Rusinkiewicz M, Woelk D, (1998) *Workflow and Process Automation: Concepts and Technology*, Kluwer Academic Publishers, Boston.

Cox S, Clamp H, (1999), *Which Contract?* Second edition, RIBA Publications.

De Marco T, (1979) *Structured Analysis and System Specification*, Yourdon Inc, New York.

DETR, (2000) *The Building Act and Its Regulations* DETR Consultation Papers http://www.construction.detr.gov.uk/br/index.htm DETR UK [accessed on 2 April 2000].

Holtham C, (1994) *Business Process Re-engineering–Contrast what it is with what it is not, Business Process Reengineering Myth and Reality*, Colin Coulson–Thomas editor pp 60-74

Kagioglou, M, Cooper, R, Aouad, G, Hinks, J, Sexton, M, Sheath, D, (1998), *Final Report: Process Protocol*, University of Salford, UK, ISBN 090-289-619-9

Levitt R, Kartnam N, Kunz K, (1988) Artificial intelligence techniques for generating construction project plans. *Journal of Construction Engineering and Management* Vol3 pp 329-343.

McKelvey B, (1999) Complexity theory in Organizations Science: seizing the Promise or Becoming a Fad, *Emergence.*

Mitleton-Kelly, E (1998) *Organisations as complex evolving systems*, OACES Conference Warwick, 4-5th December 1998

Muir. T, (1995) *Collaborative practice in the built environment*, T. Muir and B. Rance editors, Spon U.K.

Ndekugri I, (2000), Concurrent liability in contract and tort in the construction industry, *Construction Law Journal* Volume 16 Number1, Sweet & Maxwell, UK pp13-30.

Ould M.A., (1995) *Modelling and Analysis for Re-engineering and Improvement*, Wiley, U.K

Prasad B, (1999) Hybrid re engineering strategies for process improvement, *Business Process Management Journal* Volume 5 No 2, MCB University Press, pp178-197.

Rosenthal E, (1997) Social Networks and team performance, *Team Performance Management*, Vol 3 Issue 4, pp 225-242..

Ross D.T, (1977) Structured Analysis (SA: A language for Communicating ideas, *IEEE Transaction on Software engineering*, Vol SE-3, No 1 January.

Ross DT, Schoman KE, (1977) Structured Analysis Requirements Definition, *IEEE Transaction on Software Engineering*, Vol. SE-3, No 1 January.

Santoyridis. I, Carnduff. T.W, Gray. W. A, Miles. J.C, (1999) Assessing a versioning system for collaborative engineering design with bridge design *The Internal Journal of Computer Integrated Design And Construction*, SETO, pp 17-27.

Sanvido. V. E., (1992) Linking levels of Abstraction of a building Design, *Building and Environment*, Volume 27, Pegamon Press Ltd, pp 195-208

Uff J, (1996), *Construction Law*, Sweet & Maxwell, UK.

Verzuh E, (2000), *The fast forward MBA in Project Management: Quick Tips, Speedy Solutions and Cutting Ideas*, John Wiley & Sons, USA.

Yusuf. F, (1997) *Information And Process Modelling For IT Implementation At The Briefing Stage*, PhD thesis, Department of Surveying, The University of Salford.

Web-Based Procurement by the International Construction Industry and the North-South Transfer of Wealth and Technology.

Malcolm Murray[1] & Panos Zagaretos[1]

Abstract

To carry out a construction contract a contractor needs to procure and organise labour, materials, plant and equipment as well as managers, supervisors, foremen and technical and administrative staff. These may be procured in any part of the world where quality is satisfactory and the cost competitive. Construction is being carried out in three major regions, Asia, Europe and North America and there is a tendency for Asia to achieve dominance as a construction market within the next ten years. Construction is being carried out by a relatively limited number of large international contractors and they are establishing systems to procure resources world-wide. The tendency is for main resources to be purchased in the future in the Far East.

Engineering designers, which use skilled human resources, will probably procure these, using electronically-based agencies or strategic partnerships, in the Far East too. Again, most design work is carried out by a relatively small number of American and European companies, but these are increasingly procuring resources globally. Conclusions are drawn and recommendations for further research in the field are made.

Keywords: web-based procurement, north-south wealth transfer, north-south technology transfer

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Introduction

Murray and Appiah-Baiden (2000) and Murray and Mavrokefalos (2000) have described the tendency for an increasing proportion of construction and design contracts to be concentrated in the hands of the top ten international contractors and consultants respectively. Also, the recent trend for large contractors to establish web-based procurement sites (with one case comprising an association of five large contractors) will, it is believed, lead to world-wide construction procurement being dominated by a relatively small number of organizations.

A similar process is occurring in the engineering design industry where large international consultancies are distributing design work throughout the world to take advantage of the lower rates prevalent in developing countries and also to enable production to take place 24 hours a day. Bon and Crosthwaite (2000) have predicted that the Far East, particularly China, will develop as a major construction market in the next years.

At the same time, design and construction contracts are increasingly being advertised on the internet, enabling organisations from all over the world to compete for contracts. Finally, open competition is increasingly being encouraged by the movement to a global, free-trade economy which is being implemented by such organisations as the World Trade Organisation.

It is believed that the above trends will be beneficial to businesses established in developing countries as organisations established in those countries can easily be included in the world - wide design and construction procurement network. This will evidently lead to the transfer of wealth and technology. In the following the current world - wide distribution of design and construction work is examined. The evolution of web - based international construction procurement is described and the probable effects on developing economies discussed.

Procurement By Contractors

Cost item breakdown of construction contracts

To carry out a construction contract, labour, materials, plant and equipment are necessary, as well as supervisory personnel and a number of minor services.

Table 1. Sourcing for a typical international construction contract

	Local	National	International
Labour			
Skilled		N	I
Unskilled	L	N	
Materials			
Cement		N	I
Sand	L	N	
Crushed stone	L	N	
Formwork		N	I
Reinforcement		N	I
Structural steel		N	I
Plant and equipment			
Earthmoving			I
Trucks		N	I
Concrete			I
Lifting and placing			I
Indirect items			
Managers and supervisors		N	I
General foremen		N	I
Foremen	L	N	
Technical staff		N	I
Administrative staff		N	I
Offices and other buildings	L	N	I
Financial services		N	I
Transport		N	I

The above may be transferred from the contractor's existing organisation (for example experienced managers and concrete batching plants) or may be procured internationally (for example, cement, reinforcing steel and engineers). Some items may be procured locally, such as labour, sand and crushed stone. Table 1 lists items of a typical construction contract which contribute more significantly to the total cost and indicates from where they may be procured, locally, nationally or internationally.

Where is construction being carried out?

Murray and Zagaretos (2001) have shown the distribution of construction spending by region, as reproduced in Table 2.

Table 2: Construction spending by region, 2000

Region	Construction spending US$ billion	Percentage
Asia	1.113,5	32.6
Europe	1.016,6	29.8
North America	884,5	25.9
Latin America	241,4	7.1
Middle East	101,2	3.0
Africa	56,1	1.6
Total	3.413,3	100.0

Source: ENR

This spending is, according to Engineering News Record, from which the figures are derived, " ... spending and investment ... for each year from 1998 to 2000". From the table, it can be seen that about 33% of recent construction spending took place in Asia, 30% in Europe and 26% in North America. Murray (2000) has indicated that by 2010 the largest construction market in the world is expected to be China, closely followed by the United States and Japan.

Table 3 has been adapted from that paper and shows the expected construction investment in 2010, by region, for the top ten markets. The expected growth of the Asian market is evident.

Table 3. The largest regional construction markets in 2010 (based on the top 10 countries)

Region	Construction investment US$ billion	Percentage
Asia	2.326	46
Europe	1.586	31
North America	959	19
South America (Brazil)	202	4
Total	5.073	100

Who are the international contractors?

Table 4, again extracted from Murray and Zagaretos (2001), shows the revenue of international contractors by home region of the contractor. Asian contractors head the list with 42% of the total turnover, followed by Europeans with 37% and North Americans with 19%. Japanese contractors account for 70% of the turnover of the Asian contractors, Chinese contractors 18%.

Table 4. Total revenue of top 225 international contractors, 1999

Home region of contractor	Total revenue US$ billion	Percentage
Asia	151,325.1	41.7
Europe	133,492.4	36.8
North America	69,564.4	19.1
Latin America	2,932.6	0.8
Middle East	3,707.3	1.0
Africa	2,010.0	0.6
Total	363,031.8	100.0

Source: ENR

Procurement systems

The advertising of tender opportunities on the internet by government authorities is becoming usual; examples of agencies that use this procurement vehicle are Mozambique's National Road Administration (www.dnep.gov.mz).

A consortium of 16 mining houses have announced the establishment of a joint procurement system (www.mmprocurement.com) and they have been followed by contractors. In late 2000 a joint web-site was launched by Skanska of Sweden, Hochtief of Germany, Amec and Bovis Lend Lease of the UK and Turner of the USA (www.aecventure.com). Between them these companies employ over 100.000 people and have a turnover in excess of US$ 25 billion.

On the suppliers' side a number of web sites have been established offering equipment for sale, by negotiation or auction (www.yellowtrack.com).

Consequences. The results of world-wide procurement being carried out by a limited number of very large international contractors or consortia of contractors can be seen by examining trends in the procurement of key construction resources.

a. Semi-skilled labour

With on-going drops in transport costs it is becoming usual to recruit semi-skilled labour in countries such as Thailand, Pakistan and the Philippines, especially for work in Middle-Eastern countries and Malaysia. The beneficial effects of the flow of wages of migrant workers back to their countries of origin has been registered by economists. Examples of this are Portuguese workers who have worked in France and Turkish guest-workers in Germany: the economies of Portugal and Turkey are believed to have been sustained in the past by remittances sent home by the workers.

b. Cement production

Table 5 and Figure 1 show the world production of cement by the top 15 countries in 1998. The dominance of China is evident. Figure 2 shows the evolution of the production of cement from 1993 to 1999 for selected countries. Again, the growth of production in China is in evidence, with the

Table 5. World cement production of top 15 countries (in thousand metric tons)

Country	1993	1994	1995	1996	1997	1998	1999	Total	%
China	367,880	421,180	475,910	491,190	511,730	513,500	520,000	3,301,390	44,1
Japan	88,046	91,624	90,474	94,492	91,938	81,328	80,000	617,902	8,3
United States	75,117	79,353	78,320	80,818	84,255	85,522	87,300	570,685	7,6
India	53,812	57,000	62,000	75,000	80,000	85,000	87,000	499,812	6,6
Korea	47,313	50,730	55,130	58,434	60,317	46,791	55,000	373,715	5,0
Brazil	24,843	25,230	28,256	34,597	38,069	43,000	43,000	236,995	3,2
Germany	36,649	36,130	33,302	31,533	35,945	36,610	37,000	247,169	3,3
Turkey	31,241	29,493	33,153	35,214	36,035	38,200	37,000	240,336	3,2
Thailand	26,870	29,900	34,900	38,600	37,309	30,000	34,000	231,579	3,1
Italy	33,771	32,713	33,715	33,327	33,721	35,000	35,000	237,247	3,2
Spain	22,878	25,150	26,423	25,157	27,632	27,943	28,000	183,183	2,4
Mexico	27,120	29,700	23,366	25,366	27,548	27,744	30,000	190,844	2,6
Russia	49,900	37,200	36,500	27,800	26,700	26,000	27,000	231,100	3,1
Indonesia	18,934	21,907	23,129	25,000	27,500	22,000	25,000	163,470	2,2
Taiwan	23,971	22,722	22,478	21,537	21,522	19,538	21,000	152,768	2,0

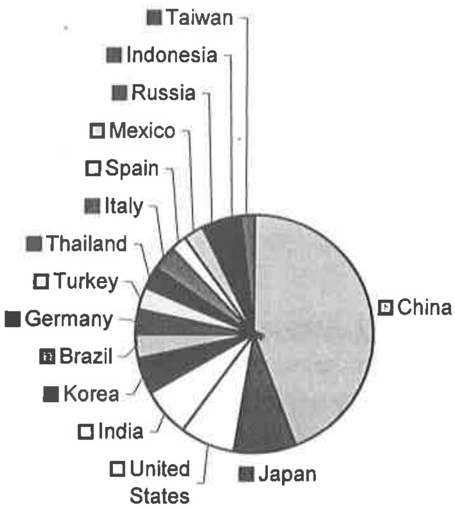

Figure 1. World production of cement by the top 15 countries 1993 – 1999

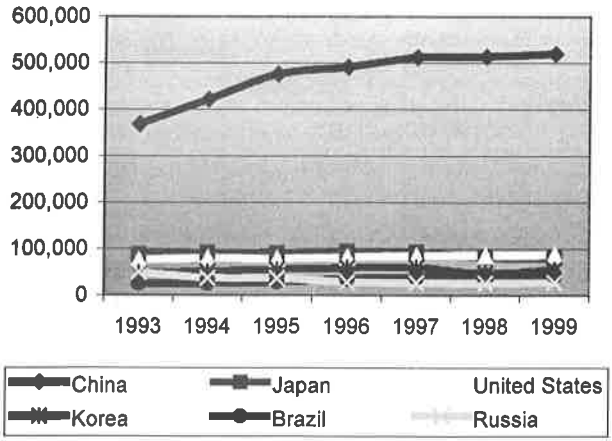

Figure 2. Evolution of production of cement (in thousand metric tons)

production of cement by the other five countries showing negligible change (www.global-cement.dk/files/facts.htm).

The top 15 cement-producing countries accounted for over 70% of the world total production in 1998. The countries are, in descending order, China, Japan, the United States, India, the Republic of Korea, Brazil, Germany, Turkey, Thailand, Italy, Spain, Mexico, Russia, Indonesia and Taiwan. Of the 15, nine have developing status and seven are from the Far East. It is believed that, as construction work continues to shift to the Far East, procurement of cement will take place in countries of that region.

c. Steel consumption

Table 6 shows world steel consumption from 1999 to 2001 and Figure 3 shows the data in graphical form. China is the second major producer with 19,4% of the production and Far Eastern countries (China, Japan, other Asian, Korea and Taiwan) account for 46,2% of the total. Figure 4 shows the growth of world steel consumption from 1999 to 2001 of seven selected countries and regions. Again, these data indicate the importance of the Far Eastern countries in steel consumption; it is believed that these figures mirror steel production and hence regional production capacity.

d. Equipment

Multinational equipment manufacturers will inevitably establish plants in countries where construction booms are forecast. Caterpillar (www.cat.com) exported in 1999 US$ 5,2 billion worth of construction equipment with half of its sales being outside the United States. The company has manufacturing capabilities in 18 countries outside the United States in Australia , Belgium, Brazil, Canada, China, France, Germany, Hungary, India, Indonesia, Italy, Japan, Mexico, Northern Ireland, Poland, Russia, Sweden and the United Kingdom. Five of these are in developing countries and four in the Far East.

Country	1999	2000	2001 (est)	Total	%
EU 15	138.00	144.20	144.80	427.00	20,0
China	130.80	137.00	147.00	414.80	19,4
United States	110.70	114.90	114.80	340.40	15,9
Japan	68.90	73.80	73.30	216.00	10,1
Other Asian	56.50	61.20	62.30	180.00	8,4
Korea	34.00	38.60	40.40	113.00	5,3
Other European	31.80	33.70	35.40	100.90	4,7
South America	10.60	27.40	29.00	67.00	3,1
Taiwan	20.40	21.60	22.50	64.50	3,0
Russia	16.90	17.70	18.00	52.60	2,5
Middle East	15.10	16.20	16.40	47.70	2,2
Brazil	14.10	15.80	16.80	46.70	2,2
Africa	14.80	15.30	15.60	45.70	2,1
Australia	6.70	6.30	6.00	19.00	0,9

Table 6. World steel consumption 1999-2001 (in million metric tons)

Used construction equipment will tend to be auctioned in the country where it has been used on site, using web-based systems. New equipment can be bought directly from the large manufacturer, such as Caterpillar or via web-based agencies (www.yellowtrack.com).

e. Managers, supervisors, foremen

There has been a marked growth of web-based employment agencies over the last ten years. Many of these have a wide range of international staff on their books and supply a range of multinational companies. www.careersinconstruction.com for example, has a register of 13.000 job-seekers and filled 10.000 vacancies during 2000. Currently 60.000 visitors use the service every month.

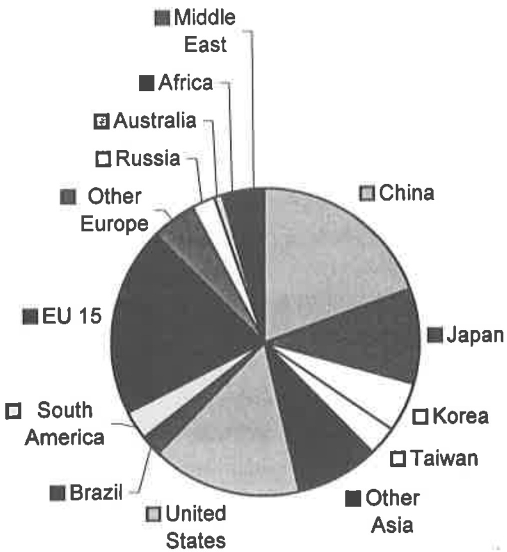

Figure 3. World steel consumption 1999-2001

Engineering Designers

Cost breakdown of a design contract

Engineering designers and consultants sell knowledge and their major assets are skilled and specialised personnel. A recent, legal, consultancy contract that the lead author was involved in had the following breakdown in costs which confirms the above statement:

Remuneration of professionals:	70%
Reimbursables: (flights, accommodation etc)	9%
Miscellaneous (overheads etc)	21%

Where is design work being carried out?

Design has been traditionally carried out in the consultants' home offices. With the advent of reliable communication

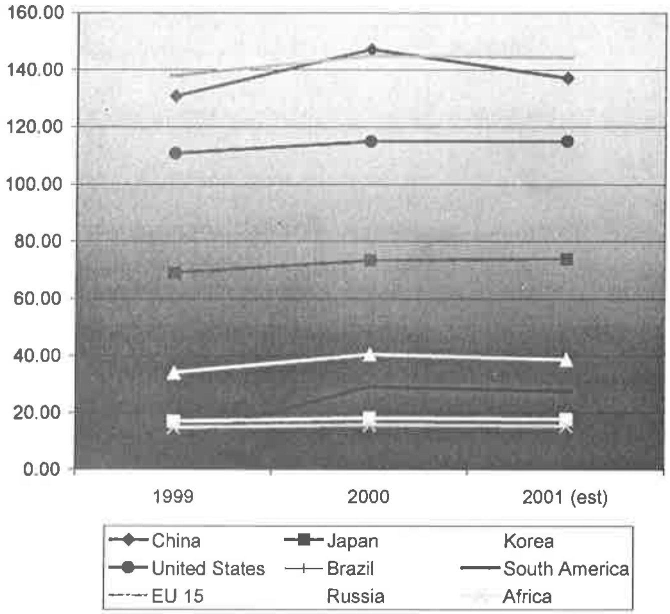

Figure 4. Growth of World Steel Consumption

technology three trends have developed. The first involves outsourcing of work to independent professionals, often working from a home office. The second trend is for the, often US, company to acquire a company in a country where there are skilled, inexpensive professionals. An example of this is the establishment over the last decade of US subsidiaries in the UK by acquisition. The third trend is for 24 hour a day working. This involves sending electronic files to, say, India at the end of the US working day for Indian professionals to work on them during the (US) night and return them early in the (US) morning for the US office to work on them during the day.

In the case of the legal project cited earlier, coordination of the 13-month project was carried out in South Africa and (legal) drafting done in Brazil, Mozambique, the USA, South Africa

and Portugal and fed by e-mail to the South African office. A project web-site was established to distribute information efficiently to the multiple role-players.
Who are the international designers?

Murray and Mavrokefalos (2000) have examined the activities of the large international consultants. Table 5, adapted from that paper, shows the share of market taken up by consultants of different nationalities.

Table 5 shows that 43% of the work carried out by the top 200 international firms is done by 80 American companies and 37% by 74 European firms.

Table 5. Share of market by consultants of different nationalities within the top 200 international design firms: 1998

Nationality	No. of Firms	International Invoicing (US$ millions)	%
American	80	7,359	43
European	74	6,249	37
Japanese	13	993	6
Others	23	1,058	6
Total	200	16,972	100

Source: ENR

Procurement systems

The procurement systems of the international designers evidently focus on human resources. One US firm known to the lead author, employing about 200 professionals in its home office, has a computerised data-base of 6.000 independent professional service providers from around the world on whom the firm relies on an as-and-when needed basis.

Consequences

It is believed that the result of the evolution of communication systems, the globalisation of the economy and the advances in technical education in developing countries is that American and European international consultancies are tending to rely heavily on multinational staff and on associated companies based in 'developing' regions.

Conclusions

A number of conclusions can be drawn from the preceding.

1. International contractors can, and do, source labour, materials, plant and equipment and construction professionals from anywhere around the world where these resources are available at a competitive price and within the required quality standards.
2. International manufacturers of construction plant and equipment, cement, steel and formwork will tend to establish subsidiaries in those regions where construction activities are expected to develop.
3. International designers will source their human resources from those countries where there are skilled, inexpensive professionals available.
4. International designers will tend to establish partnerships with consultancies established within time-zones lying 12 hours from the USA and Europe (i.e. within Asia or Far-East Asia, including Australia) to benefit from two-shift working, conducted electronically.
5. Major construction activity in the future will take place in Asia, principally China.
6. Wealth will flow from developed to 'developing' countries as international contractors and consultants source and pay for labour, key materials, plant and equipment and professional services from those countries.
7. Knowledge will flow from 'north' to 'south' and technology will be accordingly transferred, as professionals from 'developing' countries acquire skills and knowledge by working with contractors and consultancies from Europe and North America.

Recommendations

Further areas of research include:

1. The use of web-based procurement systems by large international contractors.
2. The internationalisation of design consultancies.
3. The availability of professional contracting and consultancy skills in 'developing' countries.
4. The availability of key construction materials and equipment in 'developing' countries.

References

Bon R and Crosthwaite D, *The Future of International Construction.* Thomas Telford Ltd. 2000

Murray M, New Opportunities in China for South African Construction Professionals. *Civil Engineering, South Africa Institution of Civil Engineering*, September 2000, vol 8 no. 8, p.7-15

Murray M and Zagaretos P, International Construction Markets and the Availability of Local Contractor Capacity. *Association of Researchers in Construction Management (ARCOM) Conference*, Sept. 2001 (paper submitted)

Murray M and Appiah – Baiden J, Difficulties Facing Contractors from Developing Countries: Problems and Solutions *Proceedings of the 2nd International Conference of the CIB Task Group 29 on Construction in Developing Countries*. Nov 2000 p 277 – 286

Murray M and Mavrokefalos D, Opportunities for Consultants from Developing Countries in the Global Village. *Proceedings of the 2nd International Conference of the CIB Task Group 29 on Construction in Developing Countries*. Nov 2000 p 306 – 315

www.aecventure.com. Architectural, Engineering and Construction Venture www.dnep.gov.mz. National Road Administration, Mozambique

www.global-cement.dk/files/facts.htm. Aalborg Portland, Denmark

www.cat.com. Caterpillar

www.mmprocurement.com. Alcan Aluminium Ltd and fifteen other mining companies

www.yellowtrack.com Selection and purchase of new construction equipment in E.U.

www.careersinconstruction.com Recruitment Agency

Minimizing the Risk of Construction Nonperformance

Using an Artificial Intelligent Procurement System and Information Measurement Theory

Dean T. Kashiwagi[1]

Abstract

The risk to a user in the procurement of construction can be defined as not getting the construction on-time, on-budget, and meeting quality expectations. The Performance Information Procurement System (PIPS) uses Information Measurement Theory or the measurement of information and an artificial intelligent processor to transform data into information. PIPS allows the user to use information generated by an AI processor to make the decision instead of using it to aid the subjective decision making of experts or engineers. PIPS has identified that the major cause of risk in the procurement of construction is the subjective decision making and attempt to control the quality of construction using minimal standards, and inspection. This article will focus on how subjectivity and bias in the low-bid environment can be minimized by using PIPS and performance information. It will discuss the results of two tests, a $17.25M Physical Education Building and a $800K waterproofing of a courthouse building in Hawaii.

Keywords: Performance Information Procurement System, Information Measurement Theory, artificial intelligent processor, risk, quality

Introduction

Government users and facility managers have had difficulty procuring construction on-time, on-budget, and meeting quality expectations. This difficulty in minimizing risk has resulted in government users and owners moving to design-build,

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construction management at risk, and indefinite delivery, indefinite quantity (IDIQ) and other similar delivery systems. There are numerous problems that exist in the current low-bid delivery system environment:

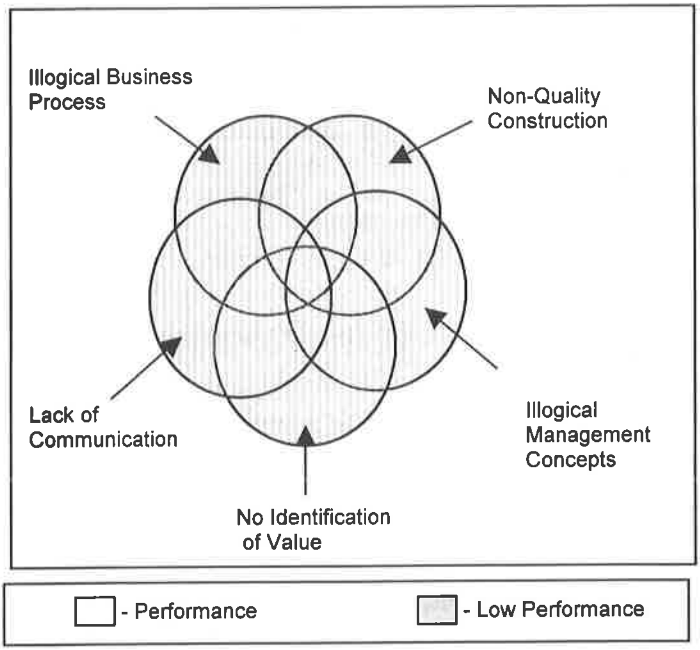
1. Lack of communication and perception. Subjective description of work including means and methods and minimum standards by a designer which has to be interpreted by contractors.
2. No performance information. Low-bid contractors are inaccurately identified as having equal capability.
3. Illogical business process. The process requires a "price" for construction. There is no method to confirm if the price is sufficient to meet the requirements of the owner.
4. Low-bid. The low-bid award motivates low price. The low-price leads to poor quality, change orders, and unacceptable risk.
5. Lack of quality construction. Users have moved to construction management @ risk and design build to minimize quality problems. Craft training in construction has not been able to maintain the industry's skill level thus systems are being continually redesigned to meet minimum standards.
6. No identification of value. There is no identification of value in the construction industry. The difficulty is caused by the uniqueness of construction: differences in level of difficulty, requirement, user expectations, availability and environment make benchmarking value inaccurate.
7. Illogical management concepts. The concepts of control, inspection, decision making by those without liability, high risk and low profit, and win-lose relationships are commonplace in construction.

A process that minimizes risk will be successful to a relative degree of minimizing the above problems. Many of these problems are overlapping or dependent problems (Figure 1.)

Information Measurement Theory (IMT)

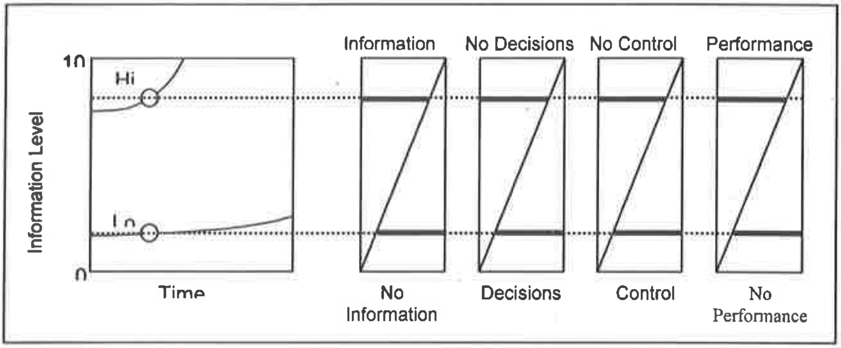
IMT is the measurement of differential to predict the future outcome (Kashiwagi, 2001) IMT proposes that contractor performance can be predicted. It also states that selecting contractors and key personnel that have proven capability in the type of work required can minimize risk.

Figure1: Venn Diagram of Construction Nonperformance



IMT also encourages the minimization of direction, control, management, and inspection of construction work by third parties who have no liability or responsibility of performance. An increase in performance will only occur if contractors are motivated to improve their performance (Deming) Figure 2 compares two extreme options the high information option and the low information option. It then uses Kashiwagi Solution Models ("two outcome" charts that assume everything is relative and related) to show that improvement in performance can only come with information, minimal decision-making, control, and inspection.

Figure 2: Improvement of Performance Using Kashiwagi Solution Models (KSM)



Performance Information Procurement System (PIPS)

PIPS was developed using IMT to minimize the seven problems of non-performing construction. It addresses the problems in the following manner:

1. Perception of performance. The "best available" options are described by the proposing contractors. The user, using a consistent nonbiased approach, uses an artificial intelligent processor to select the best available option. The best available option is not described by the owner, but by the best performing contractor. PIPS minimizes the need for communication and perception by competing the options, minimizing the choices, and allowing the contractor to explain what they can do. The performance specification would then include the owner's requirement (full design, partial design or requirement only) and the contractor's means and methods to perform. The contractor then takes responsibility for meeting both requirements.

2. No performance information. PIPS collects and then transforms performance data into information (data that differentiates and predicts the future outcome) by using an Artificial Intelligent (AI) engine (modified Displaced Ideal Model (Zeleny, 1985) Kashiwagi, 2001.) Each piece of data is transformed into information on a relative basis and then measured against a requirement to minimize the options. The AI processor has the following characteristics:
   - Makes a decision with no bias. The processor does not have a bias. It makes a new decision, each and every time, which is not based on past experience. It is not an expert system or a neural network. Expert systems simulate experts, and experts are biased.
   - Multicriteria decision making processor, that accepts a biased requirement from the owner (relational weights.) All owners are biased. IMT identifies that a biased owner should not have their requirement translated into something else by an expert.
   - The AI processor prioritizes performance barcodes of contractors, which includes the past performance and current capability to identify and minimize risk, and then associates a price to the level of performance.
   - The AI system gets more powerful with more data, but uses the same decision making process each time. Data can be reused, but information cannot be reused.
3. Illogical business process. The process has several gates, which allows the contractors to make self-assessments to ensure that they can meet the needs of the owner. The first is identification of past performance. The second gate is to be able to identify the risk to the owner (failure to meet budget, time, and quality,) identify how to minimize the risk, provide a detailed cost breakout, and a construction schedule. The third gate is the requirement to provide key personnel who must have past performance and who can predict the future outcome on the proposed project. The fourth gate and most important, is that the "best available option" is then requested to coordinate the

drawings with all critical subcontractors and identify all "unconstructable" elements, construction schedule, and quality requirements. All items are responded to before the pre-award meeting. The contractor signs a contract, which includes the owner's requirement (includes plans and specifications,) the contractor's management plan and interview information, and pre-award discussions. Additional cost change orders will only be issued for unforeseen conditions or change in scope as identified by the owner's representatives. The fifth gate is that all critical elements (contractor, subcontractors, project manager, and site superintendent) will be rated by the owner's representatives. Everyone receives the same rating. These five gates ensure that the best business decision is made. This process minimizes any problems caused by non-performing contractors.

4. Low-bid. PIPS compares relative performance and price using the AI model.
5. Lack of quality construction. The contractor must verify that their work meets the self-imposed standard. This leads to the "best available quality."
6. No identification of value. Value (performance and price) is unique to every construction project. The value can only be identified against the best available options for the unique project. The best value is identified by the PIPS AI processor as the differential between the best available and the other available alternatives. Value is then determined by availability, requirement, competition, price, and performance.
7. Illogical concepts. PIPS encourages the owner's representative to minimize decision making in identifying the requirement and rating the management plans (blind review) and interviews in terms of differential. The PIPS AI processor then prioritizes the alternatives. PIPS encourages the owner not to participate in the management of the job, and to minimize the inspection of the job. This makes the contractors' responsible for quality construction.

The results of the two projects that will be discussed in this paper include:

1. $17.25M physical education building for the Southern Utah University campus.
2. $800K waterproofing of the Kapuaiwa courthouse in Honolulu.

Southern Utah University (SUU) Physical Education (PE) Building

The SUU PE building location was in the middle of the SUU campus adjacent to the major entries into the campus. The project situation included:

1. The project budget was $17.25M. The project was over designed with a scope of $18 to $20M.
2. If procured the traditional way, a low bidding contractor who specialized in change orders, was not on-time or on-budget, had difficulty keeping their site superintendent and project managers on the projects, and did not always pay their subcontractors, would have had a good probability of getting the project.
3. Previous State managed projects of this magnitude were not on time or on budget.
4. The greatest risks would be the short construction time (16 months,) the shifting soil conditions which the design would not fully address, the construction of an indoor Olympic size swimming pool, and the over designed requirements which would threaten the customer satisfaction of the project.

PIPS was run to select the contractor. The following were the results:

1. The top performer was $1M more expensive than the second highest performer.
2. The lower bidder selected a pool contractor who had a lower performance.

3. The top performer selected all their critical subcontractors based on performance.
4. The biggest difference between the contractors was that one was team approach while the other was the "I" approach of the general contractor. The performance and cooperation of the critical subcontractors has been identified as one of the major reasons for the success of PIPS projects. The highest performing contractor on this project represented the philosophy of PIPS: use the best subcontractors and allow the subcontractors to make the critical decisions, facilitate using information, and performance is staying within budget, time, and doing quality work.

The contractor selected for the project had the following strengths:

1. The project manager was from their main office with the most experience and volunteered to manage the project.
2. The entire team (critical subcontractors) was selected based on performance and not price.
3. The swimming pool subcontractor selected was the highest performing pool subcontractor. The swimming pool construction was the centerpiece of the construction.
4. The contractor's team had taken advantage of every educational opportunity on PIPS and the information environment, sending their entire management team to the presentations.
5. The contractor restructured their operations to implement a full information system with the owner and subcontractors.

The following unforeseen conditions were encountered on the project:

1. The soil was found to be unsuitable, and the soil removal was twice what was specified. The excavation contractor quickly enlisted the assistance of another excavation contractor to stay on schedule.
2. The window manufacturer did not deliver the windows as

contracted. The general contractor ended up manufacturing on site to meet the schedule.

3. The air handling unit manufacturer told the contractor that they would not deliver on schedule. The contractor quickly notified the State of Utah, and the State of Utah project manager assisted the contractor by notifying the manufacturer that their products would not be used if they did not deliver as contracted.
4. The SUU staff made a number of scope changes, which the contractor completed without extending the construction time.
5. The subcontractors on the site made value-engineering changes throughout the project to improve the construction of the facility.

As the information used to make the award predicted, the performing contractor performed. The following are results on the project:

1. The PE building was completed and finished on time with no contractor generated change orders, which increased the cost of the project.
2. The user was impressed with the quality, the coordination and cooperation among the subcontractors, and the management skills of the contractor. A material manufacturer was so impressed with the coordination, cooperation, and quality of the project that he wrote a letter to the State of Utah stating that in his career he had never seen such a construction environment. The letter states, "In all of my years as supplying material to work sites….I have never seen such a cooperative and quality environment."
3. The State of Utah project manager was impressed with the design-build attitude of the general contractor and subcontractors who continually brought up improvements to the design during construction. The subcontractors used their ingenuity to reduce costs. For example, due to the poor soil conditions, the pool excavation was deeper than expected, requiring shoring for the excavation.

Instead, the contractor suggested making the excavation pit footprint larger, thus avoiding the shoring costs. The mechanical, electrical, plumbing, and roofing contractors created a total quality and cooperative environment.

4. The price of the contractor was $1M over the low bidder. The major differences were in the choice of the pool subcontractor and the ability of the contractor to modify the construction without processing change orders. When asked at the end of the project, the general contractor's site superintendent stated that the project would not have been completed on time and with the same quality, if the pool subcontractor had not been selected.
5. The quality of the construction exceeded everyone's expectation. The construction went so well that the major question was why did a small university like SUU get such a high tech PE facility (three floor facility with an indoor Olympic size swimming pool, three court basketball court gym with a suspended track 40 feet above the gym floor, classrooms, racquetball courts and an architecturally stunning structure.)
6. The SUU president was also asked if they would use PIPS again to select the contractor and award to a higher priced contractor, and his answer was, "I would do it again." (Steven Bennion, 2001) At the time of the selection, a much larger contractor with a lower price was the subjective "best value" of many State of Utah facility management personnel and industry representatives. However, the State of Utah facility manager stayed with the PIPS award and the result was as predicted; high performance, on-time, and on-budget.
7. One of the keys to the successful construction was the high performance of the critical subcontractors. This was attributed to the past performance ratings and the entire construction group being rated the same at the end of the project. The State of Utah project manager stated that the full information and facilitation approach of the general contractor changed the entire construction environment. He also stated that the approach was totally different from

the previous attitudes of general contractors who used a "win-lose" attitude that is so predominate in the construction industry.

8. The factors, which led to the selection of the contractor as the best value; were past performance, facilitation and coordination abilities, risk identification and minimization. The results showed that the information predicted the outcome. The contractor's site superintendent stated that there was not a single meeting on the project that had a negative or finger-pointing occurrence.

The contractors were given an overall rating of 9.8 (out of 10). The State of Utah project manager had a great experience with the PIPS procurement and construction. He stated that what some State officials called problems were merely bureaucratic problems caused by the user and facility management bureaucracy. He stated that the impact of the IMT on the process was so successful, that he also implemented the philosophy in his personal life with great results. The project manager rated the PIPS system over three times better than the previous low-bid process.

Waterproofing of the Kapuaiwa Courthouse

The Kapuaiwa Courthouse in Honolulu, Hawaii had the following unique conditions:

1. The project was in design for a year, and with lapsing funds, needed to be bid and awarded in a couple months. It was a 60-year-old, three story, and 20,000 SF historical site being monitored by the Historic Preservation Society. The user, facility management group, and designer were very unsure about the ability of the contractors to follow the design and specifications and solve the water penetration problems due to the complexity and age of the building, the previous results of roofing and waterproofing projects awarded by the low bid, and the

lack of funding. The project was designed to stop water penetration from a leaking roof. It was then decided by the facility management to use PIPS.

2. The two story-building exterior was constructed of brick, decorative concrete ledges, decorative reinforced concrete balusters surrounding the roof, and wood framed doors and windows. Much of the wood framing was rotted, the mortar was in poor condition, and the concrete ledges and balusters were badly deteriorated.
3. The contractors quickly pointed out that the parapet wall of balusters (inside and outside) were also sources of leaking. Leaking was also identified in the windows and decorative concrete ledges, as well as from the deteriorated masonry.
4. The building had high visibility and is in close proximity to other historical buildings. There was continuous traffic around the building.
5. The court's judges' cars were parked adjacent to the building.

There were many different parties involved including the Judicial Court facility manager, the building occupants, the State of Hawaii facility management group, and the Historic Preservation Society. The most difficult to work with was the Historic Preservation Society. They wanted the water penetration stopped, the building restored, and they wanted the building to look exactly as it looked in the past for $800K. The Director of Facilities for the State of Hawaii was concerned that funding would be used, only to have the same problems with the building in two or three years.

The Performance Information Procurement System (PIPS), had been used by the State of Hawaii for a year before this project. Thirty projects had been procured using PIPS. The PIPS environment had the following conditions:

1. Manufacturers and contractors were very cognizant of the performance based requirements and the impact of the performance ratings.

2. Performing contractors had learned that if the job had excessive risk, it was better to pass on the project.
3. Contractors learned to work with the manufacturers to provide the best value to the owner.
4. Warranties were much more meaningful. With the contractors and manufacturers responsible for their own specifications and drawings, the performances of the systems were much higher.

The PIPS process had the following advantages:

1. Did not exclude any contractors or manufacturers' products.
2. Did not have to identify warranty periods. PIPS is looking for the best available warranty based on proven performance.
3. Did not have to identify the "available" level of quality.
4. Did not have to address details and means and methods which would differ from contractor to contractor

The requirement was "to waterproof the building for the longest possible period of time." Only one contractor submitted a proposal to the State of Hawaii. They were within 6.25% of the budget ($862,195, additional scope changes were also included in this price.) They proposed the following:

1. To restore the restorable balusters on the parapet wall. The balusters that were too deteriorated, they would replace by recasting.
2. To restore all decorative concrete ledges.
3. To cover the existing roof system with a sprayed in place polyurethane foam roof system with a urethane elastomeric coating (documented performance of over 20 years.)
4. To waterproof the walls, and balusters with acrylic elastomeric coating. The Historic Preservation Society had requested that the walls be sealed with a clear sealant to keep the original look of the brick walls. The contractor stated in their proposal that there was no clear sealant that would work on this application for a

prolonged period of time within the proposed budget. The contractor proposed to match the existing brick color as close as possible. The contractor also realized that the window required sealing. However the user did not have the funding. The contractor sealed the windows at his own cost.

5. To give a joint and several warranty contractor and manufacturer on the roof for 10 years and on the walls for 5 years. The joint and several warranty is the only warranty in the waterproofing and roofing industry. The warranty was five times what the low bid situation would have provided.
6. Construction schedule of 179 working days.

The contractor finished the project on time (11 days or 6% early,) on budget, with no change orders, exceeding the quality expectations of the user. The contractor "tented the roof during construction to avoid over-spray on cars" and individually covered ever car with plastic that drove into the adjacent parking lot. There was one complaint of dust from the construction site that was quickly rectified during the construction.

Instead of making many design decisions (means and methods, level of quality, warranty, safety and construction control requirements), the PIPS process allowed the contractors to identify the "best available options." Even if a full design is used, the contractor has the option to propose changes to increase the value of the construction. In the low-bid environment, the contractor does not make the decision. The designer tells the contractor what to do, and then makes sure through inspection that the work was done properly. The solution will not lead to performance, however, since the contractor did not participate in the decision. With someone else making the decision, the contractor has no liability and less motivation to perform. The only decision the user and designer made in PIPS was to determine whether the option was acceptable. Once the decision was made, the contractor was left to meet their own schedule, budget, and quality expectations. It is very important to realize that the "designer's option" would not have solved the user's needs and the PIPS solution was not identified by the designer.

Conclusions

PIPS is a performance based procurement system with a AI processor that relates an owner's requirement with the best available performing contractor. The performance level is dictated by the best performing option. The performance specification identifies the owner's requirement and how the performance will be defined, but leaves the definition of performance to the best available performing contractor. The contractor is then required to meet the performance level that is set by their past performance and their proposal to meet the owner's requirements.

Reference:

Deming, W. Edwards (1986) *Out of the Crisis,* Massachusetts Institute of Technology, Cambridge, MA.

Kashiwagi, Dean T. (1999) *Construction Delivery System of the Information Age, Automation in Construction*, Vol. 8, Issue 4, pp. 417-425.

Kashiwagi, Dean T. (2000) *Artificial Intelligent Performance-Based Procurement System,* Construction Congress VI, Orlando, pp. 49-58.

Kashiwagi, Dean T. (2001) *Information Measurement Theory Fourth Edition*, PBSRG, Arizona State University, Tempe, AZ.

Kashiwagi, Dean T. and Mayo, Richard E. (2001) *State of Hawaii Selects 'Best Value' by Artificial Intelligence,* Cost Engineering, Vol. 43, No. 4, pp. 38-44.

Kashiwagi, Dean T. and Mayo, Richard E. (September 2001) *Procurement of Construction in the 21st Century,* COBRA 2001 Conference, Glasgow Caledonian University,

Scotland, Volume 2, pp. 535-545.
Letter from James P. Morgan, (2000) Grace Construction Products, Park City, UT.
Personal Conversation with Steve Bennion, President of Southern Utah University, on February 16, 2001.
Post, Nadine M. (May 14, 2001) *Bumpier Road to Finish Line,* Engineering News – Record (ENR) McGraw-Hill, New York, Vol. 246, No. 19, pp. 56-63.
Zeleny, Milan (1982) *Multiple Criteria Decision Making,* McGraw-Hill, New York.

Capability Alignment: the Impact and Effects Of Corporate Culture on it Training

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Abstract

Construction organisations must reconsider their recruitment strategies, performance appraisal systems, and education and training policies in order to benefit from information technology (IT) capabilities. Trained and skilled operatives can help organisations be more customer-responsive, and readily adaptable to change initiatives. However, a lack of training can often adversely affect an organisation's capacity to respond to market forces, which in turn can have a detrimental influence on performance and overall profitability. Thus, training can be said to be an investment that aims to prepare organisations to adapt to the changing business environment, and should therefore be part of a capacity-building infrastructure to meet current and future business requirements.

This research demonstrates the use of a Generic Assessment Process Protocol model for IT training (GAPP-IT): an IT training model developed using process protocol (PP). Phase six of this model is presented, and a method of applying this tool to satisfy (and close) the 'performance gap' between the business strategy (BS) and IT training is explored, focussing specifically on capability alignment and the impact of corporate culture.

Keywords: Business Strategy; Information Technology; Training Strategy; Process Protocol; Maturity Models; Culture

Introduction

The fragmented nature of the United Kingdom (UK) construction industry (Emmerson, 1962; Banwell 1964; Latham, 1994) has been identified as a causal factor adversely

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affecting performance and productivity. Contemporary 'change' initiatives have tried to address this by focussing on time, quality or cost elements. However, Kagioglou et al (1998), noted that these issues were predominantly process related, and not product related. Furthermore, the micro and macro issues of process and IT maturation have been identified as being interrelated (Hinks et al, 1997), which suggests issues of contextualisation must also be identified.

Advances in communication, networks, and the Internet have created new rules for working environments. Organisations are increasingly using IT in an attempt to secure existing markets, or gain competitive advantage. In addition, they are restructuring and aligning their internal departments accordingly, adopting 'enabling' policies in order to sustain growth and improve efficiency. However, the use of IT in strategic planning requires major management initiatives to help deliver strategic objectives (Rockart et al, 1996). These approaches have undoubtedly helped managers assess their capability in order to determine the IT and business maxims needed to clarify the gap between what exists and what is required, and find if they have achieved a 'reasonable' match between their actual and desired capabilities (Broadbent and Weill, 1997). However, cultural boundaries within business departments can often cause problems (Taylor-Cummings, 1998; Grindley, 1992; Mockler and Dologite, 1995), and 'gap' analysis requires a whole series of strategies to be formulated and implemented in order to facilitate the appropriate courses of action (Venegas and Alarcón, 1997). Designing strategies for implementing IT solutions into the workplace must therefore include the adoption of new management strategies in order to be successful (Korac-Boisvert and Kouzmin, 1995). Furthermore, whilst there is a need for mangers to align their IT strategy to the company's Information System (IS) strategy and BS; more fundamentally however, it is equally important to ensure their IT training strategy is also aligned.

This paper presents an IT training model (Goulding, 2000) based on the principles of Process Protocol, the remit of which identifies the impact and effects of corporate culture on IT training.

Organisational Personnel and IT Training

Advances in IT can often place demands on personnel (Heng, 1996), but training and development programmes can also facilitate and provide changes in organisational behaviour, which in turn can enhance the organisation's capability to survive (Kessels and Harrison, 1998). Furthermore, training is not only instrumental in addressing skill deficiencies (Krogt and Warmerdam, 1997); it can also be used to integrate with the long-term needs of the company (Kumaraswamy, 1997).

From a skills perspective, the development of skills can often take years to build up (Klein et al 1991), and it is therefore essential that these are managed as a strategic resource, and carefully linked to the human resource management (HRM) strategy through the BS. This was reinforced by Doherty (1997), who highlighted the importance of maintaining skill levels within the construction industry, and by O'Connell (1996), who identified that employees often became more valuable to the company as a result of their increased knowledge and skills. Thus, training can be seen as an investment that aims to prepare organisations to adapt to the changing business environment. Therefore, managers should determine what IT skills and capabilities are required to bridge the gap between what currently exists, to what is needed. This precept however must not be used to address IT skills gaps per se, it should be procured through a carefully considered process (directing resources to areas which are perceived to have the greatest impact on the BS). A fundamental part of this process is to determine and classify the needs requirements from an IT training perspective. For simplicity, these needs can be categorised into three areas, namely executive; managerial;

and operational (Goulding and Alshawi, 1997). Within these sectors, provision should also be made for identifying and capturing the generic needs (common to all), and specific needs (common to specialist remits).

Organisational Culture

The precise definition of 'culture' tends to embrace many different notions and meanings, ranging from beliefs, language and ceremonial acts, through to stories and perceptions (Young, 1989). From an organisational perspective, it can often encompass the internal and external environment, and embody the whole essence and driving force of an organisation. Corporate culture can therefore be ingrained and very difficult to influence and change. It is affected by employees' deep-rooted values and beliefs, the nature and causes of which, can often have far reaching consequences (Johnson, 1992; Mockler and Dologite, 1995; Geletkanycz, 1997).

The term 'culture gap', is the difference between the values and perceptions held by one person, group, or subset; against the perceptions held by others (individuals, groups, or subsets). An example of which is to consider the views of management against operatives; each have different perceptions of culture, and of each other; but neither are able to identify why this gap exists, how wide it is, or how this gap can be closed. These fundamental differences therefore can often instill mistrust and create communication problems, particularly where no common agreement has been reached concerning social rules and protocol. Therefore, key cultural milestones or barriers must be addressed to maximise shared beliefs, and minimise any negative effects associated with misunderstanding. The process of resolving differences requires an in-depth understanding into the root causes of all preconceptions (Mockler and Dologite, 1995), which may also require organisational subcultures to be integrated, before any attempt is made to bridge the culture gap (Grindley, 1992; Peppard, 1995).

From an IT perspective, culture can affect the success of any IT initiative (Grindley, 1992; Davis, 1993; Taylor-Cummings, 1998), and cultural equilibrium (where all share the same perception) can only be restored when IT becomes part of organisational culture (Earl et al, 1988). This can be achieved through effective management intervention, but this requires acknowledgement that people by their very nature are averse to change, and feel uncomfortable with issues that affect their social standing and working practices (Johnson, 1992). Socialisation issues should therefore encompass the sharing of norms – knowledge; skills and competence; continuous learning related to IT needs; cooperative relationships with IT professionals; and commitment (Taylor-Cummings, 1998). Managers should therefore look carefully how they recruit, manage, train and reward their staff to minimise these difficulties (Tonks and Wan, 1991; Samler, 1993; Luoma, 2000).

Communication and training issues are therefore fundamentally important to organisational success (Mockler and Dologite, 1995; Ward and Peppard, 1996), and whilst managers may not be able to control culture, they can influence its evolution (Walsham, 1993). A congruence of shared values should therefore be sought (Ward and Griffiths, 1997), which links all organisational personnel together – forming a set of shared beliefs, perceptions and goals, directed towards one corporate philosophy and vision (Gunning, 1996).

Performance Analysis in Construction

Performance analysis (often termed gap analysis) is a technique that can be used for measuring performance achievement against set targets. Various forms of this approach are used in the construction, manufacturing, and financial sectors. It is particularly useful for measuring outputs over time. The difference between the current level of achievement and the target set for a particular timeframe is known as the performance gap (or opportunity gap). The scale and importance of this gap enables managers to assess the subsequent likelihood of this affecting the key BS deliverables, thereby enabling corrective action to be taken as appropriate. In this context, IT training initiatives can be cited as having a causal link with improved company performance, but no formal procedures for measuring, documenting, integrating or evaluating its impact on the BS are widely acknowledged. However, organisations should aim to balance a range of skills and competence to meet business goals (Andrews, 1987; Mintzberg and Quinn, 1991), as "companies which are adept at using their skillbase effectively are able to use and reuse.... these skills many times" (Klein et al, 1991).

From a resource justification perspective, most organisations do not have sufficient resources to address all their training needs (Sleezer, 1993). In this context, training costs are almost always underestimated, as managers often fail to appreciate the full resource implications of designing and implementing IT training initiatives (Robson, 1997). Costs however, may not always be financial by nature – they can also embrace many other issues, the main factors of which often include time and corporate 'energy'. Managers should therefore recognise the myriad of complexities that exist with training initiatives (Miles and Neale, 1997), and the subsequent impact they can have on corporate resources. Thus, securing resources for the provision of IT training can often be difficult to achieve (Philip et al, 1995), especially where expenditure has to be justified (Michalski and Cousins, 2000). In addition, construction organisations need to evaluate the "real net benefit/cost of training" (Kumaraswamy, 1997). However, justifying IT training expenditure can often be difficult to achieve, especially where benefits or improvements are intangible and unable to be measured. The difficulty therefore is to determine a framework from which the justification process can be matched (and measured). From a business performance perspective, considerable research is therefore required to investigate the type of training (and competence requirements) needed to make an impact on organisational performance (Horwitz, 1999).

From a process perspective, many improvements in performance have been cited using process (Davenport, 1993; Hammer, 1990; Valiris and Glykas, 1999), as this has enabled organisations to focus on 'how' work is done, in contrast to 'what' is produced. Furthermore, developments with initiatives such as the Capability Maturity Model (CMM) (Humphrey, 1989; Paulk et al, 1993) have provided significant benefits in many industries, including construction (Hinks et al, 1997; Sarshar[1] et al 1999; Barrett, 2000), the remit of which has extended to incorporate process capability with IT capability (Aouad et al, 1999). Other process-based models in construction include Process Protocol (PP), the application of which can be used to represent all diverse parties in 'process', and a good example of PP in construction is the Generic Design and Construction Process Protocol (GDCPP) model (Kagioglou, 1998).

In summary, whilst the construction industry is increasingly using IT to deliver its core information systems (IS) and BS strategic and support needs (Betts et al, 1991; Betts, 1992; Ahmad et al, 1995; Venegas and Alarcón, 1997; Sarshar[2] et al; Andresen, 2000) this requires appropriately trained and skilled personnel to deliver capability (Samler, 1993; Heng, 1996; Moreton and Chester, 1997; Kumaraswamy, 1997; Ward and Griffiths, 1997). It is therefore important to assess the corporate IT skills needed to perform the identified tasks, the details of which should then be 'matched', 'measured' and 'evaluated' against targets (especially from a BS performance perspective). A Generic Assessment Process Protocol model for IT training (GAPP-IT) model is offered as a solution to this problem, the remit of which is specifically geared to analyse the key sequential stages and links needed, to satisfy (and close) the 'performance gap' between the BS and IT training strategy (ITTS). This model is process-based, uses the principles of PP for presentation, and the concepts of the Capability Maturity Model for evaluation. The following sections explain these issues and the application benefits of this model.

Generic Assessment Process Protocol Model For It Training

The GAPP-IT model was developed with two major United Kingdom (UK) construction industrial partners (supported by domain experts, process stakeholders and specialist advisers) to determine and 'map' the key generic processes associated with IT, IT training, and the impact on the BS (Goulding, 2000). In this context, this research aimed to analyse the key sequential stages (processes) required for evaluating the impact of IT training on the BS. In this context, IT training issues and processes were transposed into the GAPP-IT framework for discussion and subsequent evaluation. Various iterations were assessed during the prototyping and testing stage to secure consensus, especially in the validation of processes to achieve taxonomic understanding.

The first step in the development stage of this process model had to identify and define the target audience. In this context, training needs were divided into three discreet categories, specifically: operational, managerial and executive. These categories were chosen to differentiate between the different types of skills sets needed. Subsequent stages considered the outline stages (processes) and sequence of events required for instigating and deploying IT training within a construction environment. This included all contextual issues associated with training, from inception through to evaluation and final reflection. Consequently, this process needed to appreciate (and embrace) all human resource enablers and business process issues into one holistic PP framework. Thus, it was therefore important to identify (and critically analyse) these stages, including all key decision points, enablers and drivers. All interrelated activities, process and sub-process issues had to be included, from the intricacies of resource allocation, through to the effects of corporate capability and the impact of organisational culture.

Seven key phases are offered for discussion, encompassing the initial preliminary stage (conception of the need for IT training); through to the final evaluation and feedback phase – the representation of which is shown in Figure 1. Each of these phases can be broken down to show lower level information, and analysis of this lower level detail will be discussed in later works.

The GAPP-IT model is divided into three horizontal levels (covering the operational, managerial and executive requirements). It is commenced in Phase ZERO, and exited in Phase SIX, after sequential progression through each phase has been achieved (if required). The gaps between each phase signify the presence of a physical boundary or barrier (termed stage gate). Stage gates can be either hard or soft, the classification of which is determined by the requirements and conditions set by the preceding/succeeding phases. Upon completion, users return to Phase ZERO through the feedback loop (via the process wheel). A brief summary of each of these phases follows:

Phase ZERO: This is the initial opening phase, the remit of which aims to establish the need for IT training from an outline perspective. It is used to evaluate the existing and future business needs, contemplating the current and future IS and IT strategies (and the potential changes these may have on resource requirements). The BS is agreed and confirmed in this phase, the structure and drivers of which help to determine the overall IS and IT demand. Users subsequently pass through a soft stage gate into Phase ONE – to formally identify and clarify these needs.

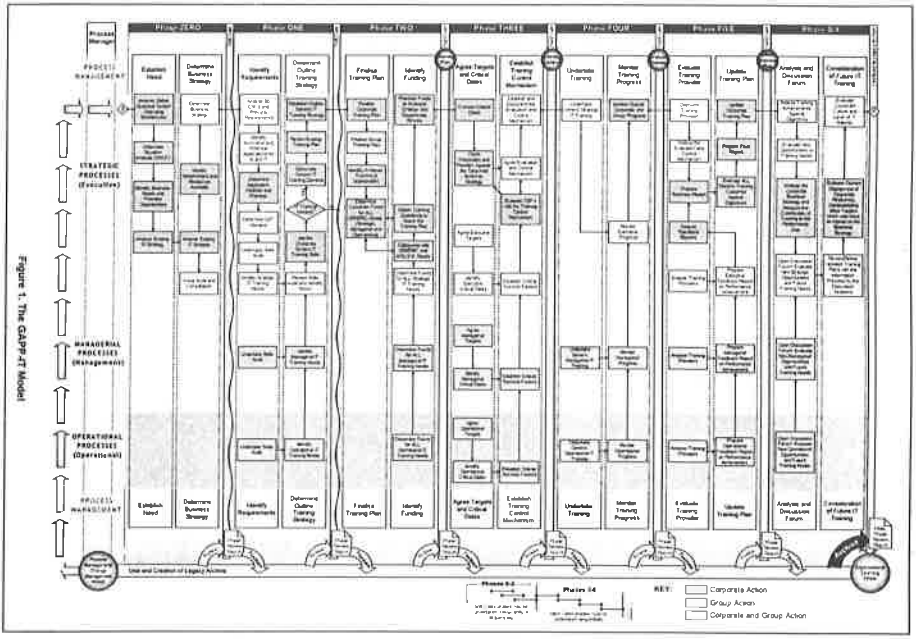

Figure 1. The GAPP-IT Model (note this figure had to be compressed to fit the page and as a result, much of the detail will not be available)

Phase ONE: This phase uses the information created in Phase ZERO to establish the processes involved in forming a generic IT training strategy. It is used to identify the BS deliverables, and to determine the precise scope and nature of the IS and IT demand to deliver these needs. A skills audit is used as part of this process, to verify the existing skill levels, and to ascertain the subsequent type (and level) of training required. At this juncture, it is possible to assess whether IT training is needed. If training is not required, users exit this model through a decision icon into the stage gate, where a Phase Review Report is completed (which is subsequently stored in the Legacy Archive). However, if training is required, an outline generic

IT training strategy is formed at this point. Users then pass through a soft stage gate (as no financial resources have been committed) into Phase TWO.

Phase TWO: The exact corporate generic IT training needs are established in the form of a structured training plan (TP) in this phase. This requires financial resources to be determined for the delivery of all operational, managerial and executive generic IT training needs; the process of which requires training quotations to be sought. Corporate funds are then prioritised to those areas perceived to have the greatest impact on the performance gap. Groups are subsequently informed of this generic provision – allowing them to make appropriate arrangements for their specific IT training requirements. However, as financial commitment is to be made during this phase, automatic progression is prevented due to the presence of a hard stage gate. In this context, a Phase Review board meeting is required to approve and sanction the anticipated resource expenditure, and to agree the scope and content of the TP. A Phase Review Report is completed, and users then exit this phase into Phase THREE.

Phase THREE: This phase is used to establish the training and control mechanism to ensure critical needs, deliverables, and deadlines are all met. All IT training needs generated from the BS are matched to delivery dates, the process of which also requires the type of evaluation and control mechanism to be agreed (conscious of the impact on resources and appropriateness to the task). This information is then reported and sanctioned in a Phase Review board meeting (where a Phase Review Report is completed). Users then pass through a hard stage gate into Phase FOUR.

Phase FOUR: This phase is used to undertake the generic IT training identified. It is also used to monitor and control training – in accordance with the training feedback and control mechanism agreed in Phase THREE. A Phase Review board meeting is conducted to assess and ratify all training achievements (and to record training progress to date), and a Phase Review Report is completed. Users then pass through a hard stage gate into Phase FIVE, where these training outcomes are subsequently evaluated.

Phase FIVE: This phase is used to evaluate training experiences and outcomes. All training achievements are assessed and measured against the original training objectives (established in the TP), the process of which also evaluates the effectiveness of the training control mechanism. The existing TP is subsequently updated at this point. The Phase Review board meeting is conducted to record all outcomes and achievements in the form of a Phase Review Report. Users then pass through the final hard stage gate into Phase SIX – the feedback stage.

Phase SIX: This is the final (and most important) phase of the GAPP-IT model. It uses a steering committee to overview and assess the whole process of IT training at the corporate and group levels. It is used therefore, to evaluate training achievements contextually – specifically against the performance gap. An 'open' discussion forum is engaged to foster and stimulate discussion on training and development issues. Any new ideas or initiatives are then evaluated, contemplating the company's current deployment of resources, level of IT maturity, and prevailing level of organisational culture. All discussions and outcomes are documented in a Phase Review Report, the content of which also records process issues for improvement purposes. Users then exit the GAPP-IT model at this stage.

Each of these phases can be identified in much further detail to show lower level process information flows – an example of which can be seen in Figure 2 for Phase Six detail.

Detailed Analysis of Phase SIX: Steering

Committee

Phase SIX is the final stage of the GAPP-IT model, the application of which aims to critically reflect upon all issues related to the provision of generic IT training in a construction environment. It is divided into two main process streams – specifically: 'Analysis and Discussion Forum' and 'Consideration of Future IT Training', the detailed phase attributes of which are shown in Figure 2.

Phase SIX is commenced in the "Assess Training Achievements Against Objectives" process box. At this stage, corporate and group executives focus on assessing the findings produced in the final report and updated corporate TP presented in Phase FIVE.

Particular attention is placed on examining the final training outcomes against the original objectives; specifically – to determine the achievements secured, or how to address deficiencies (if evident). This information is then sent to the sub-process activity "Update Skills Register", the details of which are used to update and maintain the corporate and group skill base. These findings are processed in the "Update Personnel Records" sub-process area, where all these files are updated. This procedure not only records achievements and continuing professional development (CPD) information, it is also used to identify any future personal development areas for the next appraisal period. Upon completion, confirmation is sent back to the "Assess Training Achievements Against Objectives" process box. This allows the next stage to be commenced, specifically: the "Evaluate New Opportunities or Training Needs" process box.

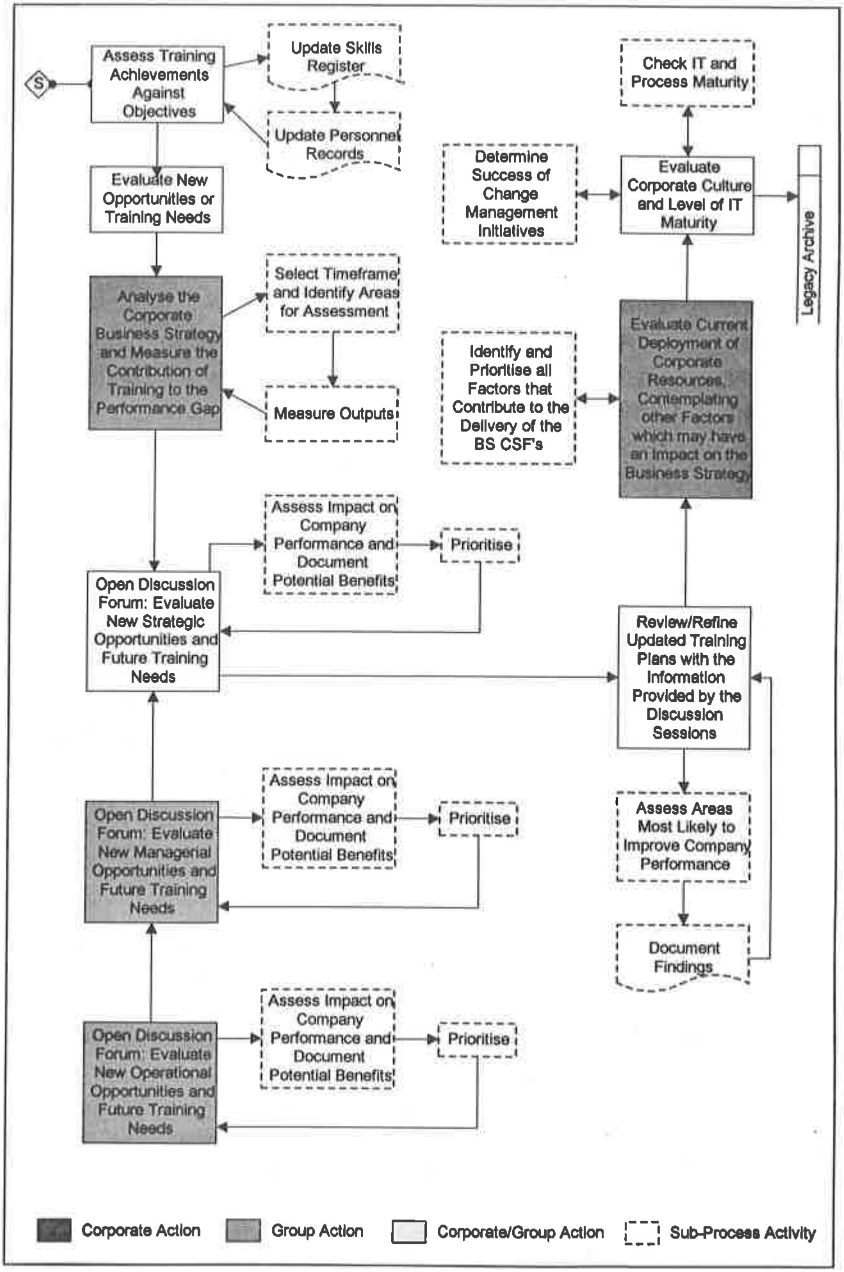

Figure 2. Detailed Phase Attributes Phase SIX

The "Evaluate New Opportunities or Training Needs" process box is used to identify any further training areas or new initiatives that have arisen from the generic IT training sessions – as the acquisition of skills and competence through the application of training can often lead to new business opportunities being identified. Typical areas often cited, include innovation (through increased understanding of process), or through new methods of working (with improved communication and level of integration). These opportunities should be developed and outlined in principle (at corporate and group level), and then subsequently forwarded to the "Analyse the Corporate Business Strategy and Measure the Contribution of Training to the Performance Gap" process box for further analysis.

The "Analyse the Corporate Business Strategy and Measure the Contribution of Training to the Performance Gap" process box is the main area where IT training's contribution to the business performance gap is evaluated and assessed. At this juncture, all BS critical success factors (CSF's) identified in Phase ZERO and Phase ONE are systematically scrutinised in context with the deliverables achieved. This procedure is assisted by two sub-process activities, specifically: "Select Timeframe and Identify Areas for Assessment" and "Measure Outputs".

The "Select Timeframe and Identify Areas for Assessment" sub-process activity is used to refine the areas allocated for assessment, and to define the timeframe (in which to measure achievements). Once this timeframe has been agreed, it is subsequently sent (along with the areas identified for assessment) to the "Measure Outputs" sub-process box for analysis. This "Measure Outputs" sub-process box is used for defining and measuring outputs. These outputs are generated from statistical evidence, the results from which should be presented in the most appropriate way (for example, graphs, tables, charts etc). The output medium should be uniform (to enable comparisons to be made), and clearly indicate performance achievements levels (and variances from the expected norm). These findings are then directed to the "Analyse the Corporate Business Strategy and Measure the Contribution of Training to the Performance Gap" process area for final analysis and reflection. Key findings from this stage are subsequently processed and sent to the "Open Discussion Forum: Evaluate New Strategic Opportunities and Future Training Needs" process area for further discussion.

The "Open Discussion Forum: Evaluate New Strategic Opportunities and Future Training Needs" process box is used specifically for analysing all training findings (from a strategic perspective). This is undertaken using an 'open forum' format, whereby all corporate and group stakeholders are able to positively contribute and discuss key issues and findings secured to date. This forum is not however undertaken until two other identical fora have been accomplished at the operational and managerial levels – indicated by the process boxes: "Open Discussion Forum: Evaluate New Operational Opportunities and Future Training Needs", and "Open Discussion Forum: Evaluate New Managerial Opportunities and Future Training Needs" respectively. The information generated by these sessions can be fundamental to the progression of the strategic meeting, as these findings often shape (and influence) the final strategic decision-making process.

The operational and managerial open discussion sessions are used therefore to gain insight into 'grass root' perceptions and beliefs (the equivalence of a conventional 'suggestion box'). These sessions offer stakeholders an opportunity to directly contribute to the business, the consequence of which could lead to new opportunities being developed and exploited, or may highlight more efficient methods of working (or improvement measures). These sessions are assisted by two sub-process activities to help facilitate and direct outcomes, specifically: “Assess Impact on Company Performance and Document Potential Benefits”, and “Prioritise”.

The “Assess Impact on Company Performance and Document Potential Benefits” sub-process box is used to test ideas and concepts generated by the discussion sessions with seniors and peers. These findings are refined and subsequently prioritised in the “Prioritise” sub-process box, and are then redirected to the discussion group for final reflection. In this context, all findings generated from the “Open Discussion Forum: Evaluate New Operational Opportunities and Future Training Needs” process area are then sent to the “Open Discussion Forum: Evaluate New Managerial Opportunities and Future Training Needs” for evaluation. The combined results from these sessions are then refined and forwarded to the “Open Discussion Forum: Evaluate New Strategic Opportunities and Future Training Needs” process area for strategic analysis. When all data, ideas and concepts have been evaluated at the strategic level, the combined findings are then directed to the “Review/Refine Updated Training Plans with the Information Provided by the Discussion Sessions” process area for final reflection. In this remit, the main task is to update and refine the group and corporate TP’s. This is undertaken with two sub-process activities, specifically: “Assess Areas Most Likely to Improve Company Performance”, and “Document Findings”.

The “Assess Areas Most Likely to Improve Company Performance” sub-process box is used specifically to identify ‘quick wins’ (or factors perceived to make an immediate impact on business performance). This process activity also investigates high potential areas deemed likely to have an impact on closing the performance gap. These findings are then sent to the “Document Findings” sub-process box. The “Document Findings” sub-process box is therefore used to document (and prioritise) all evidence; the confirmation details of which are then redirected to the “Review/Refine Updated Training Plans with the Information Provided by the

Discussion Sessions" process area for ratification. The updated TP's are subsequently forwarded to the "Evaluate Current Deployment of Corporate Resources, Contemplating other Factors which may have an Impact on the Business Strategy" process box for evaluation. This process area is thus used for assessing the impact and subsequent 'value' derived from the generic IT training sessions (from a corporate perspective).

From a strictly a resource perspective, executives often have the opportunity to direct corporate resources in a variety of different ways. These decisions are normally directed towards achieving maximum benefits (tangible or otherwise). For example, should resources be used to upgrade a computer network?, purchase new software?, or perhaps recruit more staff?. Irrespective of outcomes, a formal strategy must exist that is capable of rationalising data into decisions that can be justified accordingly. Thus, part of the discussions within the "Evaluate Current Deployment of Corporate Resources, Contemplating other Factors which may have an Impact on the Business Strategy" process box would debate these issues in depth. All interim findings from these sessions are then sent to the "Identify and Prioritise all Factors that Contribute to the Delivery of the BS CSFs" sub-process box for evaluation. In this sub-process arena, anticipated resource issues are matched to expected outcomes. For example, allocating £ 'x' to 'y' area, will have 'z' probability of achieving success. These scenarios should however be flexible enough to encompass subjective (or unconventional) outcomes. These findings are then redirected to the "Evaluate Current Deployment of Corporate Resources, Contemplating other Factors which may have an Impact on the Business Strategy" process box for final reflection – and subsequently forwarded to the final process box "Evaluate Corporate Culture and Level of IT Maturity", for closing analysis.

The "Evaluate Corporate Culture and Level of IT Maturity" process box is used to evaluate the company from an holistic perspective. This is achieved by assessing overall corporate and group performance, placing particular attention to factors (positive and negative) that influenced outcomes. Part of this evaluation process should also endeavour to determine the change in corporate culture (if any), and overall employee willingness to accept (and respond to) change initiatives. The latter element in particular, is undertaken in the sub-process activity "Determine Success of Change Management Initiatives". Another fundamental part of this evaluation process is undertaken in the "Check IT and Process Maturity" process box. In this remit, the level of IT maturity is assessed (from a CMM perspective), placing particular importance on the impact this technology has made on the business (from a strategic and support perspective).

The final stage in the GAPP-IT model culminates in the "Evaluate Corporate Culture and Level of IT Maturity" process box. At this point, all results and findings are documented in the final Phase Review Report. Users then progress through a final hard stage gate (as the steering committee has been completed) and the model is subsequently terminated at this point. However, for the purposes of reflection and review, all Phase Review Reports are then directed through the Legacy Archive conduit into the 'Organisational Learning Wheel' and 'Process Management/Change Management Wheel'. These mechanisms are used to adjust (and re-align) the mechanics of the GAPP-IT model to match company-specific requirements. All process-related issues are then re-visited (by the Process Manager) to reflect best practice and improve the organisation's quality assurance (QA) systems and procedures.

Conclusion

The generic nature of this model is designed specifically to accommodate small to medium enterprises (SME), through to large construction conglomerates. IT training's contribution to the 'performance gap can be determined using this approach, the details of which can also help assess the need for (and impact of) IT training initiatives on the BS. Moreover, investment decisions can be evaluated against the performance gap using targets that measure IT training's contribution to the delivery of BS key performance indicators. In this context, this model can also be used to improve process by capturing (and sharing) best practice to facilitate continuous process improvement. This philosophy is in keeping with the concepts of organisational learning (OL), as identified by Argyris and Schon (1978), Senge (1990), Huber (1991) et al (where the collective actions of individuals are structured to improve organisational knowledge and performance).

The use of PP was particularly appreciated by process stakeholders (as the Integration Definition for Function Modelling (IDEF0) methodology still presents some users with difficulties due to complexity). However, whilst the PP approach instilled users with a greater understanding and awareness of process (especially from an holistic perspective), certain limitations were noted, specifically regarding it's inability to 'map' lower-level detail (which makes it difficult to determine process flow and connectivity below the first level), and some restrictions regarding process rules, conditions, and constraints. The GAPP-IT model identifies seven key process phases, each of which contain a series of process activities interconnected by hard or soft gates. This seven-phase arrangement was considered 'optimal' (in the trade-off between practicality and complexity). However, the exact number of phases used could equally be condensed (or expanded) to accommodate individual company requirements.

From an organisational performance perspective, construction companies can benefit from understanding how skills contribute to company performance (especially IT skills). However, it is important to note that the effectiveness of any IT training initiative can be influenced by many factors, not least, the prevailing level of organisational culture and overall commitment to training. Furthermore, the use of CMM concepts can be used to highlight progression stages, from 'immature unrepeatable processes', through to 'mature well-managed processes', the results from which can help organisations improve their appreciation of process maturity. Finally however, it is important to note that all findings and data generated from the GAPP-IT model should be routinely and systematically updated, as inaccurate (or out-of-date) information can adversely affect outcomes.

References

Ahmad I, Russell J and Abou-Zeid A (1995), Information Technology (IT) and Integration in the Construction Industry, *Construction Management and Economics Journal*, Vol. 13, Part 2, pp 163-171

Andresen, J.L (2000), The Unidentified Value of IT in the Construction Industry, *Proceedings of the International Conference on Construction Information Technology 2000*, Hong Kong Polytechnic University, Hong Kong, pp. 93-105

Andrews, K.R (1987), The Concept of Corporate Strategy, *Irwin Inc*, Illinois, USA

Aouad, G, Kagioglou, M, Cooper, R, Hinks, J and Sexton, M (1999), Technology Management of IT in Construction: A Driver or an Enabler?, *Logistics Information Management Journal*, Vol. 12, Part 1/2, pp 130-137

Argyris, C and Schön, D.A (1978), Organizational Learning: A Theory of Action Perspective, *Addison-Wesley*, Massachusetts, USA

Banwell, H (1964), Report of the Committee on the Placing and Management of Contracts for Building and Civil Engineering Works, *HMSO*, UK

Barrett, P (2000), Systems and Relationships for Construction Quality, International *Journal of Quality and Reliability Management*, Vol. 17, No. 4/5, pp 377-392

Betts, M (1992), How Strategic is Our Use of Information

Technology in the Construction Sector, *International Journal of Construction Information Technology*, Vol. 1, No. 1, pp 79-97

Betts, M, Cher, L, Mathur, K and Ofori, G (1991), Strategies for the Construction Sector in the Information Technology Era, *Journal of Construction Economics and Management*, Vol. 9, Part 6, pp 509-528

Broadbent, M and Weill, P (1997), Management by Maxim: How Business and IT Managers Can Create IT Infrastructures, *Sloan Management Review*, Spring, pp 77-92

Davenport, T.H (1993), Process Innovation: Reengineering Work Through Information Technology, *Harvard Business School Press*, Boston, Massachusetts, USA

Davenport, T.H and Short, J.E (1990), The New Industrial Engineering: Information Technology and Business Process Redesign, *Sloan Management Review*, Vol. 31, No. 4, pp 11-27

Davis, F.D (1993), User Acceptance of Information Technology: System Characteristics, User Perceptions and Behavioral Impacts, *International Journal of Man-Machine Studies*, No. 38, pp 475-487

Doherty J.M (1997), A Survey of Computer Use in the New Zealand Building and Construction Industry, *Electronic Journal of Information Technology in Construction*, Vol. 2, Http://www.itcon.org/1997/4/paper.htm

Earl, M, Feeny, D, Lockett, M and Runge, D (1988), Competitive Advantage Through Information Technology: Eight Maxims for Senior Managers, *Journal of Multinational Business*, No. 2, pp 15-21

Emmerson, H (1962), Survey of Problems Before the Construction Industries, *HMSO*, UK

Geletkanycz, M (1997), The Salience of 'Culture's Consequences': the Effects of Cultural Values on Top Executive Commitment to the Status Quo, *Strategic Management Journal*, Vol. 18, Part 8, pp 615-634

Goulding, J.S (2000) GAPP-IT: A Generic IT Training Model for Construction, PhD Thesis, *School of Construction and Property Management*, University of Salford, UK

Goulding, J.S, and Alshawi, M, (1997) Construction Business Strategies: A Synergetic Alliance of Corporate Vision, I.T and Training Strategies, *First International Conference on Construction Industry Development*, University of Singapore, 9-11 December 1997, Singapore

Grindley, K (1992), Information Systems Issues Facing Senior Executives: The Culture Gap, *Journal of Strategic Information Systems*, Vol. 1, Part 2, pp 57-62

Gunning, J.G (1996), Practical Change Management in Construction, *Proceedings of the CIB W89 Beijing International Conference*, Beijing, China

Hammer, M (1990), Reengineering Work: Don't Automate, Obliterate, *Harvard Business Review*, July/August, pp 104-112

Heng, L (1996), The Role of IT Manager in Construction Process Re-Engineering, *Building Research and Information Journal*, Vol. 24, Part 2, pp 124-127

Hinks, J, Aouad, G, Cooper, R, Sheath, D, Kagioglou, M, Sexton, M, (1997), IT and the Design and Construction Process: A Conceptual Model of Co-Maturation, *International Journal of Construction Information Technology*, Vol. 5, No.1, pp. 1-25

Horwitz, F.M (1999), The Emergence of Strategic Training and Development: The Current State of Play, *Journal of European Industrial Training*, Vol. 23, Part 4/5, pp 180-190

Huber, G.P (1991), Organizational Learning: The Contributing Processes and the Literatures, *Journal of Organization Science*, Vol. 2, No. 1, pp 88-115

Humphrey, W.S (1989), Managing the Software Process, *Addison-Wesley*, Massachusetts, USA

Johnson, G (1992), Managing Strategic Change – Strategy, Culture and Action, *Journal of Long Range Planning*, Vol. 25, Part 1, pp 28-36

Kagioglou, M, Cooper, R, Aouad, G, Hinks, J, Sexton, M, Sheath, D, (1998), Final Report: Process Protocol, University of Salford, UK, ISBN 090-289-619-9

Kessels, J and Harrison, R (1998), External Consistency: The Key to Success in Management Development Programmes?, *Journal of Management Learning*, Vol. 29, Part 1, pp 39-68

Klein, J.A, Edge G.M and Kass, T (1991), Skill-Based Competition, *Journal of General Management*, Vol. 16, Part 4, pp 1-15

Krogt, F and Warmerdam, J (1997), Training in Different Types of Organisations: Differences and Dynamics in the Organisation of Learning at Work, *International Journal of Human Resource Management*, Vol. 8, Part 1, pp 87-105

Korac-Boisvert, N and Kouzmin, A (1995), IT Development – Methodology Overload or Crisis?, *Science Communication Journal*, Vol. 17, Part 1, pp 57-89

Kumaraswamy, M (1997), Improving Industry Performance Through Integrated Training Programs, *Journal of Professional Issues in Engineering Education and Practice*, Vol. 123, Part 3, pp 93-97

Latham, M (1994), Constructing the Team, *HMSO*, UK

Luoma, M (2000), Developing People for Business Success: Capability-Driven HRD in Practice, *Management Decision Journal*, Vol. 38, Part 3, pp 145-153

Michalski, G.V and Cousins, J.B (2000), Differences in Stakeholder Perceptions about Training Evaluation: A Concept Mapping/Pattern Matching Investigation, *Journal of Evaluation and Program Planning*, Vol. 23, No. 2, pp 211-230

Miles, D.W.J and Neale, R.H (1997), Patterns in Diversity: An International Training Systems Typology, *Proceedings from the 1st International Conference on Construction Industry Development: Building the Future Together*, University of Singapore, Singapore, pp 142-152

Mintzberg, H and Quinn, J.B (1991), The Strategy Process: Concepts, Contexts, Cases, *Prentice Hall International*

(UK) Ltd, London, UK.
Mockler, R and Dologite, D (1995), Easing Information Technology Across Cultural Boundaries – A Contingency Perspective, *International Journal of Computer Applications in Technology*, Vol. 8, Part 3-4, pp 145-162
Moreton, R and Chester, M.F (1997), Transforming the Business - The IT Contribution, *McGraw Hill Book Company*, London, UK
O'Connell M (1996), Training as a Potential Profit Center, *Journal of Management in Engineering*, Vol. 12, Part 5, pp 25-27
Paulk, M.C, Weber, C.V, Garcia, S.M, Chrissis, M.B and Bush, M (1993), Key Practices of the Capability Maturity Model Version 1.1, Software Engineering Institute Technical Report CMU/SEI-93-TR-25 and ESC-TR-93-178, *Carnegie Mellon University*, Pennsylvania, USA
Peppard, J (1995), Management Challenges in Information Systems, *Journal of Information Technology*, Vol. 10, pp 127-130
Philip, G, Gopalakrishnan, M and Mawalkar, S.R (1995), Technology Management and Information Technology Strategy – Preliminary Results of an Empirical Study of Canadian Organisations, *International Journal of Information Management*, Vol. 15, Part 4, pp 303-315
Robson, W (1997), Strategic Management & Information Systems, *Pitman Publishing*, London, UK
Rockart, J.F, Earl, M.J and Ross, J.W (1996), Eight Imperatives for the New IT Organization, *Sloan Management Review*, Vol. 38, Fall, pp 43-55
Samler, T (1993), Getting the Most out of IT Professionals, *Training and Development*, July, pp 14-17
Sarshar[1], M, Finnemore, M, Haigh R, Goulding, J (1999), SPICE: Is a Capability Maturity Model Applicable in the Construction Industry?, *Proceedings of the Durability of Building Materials and Components Conference 8*, Vancouver, Canada
Sarshar[2], M, Betts, M and Ridgeway, M (1999), Does

Construction Need an Information Strategy Planning Methodology?, *Proceedings of the CIB W55 & W65 Joint Triennial Symposium*, Cape Town, South Africa

Senge, P.M (1990), The Fifth Discipline: The Art and Practice of the Learning Organization, *Currency Doubleday*, New York, USA

Sleezer, C (1993), Training Needs Assessment at Work: A Dynamic Process, *Human Resource Development Quarterly*, Vol. 4, Part 3, pp 247-264

Taylor-Cummings, A (1998), Bridging the User-IS Gap: A Study of Major Information Systems Projects, *Journal of Information Technology*, Vol. 13, Part 1, pp 29-54

Tonks, D.G and Wan, A (1991), The Hidden Curricula of Marketing Simulations, *Simulations/Games for Learning*, Vol. 21, Part 3, pp 220-236

Venegas, P and Alarcón, L (1997), Selecting Long-Term Strategies for Construction Firms, *Journal of Construction Engineering and Management*, Vol. 123, Part 4, pp 388-398

Valiris, G & Glykas M (1999), Critical Review of Existing BPR Methodologies – The Need for a Holistic Approach, *Business Process Management Journal*, Vol. 5, No.1, pp 65-86

Walsham, G (1993), Reading the Organisation: Metaphors and Information Management, *Journal of Information Systems*, Vol. 3, pp 33-46

Ward J and Griffiths P (1997), *Strategic Planning for Information Systems*, John Wiley and Sons, Chichester, England

Ward, J and Peppard, J (1996), Reconciling the IT/Business Relationship: A Troubled Marriage in Need of Guidance, *Journal of Strategic Information Systems*, Vol. 5, Part 1 pp 37-65

Young, E (1989), On the Naming of the Rose: Interests and Multiple Readings as Elements of Organisational Culture, *Journal of Organisational Studies*, Vol. 10, Part 2, pp 187-206

A Rating System for AEC E-bidding that Accounts for Rater Credibility

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Abstract

We believe that a rating system can substantially improve the effectiveness of an AEC e-commerce market since it can provide a means for market participants to share information about performance. One critical issue in the design of rating system is how to weight the ratings depending on who is the rater. Source credibility theory from the area of communication science offers a solution to this problem since it provides a means for user's to explicitly rate the reliability of a given rater. We also claim that it is important what type information that is available for assessing the raters' credibility. In this paper we propose a model for calculating ratings of AEC subcontractors based on the user's different types of information about the credibility of the rater. When comparing this model to a standard un-weighted model in an experiment we found that users using the credibility weighted model both varied decisions more and also were more confident in the ratings. Finally we found rater agreement and the total credibility of all raters that had rated a subcontractor, as well as the aggregate ratings to influence bidding decisions.

Keywords: Rating system, e-commerce, bidding, construction industry, source credibility, trust

Introduction

The Internet offers the opportunity for buyers and sellers to find new market partners at a low cost (Bakos 1997). The large and fragmented Architecture Engineering Construction (AEC) industry would therefore offer a potentially excellent

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arena for e-commerce. In April 2000 approximately $1 Billion had been invested in around 200 AEC e-commerce start-ups (Bass 2000). In reality the amount of transactions conducted in these new e-market places turned out to be very low, and only a few of them are still in business today (August, 2001). We argue that one barrier to adoption is the lack of trust in the participants in e-market places. AEC General Contractors, subcontractors, and suppliers are unlikely to do business with firms about which they do not know anything. Zolin has identified 3rd party information and gossip as one important source of trust in a model that has been validated in the context of AEC virtual teams (Zolin 2000). In this paper we investigate how a rating tool can formalize such 3rd party information in order to support trust in AEC e-commerce.

The current practice among US general contractors to evaluate the potential bidders on a project is what one chief estimator described as a "vague" process. The estimator uses his judgment in combination with information from a variety of sources to evaluate the quality of potential subcontractors. Efforts to create web based formalized prequalification systems have been undertaken in, for example, Norway (etat 2000) and Finland (Ralacon 2000). A prequalification system warrants that a market participant's goods or services are above a certain minimum standard but do not provide an accurate measure of their quality.

E-commerce has in general had a faster penetration into the consumer market compared to the Business to Business (B2B) field. It is therefore natural that the earliest and most adopted commercial rating systems can be found in consumer-to-consumer (C2C) e-commerce. eBay (eBay 2000) is the largest and most successful Internet Auction, enabling transactions between private parties. It currently (Aug 2001) has over 29.7 million registered users. These users buy and sell items that are varied, often difficult to describe, and cannot be easily evaluated, and trust is therefore a prerequisite for the transactions to take place. To foster trust, eBay has created a system by which the market participants rate each other after each transaction. The buyer will give the seller a good rating if he or she received the items in good condition (Kaiser and Kaiser 1999). A seller's aggregated positive and negative ratings are then displayed on the eBay web site. The advantage of eBay's rating system is that it is simple and intuitive to use. The problem is that all ratings weigh the same. It assumes that all raters are equally credible and trustworthy. This assumption may be valid in C2C auctions but we doubt that it will be for complex B2B transactions, such as AEC bidding. More sophisticated rating solutions have been presented in the Business to Consumer market comprising ratings of multiple criteria (e.g., Bizrate), and weighting of ratings depending on a network of trust (e.g., epinions.com). In the B2B area openratings.com have presented a solution that relies on sophisticated statistical analysis of past performance and rating behavior to calculate an overall rating (isource 2000). However, we argue that none of these solutions directly addresses the problems facing an AEC e-commerce market, being overly simple (ebay and Bizrate), and requiring a substantial amount of transaction data to calculate the ratings (Openratings). We therefore believe that a new approach is necessary and in this paper we investigate how different theoretical frameworks can be used as a basis for an AEC rating system. We describe a prototype rating tool and present the results from an experiment that tested the performance of different rating tools.

Theoretical Foundations of the Study

There are several candidate methods that can be used for synthesizing uncertain information from sources of varying reliability. Zacharia et al (Zacharia, Moukas et al. 1999) have proposed a complex rating mechanism (partly commercialized as Openratings.com described above) where the weight of the ratings is dependant on to what extent the user trusts the rater along with previous rating behavior. It does however equate trust in a business partner with trust in a rater. It is far from certain that just because a general contractor is be regarded as a trustworthy employer of subcontractors they are therefore also a credible rater. Fuzzy set theory offers a formalized manner with uncertain information and Zimmerman (Zimmerman and Zysno 1983) and others (Chen and Chiou 1999) (Romaniuk and Hall 1992)) has applied fuzzy set theory to the credit rating processes conducted by banks, a process similar to an AEC rating problem. Another potential solution is subjective probabilities where the reliability of the sources can be modeled by adjusting the variance of the output function. Such a model could be operationalized using for example Howard's 5-step interview process (Howard 1984). A common feature of all the methodologies discussed above is that they work very well once you have the right input information. If you model and accurately measure the reliability of a source and how it interacts with the message (rating) the synthesizing of the information can be done in a consistent and unarbitrary manner. However, without the correct input they provide little value in themselves. We argue that the major problem in creating a functioning rating mechanism instead seem to be to accurately model and measure the reliability of the sources. Unless this can be done in a non-arbitrary manner the algorithms serving to calculate the overall rating add little value in a real world situation. One way to approach this problem is to take recourse in communication where source credibility theory has been developed to explicitly judge the credibility of media sources. In the following paragraphs we investigate how source credibility can be operationalized and extended in order to "rate the rater" in an AEC rating system.

Source Credibility theory

The foundations to source credibility theory were laid by Hovland, Janis and Kelly (Hovland, Janis et al. 1953), who identified the perceived trustworthiness and the perceived expertise as the main dimensions of a source's credibility. The higher the trustworthiness and expertise a source are perceived to have, the higher will be the importance given to information coming from that source. Early work in the field applied source credibility in the context of public opinion (Hovland and Weiss 1951; Hovland, Janis et al. 1953; Berlo, Lemert et al. 1969) and interpersonal communication. (Berlo, Lemert et al. 1969). Later studies have shown that source credibility theory applies also applies to commercial settings where the receiver of information is evaluating possible transactions. Examples can be found in areas such as advertising (Vandenbergh, Soley et al. 1981), evaluations of used cars (Birnhaum and Stegner 1979), job offer acceptance (Fisher, Ilgen et al. 1979), buy or lease decisions (Harmon and Coney 1982), job performance - evaluations (Albright and Levy 1995), admitting students to business schools (Higgins 1999) and price-perceived risk relationships (Grewal, Gotlieb et al. 1994). Our conclusion is that the task of a contractor evaluating the performance of a subcontractor share similar characteristics with the situations listed above, and we therefore hypothesize that source credibility can also be used to assign weights to different raters in an AEC rating system. The McCroskey (McCroskey 1966) 12 item Likkert scale that has emerged as the predominant measure of source credibility is very similar to Hovland's original concept. McGroscey's Authorativeness and Character correspond to Hovland's Trustworthiness and Expertise, respectively. We have therefore chosen to use this scale to operationalize the evaluation the credibility of message sources in the model below. It has been cited over 100 times and "seems to have emerged as the predominant method of scaling"(Rubin, Palmgreen et al. 1994). In order to avoid confusion, I will still use the terms *Trustworthiness* and *Technical Expertise* (the most commonly used definitions) throughout this note.

Types of information available to judge rater

credibility

Given that source credibility is used as the basis of a rating application the first step is to assess the credibility of the source, the rater. Based on interviews with potential users (AEC project managers and estimators) and previous research we have identified the following types of information that can be used to deduct rater credibility.

First Hand Knowledge- If the user personally know the rater they can themselves directly asses the credibility of this person.

2nd Hand Knowledge – If the user knows a credible person who states that the rater is credible, this is likely to positively influence the user's assessment of the rater's credibility (*Rohit Khare* 1997; Zacharia, Moukas et al. 1999). However, one cannot assume that trust is perfectly transitive (that you trust a friend of a friend as much as a friend) (Abdul-Rahman and Hailes 2000).

Credibility measure inferred from network– Another interesting measure of credibility of a rater is to measure how many other users find particular rater credible. Similar models have been proposed by other researchers (*Rohit Khare* 1997; Higgins 1999; Zacharia, Moukas et al. 1999).

Credibility of the Organization - Newhagen and Nass (Newhagen and Nass 1989) point out the importance of differentiating between an organization and an individual when evaluating the credibility of a message source. Our interviews with industry practitioners show that this is certainly true for the construction industry. An estimator may regard a GC as an organization that is the definition of dishonesty and corrupt behavior but still trust those of the GC's employees that he/she knows on a personal basis.

Past ratings – Statistical analysis of past ratings can provide a measure of the expertise and trustworthiness of raters in the AEC e-commerce market. This solution has been proposed by Avery et al. (Avery 1999) for an Internet market for consumer evaluations. They suggest that a statistical analysis will provide a means of monitoring the quality of subjective information such as ratings. The idea is that someone whose ratings deviate substantially from those of the rest of the market may not be honest or do not posses the expertise to rate properly. However, as Avery et al. point out, if you only penalize raters that are too far from the mean, this may discourage actors from posting idiosyncratic opinions and result in a universal "average" rating. In their article they suggest that raters should be penalized both for staying too close to and too far from the average.

Other factors affecting weight of ratings

Rater credibility is not the only factor that influences the weight of a rating.

Zacharia et al (Zacharia, Moukas et al. 1999) point out that time is another important factor. Based on interviews we have found that ratings that were more than 2 years old were regarded as substantially less credible than recent ones, even though the discount factors seemed to be highly individualized.

Stone and Stone (Stone and Stone 1984) reported that information from two sources was perceived to be more credible than from a single source. As a result, a potentially useful indicator to the user would that of total rater credibility corresponding to the sum of the credibility of all raters that have rated a given subcontractor. A user may want to know whether only one rater with low credibility has rated a subcontractor or if the overall ratings are based on those from several very credible raters.

They also found (Stone and Stone 1985) feedback consistency to be an important indicator when assessing the accurateness of performance feed back from multiple sources. Similarly, Albright and Levy also found that (Albright and Levy 1995) rating discrepancy to b be an important factor affecting recipients reactions to ratings. We therefore propose the calculation of an agreement index that is displayed to the user.

Grewal, Gotlieb and Marmorstein (Grewal, Gotlieb et al. 1994) identified the importance of message framing when assessing risk. Our initial investigations indicate that some AEC decision makers tend to attribute greater importance to negative ratings compared to positive ones. We propose that this effect can be accounted for by modeling each user's risk preference.

A rating tool operationalizing source credibility theory

In order to investigate in what ways source credibility theory can support AEC ratings we designed a rating tool. The first version of the tool is limited to two of the types of information that can support credibility: direct knowledge and organization. This credibility weighted rating tool follow a 3-step process :

Step 1: Credibility Input

The tool lets the user rate three different types raters on the 12 item McCroskey credibility scale:

***Unknown Rater**:* The user is asked to evaluate a person that he/she is unfamiliar working for a unknown organization. The user's z-scores for each item are added together to obtain credibility of an unknown rater C_u. This corresponds to the base line credibility that the user attributes to attributes to anybody working on the AEC industry.

***Unknown Rater, Known Organization**:* The z-scores added in the same way as above. The credibility of the organization C_o

then equals the sum of z-scored minus then credibility of the unknown rater (C_u). This way C_o reflects the net credibility attributed to the organization that the rater works for.

Direct Knowledge: In this case the user knows the rater (and therefore also the organization. The personal credibility of the rater C_p now equals sum of the z-scores minus the credibility of an unknown rater (C_u) minus the credibility attributed to an unknown rater working for the same organization (C_o.)

Step 2: Calibration

To aggregate the three measures of credibility (C_p, C_o and C_u) it is necessary to calculate the weights (α, β_p and β_o) that the user attributes to credibility information relating to the three measures. These measures reflect the user preferences when aggregating credibility information. A user may consider direct information about the rater or the organization much more important than any other information while another user may find all rater more or less equally credible. To estimate these weights we use a methodology of pairwise comparisons that have been widely adopted in decision-making tools that apply the Analytic Hierarchy Process (AHP). Normally in AHP, an eigen-vector method is then used to calculate the weights of the different criteria allowing for inconsistencies among the pairwise comparisons. However, one obtains similar results using a least-square method (Hwang and Yoon 1987), which has the advantage that it can be readily adapted to account for the added complexity of our 3-level model. The users are shown a user interface where a painting subcontractor ("PaintA") had been rated by two of the seven raters. Rater 1 rated PaintA's performance as "Good", the Rater 2 claims it was "Poor". Participants were asked to submit their evaluation by dragging a continuous slide-bar in between the values "Poor" and "Good". This value (w_{12}) corresponds to the weight that the user attributes to rater 1's ratings vis-à-vis rater 2's. By modeling the credibility of each rater as an exponential function we then obtain the following model for w_{12}:

$$w_{12} = C_1/(C_1+C_2)$$

where
$C_j = 1/1\text{-}\exp(-(\alpha+\beta_p*C_{pj} + \beta_o*C_{oj})$
$j = 1,2$

We can then estimate α, β_p and β_o by minimizing:

$$\sum_{k,l}(w_{kl} - w_{kl})^2$$

The estimation will then correspond to a logistic regression.

The overall rating R_i of a subcontractor i will then equal the ratings provided by each rater j multiplied by the rater's estimated credibility. As a result, we obtain the following straightforward formula:

$$R_i = \sum_j R_{ij} * C_j / \sum_j C_j$$

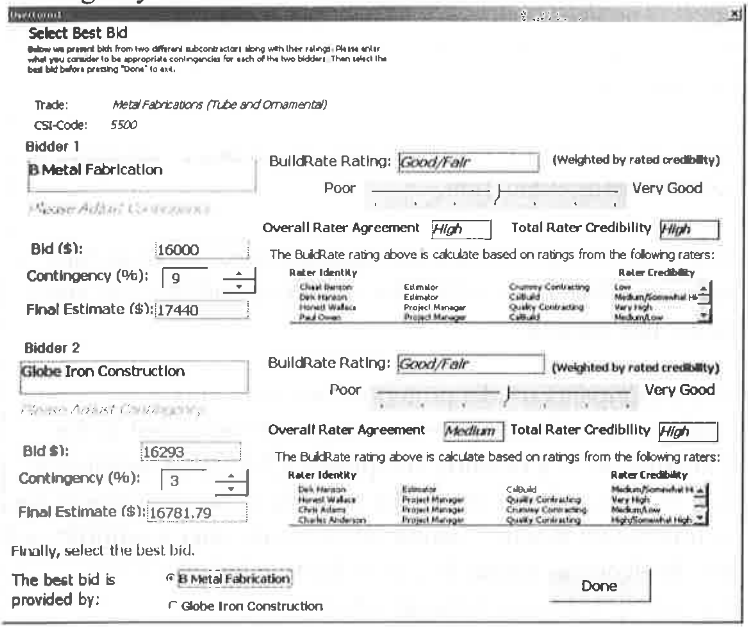
$$Rij \neq 0$$

Having calculated a numeric value for the credibility of each rater, the system then asks the user to rate the rater with the highest and lowest numeric values on a 10 point Likkert scale in order to the translate the numeric values to a symbolic values.

In order to calculate rater agreement we use an adoption of a raw agreement index (see for example (Uebersax 2001)). The adoption consists of incorporating the notion of rater credibility when calculating rater agreement. Total credibility is simply the sum of all the raters individual credibility. The user can also see a symbolic measure ("High"," Medium", "Low") of the agreement between the rater and their overall credibility.

Step 3: Display Ratings/Select bidders

In the prototype user interface the user can see the calculated values for two different subcontractors. An example of the final user interface is shown in Figure 1 below. . The user can see overall rating (weighted by credibility) both on a continuous scale and as a symbolic vale. She can also see the agreement raters of each contractor along with their assessed credibility. The prototype also allows the user to input contingency for each bid and select the best bidder.



An experiment to evaluate rating systems for bidding

In order to test the applicability of source credibility theory as a basis for an AEC rating system we designed experiment that compared three different rating mechanisms:

Unweighted Ratings: The subcontractor's overall ratings are calculated as the average rating where all raters weigh the same. The user is shown the number but not the identity of the raters that have rated the subcontractor. This is the standard mechanism similar to for example eBay's and Bizrate's systems.

Credibility weighted Tool: This tool is described above and ach subcontractor rating is weighted by the user-defined credibility of the rater. The rater is shown the overall rating along with the total credibility of and agreement between the raters. The major purpose of the experiment was to compare the performance of this mechanism with the unweighted mechanism.

No ratings: The users do not have any ratings to support the subcontractor evaluation.

prototype rating tool. We included this mechanism to have a base-line measure to which we could compare the two above rating mechanisms.

The participants used a prototype tool to evaluate subcontractors bidding for the trades subcontracted in the construction of a recently completed $5M office building in San Francisco, California. The purpose of the experiment was to investigate whether taking into account rater credibility will aid the decision-maker that is evaluating bids from a previously unknown subcontractor.

The experiment was designed to test the following hypotheses:

H1: In the context of making pairwise comparisons credibility measures based on the McCroskey scale is no better than a unweighted (constant) model when it comes to predicting the weights users attribute to different raters.

H2: Users will vary their bid evaluations more when using credibility weighed rating tool than when using an unweighted rating tool.

H3: Users will be more confident in the correctness of their decisions when using the Credibility weighted rating tool than when using an unweighted tool.

H4: When using a credibility weighted rating tool to evaluate bids users will take into account agreement and total credibility as well as the overall rating.

Method

Participants

The participants were 16 construction management students, faculty and professionals (ages ranged between 24 and 55, M= 34.5, SD=9.3). They were all familiar with AEC bidding. They were all fluent in English even though they were of various origin (European= 8, Asia=6 and North America=2). The participants were randomly assigned to the condition regarding the order in which the different rating tools were presented.

Procedure

The experiment was a within subject design that carried out on an individual basis where each participant was supervised by an instructor. The experiment was carried out on a personal computer at the participant's place of work. The instructor began by showing the participant a 10 minute tutorial introducing the concept of rating systems. The instructor then opened a Microsoft Excel program and asked the participant to press "Run" to start the program.

At the start of the application, participants read an introduction telling them that they were going to act as a project manager at a general contractor in charge of composing a bid to the owner to construct a small office building. To their aid they would have three different Internet based rating systems.

After having read the instructions, participants were asked to name three different people in the construction industry working for different organizations. Next the participants were asked to rate seven different people using the McCroskey source credibility scale. The rated people were; the three persons the participants had named, three unknown project managers working for the same company as the 3 named persons, and finally an unknown project manager working for an unknown contractor.

After having completed the subcontractor ratings, the participants were asked to calibrate the rating tool. This was done by having the participants make pairwise comparisons of the credibility of the different raters as described above. This was repeated for all possible (21) pairs of raters before the system performed a logistic regression. Finally, the users were asked to "for statistical purposes" re-enter those values where the regression found a particularly high error in order verify that the entered value was not a mistake.

After having finished the calibration, the participants evaluated one pair of subcontractor for each of the 17 trades on the job. The participants were shown bids from each of the two subcontractors and asked to add contingency to each bid along with selecting the best bidder. To support their decisions they had ratings of the subcontractors in one of the three rating tools.

After having finished the evaluation of the 17 pairs bidding subcontractors, the participants were asked to provide information for the general contractor's "risk management program" by assessing the likely performance (along with the confidence in their judgment) of a pair of bidders rated using each of the three tools.

Finally, the participants filled out a final questionnaire about their attitude towards rating system and their experience during the experiment.

Manipulation

Given the exploratory nature of the study we decided to work with hypothetical data. For each of the 17 trades we invented two competing subcontractors. We also created 8 raters who each had evaluated some but not all of the subcontractors. We then randomly generated ratings of the subcontractors. The subcontractors also bid random amounts but for each trade the two bids were correlated so that they did not differ by more than 5%. The tool provided three different user interfaces corresponding to the rating systems (unweighted, credibility weighted, and no ratings.) The user interface for the credibility weighted system was the most complex and is shown in Figure 1. Both the agreement and the total credibility measures were relative and with arbitrarily chosen cut off values. The 40% of subcontractors where the raters agreed the most were assigned to have "High" agreement, the 30% with the lowest agreement were shown as "Low" and the midrange as "Medium".

The unweighted rating tool was a simplified version of the credibility weighted rating tool. The user could see the average rating on both a symbolic and continuous scale along with the number of people that had rated the subcontractor. However he did not know who had rated the subcontractor.

The tool without ratings was very simple. It consisted of the two subcontractors' names and bids.

Measures

Rater credibility was measured with the McCroskey 12 item credibility scale.

Goodness of fit of model was measured using the sum of squared errors in the pairwise comparisons for the two models.

Bid contingency was measured with a single item. The users entered a number between 0-100% for bid contingency. This number was intended to reflect both their assessment of the risk buffer that should be added to the bid both and the extra cost of managing an under-performing subcontractor.

Users' confidence in their assessments was measured with a single item "How confident are you in your judgment?"

Risk Attitude: We measured the user's risk attitude by letting them make pairwise assessments of two pairs of unknown subcontractors. Participants who put on average more than 55% weight on the negative rating was categorized as risk averse.

Results

Goodness of Fit

To test H1 we performed a generalized maximum likelihood ratio test (see for example (Rice 1995)) to compare the unweighted and the credibility weighted models. The errors were considerable larger for the unweighted model (see Table 1.)

Unweighted	Credibility Weighted
17.52	5.11

Table 1 Sum of Squared Error (N=336)

The result was that H1 could be rejected ($p<0.001$). This indicates that the credibility-weighted is superior to the unweighted model when it comes to predicting weight of raters.

We also performed a principal component factor analysis to check whether the McCroskey scale did factor into the two factors "perceived expertise" and "perceived trustworthiness". We limited this analysis to those cases where participants knew the raters personally. The results were encouraging but non-conclusive. As shown in the appendix when using varimax rotation and a cut-off eigen value of 1 we obtained 3 factors.

The first two corresponded to the expected perceived trustworthiness and expertise respectively. However, two items expected to belong to the expertise factor ("reliable" and "intelligent") were evenly distributed over the two factors. The word "reliable" was expected to cause some problems given its dual meaning in English. The even distribution of the world "Intelligent" was more surprising. One explanation may be that this was seen as a sensitive item by some of the Europeans, two of which pointed out that they did not feel comfortable rating their peers on this item. Furthermore, the analysis shows "selfish" as a third separate factor.

However, even though the credibility weighted model seemed to perform better than the unweighted model it was not problem free. Problem areas in the calibration phase was to accurately find the zero point for C_p and C_o. Some users gave a known rater lower credibility ratings on than a rater where they only knew the organization but still found the former more credible when making a pairwise comparison. When later asked about the reason for this behavior they explained that even though the person was not very credible it was "someone you know". This indicates that a more elaborate model than simply subtracting by the appropriate C_o and C_u is called for. We believe that most problems can be addressed by refining both the operationalization of the McCroskey and the user interface design.

Contingency

The contingency added to the bid varied significantly more for the credibility weighted tool compared to the unweighted tool and the tool with no ratings, as shown in Table 2. H2 is supported since the difference in variance between the credibility weighted tool and the unweighted tool are statistically significant (F-Test: N= 176, $p<0.01$). This indicates that the users will vary their decision regarding the evaluation of subcontractors more using a credibility-weighted tool. As a result the bidding price will be of less importance.

	Unweighted	Credibility weighted	No Ratings
Variance	0.12	0.23	0.07

Table 2 Credibility weighted tool

Confidence

The participants also expressed higher confidence in the unweighted tool compared to the two other tools. Again the difference between the credibility weighed and the unweighted tools were statistically significant (T-test: N=32, p<0.01). This is consistent with the results for the bid contingency described above. A confident user will be more likely to vary her decision depending on the information provided by the rating tool.

Unweighted ratings	Credibility Weighted ratings	No Ratings
5.00	5.95	3.17

Table 3 Confidence in judgment

Agreement and Total Credibility

Agreement and Total Credibility - Both agreement (p<0.01) and total credibility (p<0.05) proved to be determinants (along with Final (Overall) Rating (p<0.01)) of bid contingency as shown Table 3 below. Overall Rating, Agreement and Total Credibility

Coefficients [a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	2.948	.260		11.341	.000	2.431	3.465
Final Rating	-.213	.036	-.560	-5.896	.000	-.284	-.141
Agreement	-.238	.065	-.349	-3.674	.000	-.368	-.109
Total Credibility	-.129	.055	-.212	-2.349	.021	-.238	-.020

a. Dependent Variable: Bid Contingency (N=176)

Table 4 Linear Regression of Bid Contingency

The results are therefore consistent with H4 presented above.

Nonetheless, we should mention that due to a methodological problem the total credibility index did not prove to be all that useful. This is because the experiment only included a limited number of raters (<8). Consequently the users could easily identify the raters and assess their total credibility by herself. The aggregate credibility measure was therefore less useful than what would not have been the case if the participants had been dealing with 40-80 to raters instead of 4-8.

Risk Attitude

4 out of the 16 users turned out to be risk averse. The remaining 12 turned out to be risk neutral. This supports the concept of modeling each user's risk attitude.

Discussion

The study suggests that source credibility is a promising basis for an AEC rating system. By filtering the ratings depending on the perceived credibility of the rater, users are likely to both let the rating tool influence their decisions to a larger extent and also be more confident in their judgments.

Furthermore the study indicates that both agreement and total rater credibility to be importance factors when evaluating ratings. Especially agreement seemed to be an important factor to many users. This study suggest a number of avenues for future research.

First, The model to measure credibility can also be elaborated in a number of ways. A first step would be to keep expertise and trustworthiness as separate indicators of credibility. We observed that users put varying importance into these two factors when assessing rater credibility. In some cases a trusted but inexperienced friend was even considered to be less credible than an unknown rater working for an unknown general contractor. We also believe that it would be interesting to explore the importance of time as well as the other types of information supporting credibility assessments outlined above (network, past ratings, and 2nd hand knowledge). Finally, an elaboration of the model suggested by several participants would be to deal with more than one criterion as an indicator of subcontractor performance. We have currently identified 7 criteria suited for subjective evaluations of AEC subcontractors.

Secondly one should repeat the experiment in more realistic conditions. This requires working with a group of participants that act in the same market and which are familiar with one another to a certain extent. These participants can rate a set of subcontractors before using the tool to complete the rating exercise. Such a study could also investigate the likelihood that different rating mechanism would have when it comes to influencing bidding decisions. Under what circumstances will a rating prevent the decision-maker from choosing the lowest bid?

Furthermore, such a study would enable researchers to statistically test the importance of the different types of credibility information using the user's own rating of the subcontractor as the target function.

A final interesting area of study would be to compare the performance of different rating tools in intra-company and marketplace settings. In an intra-company setting the general level of credibility would be higher than when dealing with raters from other contractors in an e-market. Still, several participants expressed the need for a credibility weighted rating system internally for a general contractor arguing that the credibility could vary substantially between different potential raters within the organization

Finally, we want to emphasis that a rating system that accounts for rater credibility will not be able to enforce truthful behavior in an Internet rating system. A prerequisite is an altruistic (truthful) behavior from a substantial fraction of the participants in the rating system. Still, we predict that a credibility weighted tool would provide the user with a means to filter out ratings of dubious nature. Such a tool could an important building block in a framework to create trust in AEC e-commerce. By rating the rater the user can come one step closer to trusting new business partners in AEC e-market places.

Appendix – Results from factor analysis

Rotated Component Matrix[a,b]

	Component		
	1	2	3
RELIABLE	.549	.544	.127
Uninformed	2.848E-02	.815	-8.04E-02
Unqualified	9.688E-02	.886	-.103
Intelligent	.470	.491	1.453E-02
VALUABLE	.429	.776	-6.79E-02
INEXPERT	6.736E-02	.884	-7.74E-02
HONEST	.740	.316	.117
Unfriendly	.843	8.093E-02	5.236E-02
PLEASANT	.906	9.179E-02	2.212E-02
SELFISH	.360	-2.14E-02	.857
AWFUL	.875	6.814E-02	-1.40E-02
VIRTUOUS	.473	.330	-.629

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

b. Only cases for which SELECTED = 1 are used in the analysis phase.

Bibliography

Abdul-Rahman, A. and S. Hailes (2000). *Supporting Trust in Virtual Communities*. Hawaii's International Conference on Systems Sciences, Maui, Hawaii, IEEE.

Albright, M. D. and P. E. Levy (1995). "The Effects of Source Credibility and Performance Rating Discrepancy on Reactions to Multiple-Raters." *Journal of Applied Social Psychology* **25**: 557-600.

Avery, C., Reznick, P., Zeckhauser, R. (1999). "The Market for Evaluations." *American Economic Review* **89**: 564-584.

Bakos, Y. J. (1997). "Reducing Buyer Search Costs: Implications for Electronic Commerce." *Management Science* **43**(12): 1676-1992.

Bass, C. (2000). Speach At CEE 320, Stanford University.

Berlo, D. K., J. B. Lemert, et al. (1969). "Dimensions for evaluating the acceptability of message sources." *Public Opinion Quarterly* **33**: 536-576.

Birnhaum, M. H. and S. E. Stegner (1979). "Source Credibility in Social Judgment: Bias, Expertise and the Judge's point of view." *Journal of Personality and Social Psychology* **37**(1): 48-74.

Chen, L.-H. and T.-W. Chiou (1999). "A fuzzy credit-rating approach for commercial loans: a Taiwan Case." *Omega, International Journal of Management* **27**: 407-419.

eBay (2000). *About eBay*.

etat, S. B. (2000). *Godkjenningskatalogen* - Godkjente foretak, Statens Bygningstekniske etat. **2000**.

Fisher, C. D., D. R. Ilgen, et al. (1979). "Source Credibility, information favorability, and job offer acceptance." *Academy of Management Journal* **22**(1): 94-103.

Grewal, D., J. Gotlieb, et al. (1994). "The Moderating Effects of Message Framing and Source Credibility On the Price-Perceived Risk Relationship." *Journal of Consumer Research* **21**(1): 145-153.

Harmon, R. R. and K. A. Coney (1982). "The persuasive effects of source credibility in buy and lease situations." *Journal of Marketing Research* **19**: 255-260.

Higgins, M. (1999). “Meta-information ; and time: Factors in human decision making.” *Journal of the American Society For Information Science* **50**(2): 132-139.
Hovland, C. I., I. L. Janis, et al. (1953). *Communication and Persuasion*. New Haven, Yale University Press.
Hovland, C. I. and W. Weiss (1951). “The Influence of Source Credibility on Communication Effectiveness.” *Public Opinion Quarterly*.
Howard, R. A. a. J. E. M., Ed. (1984). *Readings on the Principles and Applications of Decision Analysis*. Menlo Park, Strategic Decisions Group.
Hwang, C.-L. and K. Yoon (1987). *Multiple Attribute Decision Making - Methods and Applications*. New York, Springer-Verlag.
isource (2000). Are They Trustworthy? *isourceonline*.
Kaiser, L. F. and M. Kaiser (1999). *The Official eBay Guide*. New York, Simon & Schuster.
McCroskey, J. C. (1966). “Scales for the measurement of ethos.” *Speech Monographs* **33**(1): 65-72.
Newhagen, J. and C. Nass (1989). “Differential Criteria for Evaluating Credibility of Newspapers and TV News.” *Journalism Quarterly* **66**(2): 277-284.
Ralacon (2000). Rakentamisen Laatury (RALA) : Qualification for construction enterprises in Finland in 2000, Ralacon.
Rice, J. A. (1995). *Mathematical Statistics and Data Analysis*. Belmont, Wadsworth Publishing Company.
Rohit Khare, A. R. (1997). *Weaving the Web of Trust*. Pasadena, Computer Science, California Institute of Technology.
Romaniuk, S. G. and L. O. Hall (1992). “Decision making on creditworthiness using a fuzzy connectionist model.” *Fuzzy Sets and Systems* **15-22**(48).
Rubin, R. B., P. Palmgreen, et al., Eds. (1994). *Communication Research Measures: A Sourcebook*. New York, Guilford Publications.
Stone, E. F. and D. L. Stone (1984). “The effects of multiple

sources of performance feedback and feedback favorability on self perceived task competence and perceived feedback accuracy." *Journal of Management* **10**: 371-378.

Stone, E. F. and D. L. Stone (1985). "The effects of feedback consistency and feedback favorability on self-perceived task competence and perceived feedback accuracy." *Organizational Behavior and Human Decision Processes* **36**: 167-185.

Uebersax, J. S. (2001). *Raw Agreement Indices*. **2001**.

Vandenbergh, Soley, et al. (1981). "Factor Study of Advertiser credibility." *Journalism Quarterly* **58**.

Zacharia, G., A. Moukas, et al. (1999). *Collaborative Reputation Mechanisms in Electronic Marketplaces*. Thirty-second Annual Hawaii International Conference on System Sciences (HICSS-32), Wailea, Hawaii.

Zimmerman, H.-J. and P. Zysno (1983). "Decision Evaluations by hierarchical aggregation of information." *Fuzzy Sets and Systems* **10**: 243-260.

Zolin, R. (2000). *Modeling and Monitoring Trust in Virtual A/E/C Teams*. Stanford, Stanford University.

On the Economic Characteristics of Construction Procurement Systems

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Abstract

This paper examines the economic characteristics of procurement systems mainly in terms of transaction cost economics. This is an important founding block for a positive theory of construction procurement behaviour. This paper puts forth the theoretical principle of an *inconsistent trinity*, according to which, to determine the most efficient procurement method, the client will inevitably face the trade-off between (1) fastest delivery of the project, (2) high flexibility in accommodating changes (lower transaction costs arising from process specificity) as well as (3) single point of responsibility for design and construction (lower transaction costs from measurement problems).

Keywords: transaction costs, asset specificity, measurement costs, procurement route

Introduction

The study of construction procurement route in recent years have received lots of academic interest. The unit of analysis can be either an individual project or the whole supply chain of the client's company (eg., Cox,1997,1998). In view of the paucity of systematic investigations on the basic microeconomic properties of procurement systems, it will be useful to place the focus of analysis on the individual project first with the hope of extending the basic model to the issues on the supply chain level .

Of the project-based researches, one line of inquiry departs from crude observations or experiences in practice, then on the

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basis of these facts inferring the conditions under which each procurement route is claimed to be suitable (eg. Curtis et al., 1991, Masterman,1992). Not content with these qualitative methods, some attempts have been made to apply the multi-attribute utility approach to develop a procurement route selection technique (eg., Ambrose and Tucker, 2000; Love et. al. 1998) or use statistical methods to investigate the relations between the performance of procurement systems and some explanatory variables (eg. Molenaar and Songer,1998). Another recognized line of inquiry is due to the dedicated efforts by CIB's W92 committee, as evidenced by the collected essays of Rowlinson & McDermott (1999), which is characterised by viewing the procurement systems through the lens of different perspectives, such as trust and culture. The vibrant development in this field has enriched our understanding to procurement systems. However, the underlying economic mechanism is still opaque and some efforts should be directed to develop a systematic framework for discovering the causal relations behind the client's choice of procurement systems.

In recent decades, transaction cost economics, almost single-handedly established by Williamson(1975,1985,1996), has emerged as a mainstream approach to the economic analysis of organization. A complete transaction cost-based construction procurement theory must contain three components: first, operationalisation of the concept of the construction transaction aiming to discover the key factors, called transaction attributes in the literature, that are best able to discriminate the relative efficacy of procurement systems; second, dimensionalisation of governance structures for identifying the inherent characteristics of procurement systems that are responsible for this differential competence in dealing with the projects with different sets of transaction attributes; finally, alignment of the procurement systems with transaction attributes in an economising way. In consideration of its length, this paper will focus on the analysis of the second component – economic characteristics of procurement systems. Section 2, however, gives a very brief outline of the first component. For a complete version of this theory please refer to Chang and Ive(2001a).

Operationalisation of construction transaction

General concepts

Williamson's transaction cost reasoning starts with the premise that the rationality of decision-makers is bounded (competence gap) and radical uncertainty will be present in the future (information gap), both of which leads to the impossibility of relying on the complete contract in which all contingencies are stipulated so that the transaction process can be effectively governed. The incompleteness of the contract won't be harmful if switching to alternative traders incurs slight costs. However, when the durable investment sunk in this transaction is of little redeployable value, the flexibility of the investor will be markedly shackled. In theory, the investor will stick to the contract as long as the expected revenue of maintaining the transaction relation exceeds the *ex post* opportunity costs of the investment. Because of the reduced value of the sunk investment, there appears an excessive return, which is not a reward to the investor but an appropriable rent to another trading party, which is called appropriable quasi rent. Asset specificity is used to describe this sort of bilateral dependency. However, why is this situation sometimes troublesome? This is due to the assumption of opportunism.

Opportunism strands for the likelihood that a trader is not only self-interest seeking but also acting sometimes in the dishonest way. This implies that, when the appropriable rent is present, the informed party is *likely* to take an opportunistic strategy to seize the extra rent by the excuse of unanticipated event with asymmetrical distribution of information between traders. This kind of rent-seeking behaviour is called hold-up problem.

When the intention to redistribute the share of gains from trade occurs, the defender, even in the disadvantageous position, may not yield to the unreasonable demands. Along with the battle of defence, haggling is unavoidable, resorting to third-party arbitration or even litigation may be necessary. The bitter experience of incurring these ex post costs may pass on to the next decision so that some precautionary actions may be taken, including increased stock, lower level of investment or less specific technology being employed, and additional credible commitment (often in the form of bonding) being required. The excessive risk exposure from behavioural uncertainty can be shielded by choosing hierarchy as governance structure due to its better adaptability to deal with uncertainty and its higher efficiency in resolving the ensuing disputes.

Key transaction attributes of construction projects

Since construction cannot square with the basic standard propositions of TCE (Chang and Ive,2001b), the key variables pointed out as essential in TCE cannot be directly applied. This makes it imperative to reexamine the process of construction transaction operationalisation. We found degree of process specificity, defined as the extent of difficulties in switching to a replacement contractor, and degree of measurement difficulties (in identifying the liabilities of the client's agents, such as designer, contractor and subcontractor) are the key variables (Chang and Ive, 2001c). Besides, client's time value is also a critical attribute that affect both the discounted revenue from the project and the vulnerability of the client.

Dimensionalisation of procurement routes

This step aims to answer the question: why three main types of procurement systems will display differential competence in dealing with projects with different transaction attributes? The explanation lies in their different contractual arrangement.

In principle, the procurement systems can be characterised by two dimensions (see Table 1): (1) the extent to which design and construction can be overlapped and thus faster completion be achieved and (2) degree of fragmentation. Fragmentation is defined as the inverse of concentration of responsibility to the client. According to the arrangements of the three main types of procurement systems to be examined in this paper, fragmentation can be achieved by two ways: one is to delegate design and construction to different agents (ie., designer and main contractor); another is to split the whole construction work into small parts and assign them to different work package contractors. As will be explained later, the fragmentation of procurement systems will give rise to two opposite forces at work (see Fig.1). More exactly, as the degree of fragmentation increases, adaptability to change will be better, while the efficacy of ensuring conformance quality becomes weaker.

An attempt is made to explain why different contractual arrangement is an intrinsically decisive determinant affecting the efficacy of procurement systems with respect to three dimensions: time value, process specificity and measurement difficulties. An overview of the expository framework is exhibited in Figure 2. The analysis is made up of two steps:

1. The first step aims to wrestle with the problem of the characteristics of contractual arrangement across procurement routes and their effects on the differential efficacy of procurement routes;
2. The second step is to fill up the gap between the dimensions of procurement routes and their effects on the elements of the objective function of the client, ie. profit function, defined as the revenue from the project net of transaction costs from process specificity and measurement difficulties for fixed production cost.

The traditional method is characterized by the sequence of design then tender strategy. This makes it harder to use fast tracking strategy. As a matter of fact, it is possible to use accelerated traditional method to speed up the completion of the project. However, it may subject the client to the costs of sequential bargaining on price with the contractor. In contrast,

Table 5. Comparison of procurement systems in terms of contractual characteristics

Degree of fragmentation		Degree that design and construction can be overlapped		
		H	M	L
	H	Management systems		
	M			Traditional method
	L		Design and Build	

this strategy can be more easily implemented by design-build and management contracting. Nonetheless, to help the bidding D&B contractors formulate a proposal based on sufficient information, it takes more time for the client to prepare

Figure 1. The effect of fragmentation of procurement routes

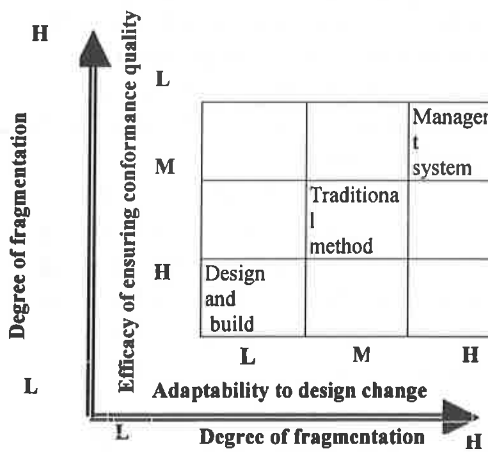


Figure 2 The matching of characteristics of procurement routes with the components of the objective function

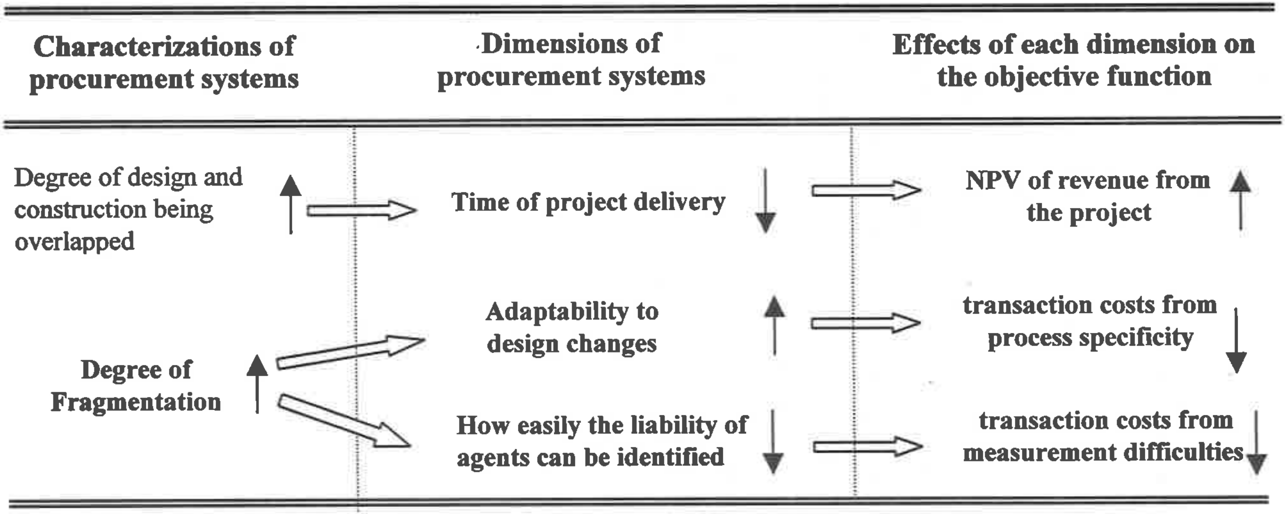
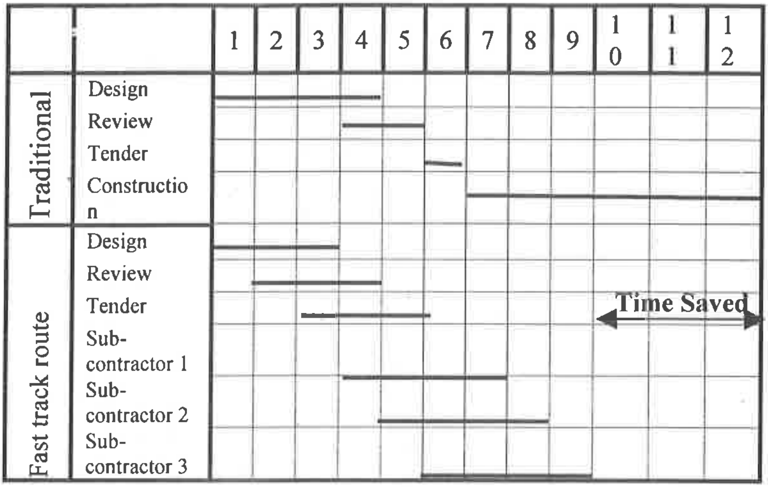


Figure 3 Comparison of traditional method and fast-track method



preliminary design in advance. As a result, the benefits of fast tracking in shortening delivery time can be more fully crystallised by management system. The above inference is consistent with empirical evidence. According to Building Economic Development Council's Faster Building for Commerce (1988), regardless of site time or total time, management contracting is most likely to deliver the earliest date of completion. Design and build comes second and the traditional method is the slowest route.

Yet, why do we need to be concerned with the time of delivery? That's due to its effect on the discounted revenue from the project. In principle, for the commercial or industrial clients, time is money. It seems safe to assume that the discounted revenue is a decreasing function of delivery time. The order of delivery time by three procurement routes is tMC < tDB < tTM, so we can infer that the order of the corresponding discounted revenue will be R(tMC))> R(tDB) > R(tTM). This is the effect of procurement route attribute on revenue from the project.

Adaptability to design changes

The second dimension of procurement systems is the differential flexibility in accommodating design changes during construction. The degree of flexibility mainly depends on the bargaining power on the client's side. For the cases where the client is able to resume a project with low costs, were it disrupted, the client will be in a strong position to negotiate with the contractor over disputes. In the face of this situation, the contractor's proclivity to behave opportunistically will be much mitigated. Accordingly, the cost of switching (COS) to a replacement contractor is a good indicator for showing the degree of flexibility facing the client. This can be defined as

$$COS=v\times(t_1+t_2)+C_e+C_{rp}+C_d \qquad \text{Eq.1}$$

where (1) t_1 and t_2 stand for the time for finding a replacement contractor and the time for the replacement contractor to carry on the unfinished project. v is the average cost of time. Thus, the first term indicates the potential loss arising from the opportunity costs of time, were the project to be disrupted. C_e is the extra costs due to repeated set-up on the construction site[1]. C_{rp} is used to indicate the risk premium asked by the replacement contractor for uncertain quality of work done by first contractor. The last term, C_d is indicative of the cost incurred due to difficulties in identifying liabilities between original and replacement contractor, were defects found in the interface between them.

The key issue here is how this cost varies as the contractual arrangement of procurement systems. We want to argue from two respects: contractual arrangement of procurement systems will, on the one hand, alter the extent of process specificity and, on the other, the efficacy of court ordering. Both of them have bearing on the cost of making changes to the client's requirement. In the following two subsections, we will try to build up these two links.

Procurement systems and process specificity effect

Let's discuss this problem from two scenarios. At the pre-contract stage, the client can elicit market prices of any constructed product with given design from all the potential bidders. However, at the post-contract stage, the price of a

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[1] This cost includes costs for installing construction machinery, administrative facilities (say temporary office), management hardware (say computers), and so on.

change is determined by the outcome of negotiation between the client and the winner contractor. The difference is, in the latter case, the loss of options for switching to alternative contractor without costs. The issue of interest is why the degree of process specificity will change as contractual arrangements.

In principle, as the route becomes more fragmented, the process specificity becomes less severe. In other words, the time spent in finding a replacement contractor and the time the replacement contractor needs to 'warm up' will decrease as degree of fragmentation. When the responsibility is more concentrated on one party (like design and build), more of the tacit knowledge obtained in carrying out this project (in particular defects in design and construction) cannot be transferred, and the more difficult it is for other agents to continue the unfinished tasks (longer t_2) , the fewer contractors that are willing to take over this task, so the more time is needed to find the replacement contractor (longer t_1). Moreover, using an integrated procurement system will increase the danger of quality uncertainty since the problem of information asymmetry as to quality will be more severe. This will increase the risk premium required by the replacement contractor C_{rp} or/and the difficulties in handling the interface problem, ie., higher C_d. In respect of C_e, if design-build or traditional method is used, temporary works and construction machinery or equipment have to be set up by the main contractor. When the original main contractor is replaced, all these set-ups need to be removed. In the management system, thought the major part of temporary works are arranged by the management contractor, the individual trade contractor is responsible for installing machinery for his own use. Thus, C_e, is much smaller in the management system than in other systems. The above discussion is summarised in Table.2. It evidently shows that it is most costly to replace the contractor in the design-build, implying this route puts the client in the weakest position to bargain with the contractor for the pricing of *ex post* requirement change. This means that design-build is least appropriate to deal with these projects with high possibility of changing the original requirements in the brief. For such projects, traditional method comes next and management system is the most desirable one.

Table 6 The effect of contractual arrangement on process specificity

	Traditional method	Design-build	Management system
t_1	Medium	Long	Short
t_2	Medium	Long	Short
C_{rp}	Medium	High	Low
C_d	Medium	High	Low
C_e	Medium	High	Low

Procurement systems and efficacy of court ordering

The presence of quasi-rent is the ultimate reason inducing rent-seeking behaviour. The severity of this problem is dependent on both the magnitude of the rent and the likelihood of successfully appropriating it. The later is considerably affected by the differential efficacy of court-ordering under different circumstances. The origin of this differentiation mainly lies in the plasticity of the decision at issue. Plasticity involves two aspects: (1) the range of legitimate options that can be chosen by decision-makers, and (2) the costs of monitoring [Alchian & Woodward,1987]. Others things being equal, the more choices the agent can take, the more plastic is the case. However, the number of choices just reflects half of the story, and the other half depends on whether reliable and less costly monitoring instruments are available. If it is easy for the principal to check the performance of his/her agents, how many options are open to the agent to choose won't be of concern to the principal. On the contrary, if monitoring cost is prohibitive, even though options were few, the principal's interest is still not secure.

When the procurement route becomes plastic, the efficacy of court ordering will be weakening because it is relatively more difficult for the third-party to make a judgment on the basis of an ambiguous yardstick. Of the three main procurement routes, design and build is most plastic since the detailed design is open at the time when the contract is placed and the contractor is given more latitude in determining undecided design as well as selecting technology and construction procedures. In the management system design is also not finished at the stage of appointment of the management contractor, but what differs is that drawing and specification are offered by an independent agent of the client, the architect. In contrast, in the traditional method design has completed before tendering, while, as far as the plasticity of the contractor's decision is concerned, these two routes are of the similar level.

A conclusion

It is claimed that adaptability to design changes of a procurement system is conditional on both its effect on process specificity and differential efficacy of court-ordering under different contractual arrangements. The results of the above discussion can be summarised in Table3. It manifestly shows that, in terms of both of the two dimensions, design-build is the least efficacious route to accommodate design changes *ex post*.

Table 7 A comparison of adaptability to design changes of three procurement systems

	Traditional method	Design-build	Management system
Extent of process specificity	Medium	High	Low
Efficacy of court ordering on design quality	High	Low	High

In contrast, management system gives rise to slightest process-specificity effect for given attributes of the project and the similar level of court-ordering effect as traditional method, so it follows that management system would be the most desirable route to carry out these projects with high process specificity.

Degree of efficacy in assuring construction quality

Apart from cost of monitoring design discussed in the previous section, measurement costs are made up of two other components: (1) costs of inspecting the completed parts of a project; and (2) costs of getting defects corrected. To make these costs comparable under the three procurement routes, the following analysis proceeds on the basis of the same design.

The costs of inspecting should be of the similar level across procurement routes. Thus, we will focus on the difficulties in getting defects corrected. Single point of responsibility is more efficient in dealing with this problem. Design and build contractor has no scapegoat to get rid of responsibility once something has gone wrong. In the traditional system, the grey area of liability between designer and contractor may give one party the opportunity to impose charge upon another.

The arrangement of management system would make the situation even worse since in this setting, designer, management contractor, subcontractors are all autonomous entities who are responsible for their own faults. For the client, this would lead to a big trouble in clearly identifying the bearer of liabilities. On the basis of this logic, it implies that marginal transaction cost arising from measurement difficulties will increase most substantially by using management system.

Table 8 Characterizations of procurement systems

Characterizations of procurement systems	Traditional Method	Design & Build	Management System
Extent to which design and construction can possibly be overlapped	L	M	H
Fragmentation of procurement routes	M	L	H

An Inconsistent Trinity

The meaning

The overriding task of procurement systems dimensionalisation is to discover the attributes of procurement systems that have direct bearing on the profit function. Contrasting Table5 with Table6, we can find that the intrinsic distinctions in terms of the extent to which design and construction can be overlapped and of fragmentation manifest themselves in the differential competence of procurement systems in the three dimensions of delivery time, adaptability to changes and degree of measurement difficulties.

As exhibited in Fig.2, fast delivery is mapping to higher net present value of revenue stream from the project, lower degree of fragmentation (or single point of responsibility) reflects less severe burden on the measurement of performance (of each participant) and high adaptability to design changes gives contractor less opportunity to take advantage of the client's quasi-rent. As a consequence, to maximise profit function, a

Table 9 Micro-economic characteristics of three main procurement routes

	Traditional Method	Design and Build	Management Contracting
Delivery time	Slow	Fast	Very fast
Adaptability to design changes	Weak	Very Weak	Strong
Ease of identifying liabilities of agents	Less difficult	Easy	Difficult

procurement route with the feature of fast delivery, single point of responsibility and high adaptability would be the ideal option. Unfortunately, this is unobtainable. The dilemma facing the client in selecting the procurement route is similar to that facing a monetary authority in selecting exchange rate policy. 1999 Nobel laureate Robert Mundell put forth a very famous "impossible trinity": a country cannot pick *free capital movement*, *a fixed exchange rate* and *an effective monetary policy* at the same time. Likewise, it is impossible for the client to choose a procurement route meeting these three conditions simultaneously. This *inconsistent trinity* connotes the necessity of seeking balance between counteracting factors.

A formal presentation

Assume the same project is carried out by three procurement routes, the profit function corresponding to each route can be expressed as

$\pi_{TM} = R(t_{TM}) - TC_{TM} - PC$ Eq.2

$\pi_{DB} = R(t_{DB}) - TC_{DB} - PC$ Eq.3

$\pi_{MC} = R(t_{MC}) - TC_{MC} - PC$ Eq.4

where discounted revenue stream *R(t)* is a function of total time of design and construction; TC_{TM}, TC_{DB} and TC_{TM} are transaction costs of three routes; PC is production cost, kept constant across procurement routes by following the standard assumption of TCE.

In the discrete structural analysis, the determination of the efficient governance structure is a comparative undertaking. Thus, we subtract Eq.2~Eq.4 permutively by each other, ie.,

$\pi_{DB}-\pi_{TM}=[R(t_{DB})-R(t_{TM})]-[TC_{DB}-TC_{TM}]$ Eq.5

$\pi_{MC}-\pi_{TM}=[R(t_{MC})-R(t_{TM})]-[TC_{MC}-TC_{TM}]$ Eq.6

$\pi_{MC}-\pi_{DB}=[R(t_{DB})-R(t_{TM})]-[TC_{DB}-TC_{TM}]$ Eq.7

For ease of notation, the average cost of time, v, is introduced to express the difference in revenue of two different delivery times. For example,

$R(t_{DB})-R(t_{TM})= v\times(t_{TM}-t_{DB})$

Besides, from Eq.1, we can find two categories of project attributes affect process specificity: average cost of time and technology. If we denote technology-derived process specificity as s and assume a constant average cost of time, Eq.5~Eq.7 can be transformed into

$\pi_{DB}-\pi_{TM}= v\times(t_{TM}-t_{DB})-[TC_{DB}(v,s,k)-TC_{TM}(v,s,k)]$ Eq.8

$\pi_{MS}-\pi_{TM}= v\times(t_{TM}-t_{MS})-[TC_{MS}(v,s,k)-TC_{TM}(v,s,k)]$ Eq.9

$\pi_{MS}-\pi_{DB}= v\times(t_{DB}-t_{MS})-[TC_{MS}(v,s,k)-TC_{DB}(v,s,k)]$ Eq.10

where k is the degree of measurement difficulties.

To get a more specific finding, we assume there is a fixed relation between t_{TM} , t_{DB} and t_{MC} . For simplicity, t_{MC} and t_{DB} are assumed to be proportional to t_{TM} with a given ratio of α and β respectively (1>α,β>0). For a project, the expected delivery time by traditional method can be estimated ex ante. This is, t_{TM} is given. Then, Eq.8~10 are simultaneous equations, consisting of three equations and three unknown variables. The problem of interest is whether there is a condition under which the desirability of the three routes are indifferent to the client. Put it in a mathematical way, this problem requires to find the solution of Eq.4~6 by setting $\pi_{DB}-\pi_{TM}=\pi_{MC}-\pi_{TM}=\pi_{MC}-\pi_{DB}=0$. Its solution (t^*,s^*,k^*), if any, stands for a set of transaction attributes where the three routes will perform equally well, In other words, in dealing with the project with the attributes of (t^*,s^*,k^*), the client will be indifferent over using any of the three procurement systems. Except for this type of project, the choice of procurement routes will influence the efficiency of project implementation.

Conclusions

This paper examines the microeconomic properties of three principal types of procurement systems in use today in terms of transaction cost economics. Three dimensions pointed out as essential to explain the differential competence of procurement systems in delivering the project with respect to the objective of revenue maximization and minimisation of transaction costs from process specificity and measurement difficulties: duration of delivery, adaptability to design changes and degree of difficulties in identifying liabilities of the client's agents. From this analysis, we derive an essential theoretical conclusion that in selecting an apposite procurement system, it is inevitable for the client to choose the tradeoff among three countervailing factors: fast delivery, high flexibility to design changes and single point of responsibility. Theoretically, it is possible for us to find a set of project attributes (t^*, s^*, k^*) which can be equally efficiently carried out by three main types of procurement systems. Apart from this point, the most desirable procurement system will be decided by the relative strength of three countervailing forces. It implies that there is no procurement system absolutely dominant over others. This result provides us a key to understand the nature of procurement system selection. The right question that should be put in the future research agenda is: under what conditions is a procurement option more desirable than others?

Reference

Alchian, A.A. and S.Woodward (1987) *Reflections on the Theory of the Firm*, Journal of Institutional and Theoretical Economics, 143, 110-136.

Ambrose, M.D. and S.N.Tucker (2000) *Procurement System Evaluation for the Construction Industry*, Journal of Construction Procurement, 6(1).

Building Economic Development Council (1988) *Faster Building for Commerce*, National Economic Development Office, London.

Chang, C.Y. and Ive, G.J. (2001a) *An Transaction Cost Theory Of Construction Procurement Behaviour*, mimeo, University College London.

Chang, C.Y. and Ive, G.J. (2001b) *On The Basic Propositions Of Applying Transaction Cost Theory To Construction*, mimeo, University College London.

Chang, C.Y. and Ive, G.J. (2001c) *Asset Specificity, Moral Hazard and Construction Procurement Routes*, Bartlett Research Paper, University College London.

Cox, Andrew (1997) *Business Success: A Way of Thinking About Strategy: Critical Supply Chain Assets and Operational Best Practice*, Earlsgate, Boston, UK.

Cox, Andrew and Ian Thompson (1998) *Contracting for Business Success*, Thomas Telford, London, UK.

Curtis, B., S. Ward and C.Chapman (1991) *Roles,* *Responsibilities and Risks in Management Contracting*, CIRIA special publication 81.

Love, P.E.D., Skitmore R.M. and Earl G. (1998) *Selecting A Suitable Procurement Method for A Building Project*, Construction Management and Economics, 16, 221-233.

Masterman, J.W.E. (1992) *An Introduction to Building Procurement Systems*, E & FN Spon, London.

Molenaar, K.R. and A.D.Songer (1998) *Model For Public Sector Design-Build Project Selection*, ASCE Journal of Construction Engineering and Management, 124(6), 467-479.

Rowlinson, S. and P.McDermott (ed), 1999, *Procurement Systems: A Guide to Best Practice in Construction*, E&FN Spon, London.

Williamson,O.E. (1975) *Markets and Hierarchies: Analysis and Antitrust Implications*, The Free Press, New York.

Williamson, O.E. (1985) *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, The Free Press, London.

Williamson, O.E. (1996) *The Mechanisms of Governance*, Oxford University Press, New York.

Building Services: A sub-optimality in procurement decision making

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Abstract

Increasing sophistication in building services technology demands a more strategic approach to technology and supply strategies. Clients are adopting more sophisticated supply strategies to energy use, and facilities servicing, causing an increase in service-based supply strategies for building services. Therefore the project business case is now extremely complex, requiring a considerable input from all parties.

However a review of current literature shows there to be a paucity of research in the way building services is procured. This paper puts forward the theory that to bring construction procurement inline with current industry developments the notion of the value proposition must be considered.

The value proposition is not considered during the procurement

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phase, and therefore procurement becomes a monopolistic process. The satisfaction rated by the client is based on their level of understanding, rather than optimal service delivery. Through the use of modalities, the value proposition comes into play, thereby delivering greater value and increasing client satisfaction.

Keywords: value proposition, satisfaction, modalities

Introduction

Building services is largely an assembly industry, where the skill and knowledge of each technical system is held by a number of unique specialist companies, consultants and component producers. Supply chains are well established and although temporary, operate within a determined environment, therefore display some characteristics of a mechanistic system.

Two independent research projects undertaken at BSRIA were used to test whether the assertions made within the current literature were comparable.

The first research project determined that highly experienced procurers seem to be incapable of distinguishing difference aspects of service. However the same criticism could be levelled against contractors in that the value proposition being offered to clients is inferior.

The second set of research found that ranking of importance by client's shows a difference in concerns between occasional, regular and large type clients. The occasional client is primarily focused on the current project, with little evidence of long-term issues, with the traditional factors of cost, time and quality rated as the highest. Although quality is expressed as work being completed to the set specification. Strategic thinking only becomes more evident as the client becomes more a regular procurer.

Detriment

M&E services in buildings have become more complex. Clients now require a higher standard of M&E services performance and provision; and generally have higher expectations of quality. These changes in M&E services requirements, together with changes in procurement methods, shortening of design periods and the increase of specialist subcontractor design; have resulted in complications in the design, procurement and cost control of M&E services (Swafield and Pasquire 1997).

Traditional belief is normally held within procurement research that the abilities of the main contractors to procure the correct specialist contractors is due to their strategic abilities of dealing with the supply chain. It normally assumes the main contractor holds a dynamic relationship with the market, with the consultants determining strategic objectives from the client. However this assumes the sub-contractor has no strategic influence and will make the best possible choice in terms of resources and methods. Furthermore, the critical success factors for project success are compatible with the sub-industry delivery process.

In reality, main contractors are management contractors sub-letting almost all the construction works to domestic sub-contractors on documentation that does not recognise this to be the case. Shoesmith (1995) states that the main contractor has little strategic control over risk or price on the projects, as their role has become that of a co-ordinator only.

Pasquire (1994) asserts that specialists claim management contractors do not have detailed understanding of requirements or technical knowledge of systems, and appears correct when calling for *"a much more open approach to construction procurement is needed and this stems from a greater knowledge of the processes involved. The tools already exist within current documentation what is required is that they are used to their fullest potential by a flexible approach to procurement."*

However a paradox develops when the clients themselves are questioned over the success of alternative procurement routes. It appears that clients preferred traditional routes due to clear management structure (Gunning and McMullan 1996) or that research showed no clear preference on main contract procurement alternatives, but some involvement of the client in specialist contractor procurement was considered beneficial (Price and Gibb 1996).

Part of this disparity can be explained by evidence that discounts the affect of a procurement arrangement. Ireland (1983), Rowlinson (1998) and Shoesmith (1996) all conclude that management variables of a project rather than procurement form, has the most effect on project performance. Lam (et al 1997) summarises the general consensus of opinion in academia; *"all results suggest that the procurement path is not a determining factor but that the use of an appropriate procurement path for particular set of project characteristics and environments, together with the most suitable management strategy would have a significant effect on quality management."*

Traditional research thought has concentrated on the concept that best value was achieved through procurement of the project principals, namely designers, engineers and main contractor, with the inherent supply chains being enabled by these principals.

This belief assumes the project procurement strategy enables value for money to be developed in the supply chain, in line with the project objectives. Moreover, it assumes the managerial strategy is in with supplier requirements and therefore the enabled processes are compatible with the established process inherent within the supply industries. Although Tookey (et al 2001) states that the traditionally parochial view of construction, where the industry is considered as a separate entity operating by its own rules, has largely disappeared, it is postulated that developing thought in procurement appears to be lagging behind other industries. Developments in procurement strategy have yet to fully encompass the notion of supply chains and understand the value process from raw material to finished product.

The need for greater sophisticated thought in procurement is opined by Rwelamila and Hall (1995), who contend that there is little or no cognisant thought that procurement is a management issue, instead it is still seen as a technical subject, underpinned by a lack of complex thought. The argument is further added to by Sheath (et al 1994), who criticises Masterman (1992), Turner (1990) and Latham's (1994) work on procurement selection as a contractual rather than an organisational arrangement, citing that it was probably due to the UK's high concern with appointing risk in construction.

Ireland (1984) set the tone for this debate, as far back as 1984, with his seminal paper in which he states that differences between alternative procurements frameworks are down to the;

arrangements for determining cost; process of selecting contractor; role of specialists; process structure; and the conditions of contract. The paper highlights that using the role of the specialist to differentiate between procurement arrangements – construction management and lump sum arrangements are equal, other than specialist being able to participate in design phase with construction management.

Building services is largely an assembly industry, where the skill and knowledge of each technical system is held by a number of unique specialist companies, consultants and component producers. Supply chains are well established and although temporary, operate within a determined environment, therefore display some characteristics of a mechanistic system. Furthermore each technical system is unique to its suppliers, contractors and methods of operation. Therefore the building services industry can be seen as a complete system, but highly influenced by its own environment and stable sub-systems.

A New Approach

Two research projects recently carried out at BSRIA, were use to test the assertions made within the current literature. The first involved a quantitative survey to determine key performance indicators, the second being a qualitative survey of 170 regular procurers of building services.

BSRIA Key Performance Indicators

The collective findings of this first area of research were derived from the completed questionnaires of 274 building services 'clients' - of which 70% were end users, 24% main contractor and 6% were consultants. This group gave insights into critical success factors and general level's of success.

Approximately 90% of the respondents stated they were regular procurers of building services with great experience. Although experienced, it would appear that an element of strategy is not evident within their procurement decisions. Of the 11 aspects of service scored, the mean score is 7 (6.9 – 7.3 on categories), with a median score of 9, consistent over all 11 categories. Therefore it is evident that clients are incapable of distinguishing difference aspects of service. However the same criticism could be levelled against contractors in that the value proposition being offered to clients is inferior.

Complexity is a dominating issue in satisfaction. The level of integration between the two major disciplines appears to affect satisfaction. Lower satisfaction is had with multi-disciplinary, with a median of 7.9, as apposed to projects with separate mechanical and electrical, scores of 8.4 and 8.3 respectively. This also evident in the mean satisfaction scores for projects - housing 7.4, offices 7.2, education 6.7 and health 6.1 – suggesting that the greater the complexity the lower the level of satisfaction available.

The greatest factor in satisfaction is the actual procurement arrangements, with specific regard to the relationship between contractor and client. A diversity of experience with contractors is evident with only 34% of projects undertaken with a preferred contractor, while 36% of clients had never worked with the contractor before and 30% had only occasionally worked together before. This shows that 66% of clients had little or no experience with the contractor, despite 95% of client stating they are serial procurers. Yet the level of satisfaction achieved on the project is correlated to experience with contractor – 6.5 never work with before, 7.3 occasional exp, 8.3 preferred /regular contractor.

Equally the poorest satisfaction was with m&e contractors used for the first time and selected on price only basis. Despite the highly reported moves of construction to a more partnership based management style, price still dominates the procurement of building services. The assessed project selection methods used price 31% of the time, with the use of a price/quality mechanism 47% of the time, with negotiation being used only for 16% of projects. Procurement decisions appear to be habitual, rather than strategic, with this dominance on using a price based decision offer lower levels of satisfaction (6.8 price only, 7.3 price/quality, 8.1 negotiation).

The focus on traditional decision making in building services procurement, is particularly evident in partnering, with only 14% of projects including partnering agreements. Moreover the m&e contractor was only included in 54% of cases, i.e. 8% in total. Yet the lowest satisfaction by clients was held when the main contractor (6.9) procured the m&e contractor. The satisfaction level was raised to 7.9 when the m&e contractor was involved directly in a partnering agreement with the client.

BSRIA Customer Satisfaction Research

The second set of research from BSRIA is based on 130 person-to-person interviews, allowing a contrast against the quantitative answers given in the other research project.

The ranking of importance by clients shows a difference in concerns between occasional, regular and large type clients. The occasional client is primarily focused on the current project, with little evidence of long-term issues, with the traditional factors of cost, time and quality rated as the highest. Although quality is expressed as work being completed to the set specification

The top six aspects of service registered as critical by clients:

1. good safety record - 9.2
2. work completed to specification – 9.2
3. work completed to time – 9.1

4. quality of workmanship – 9.0
5. low number of defects – 9.0
6. work completed to budget – 8.9

Although these factors do not appear to be evident within final contractor selection, with “selected lowest bid to meet specification” and “quality/price balance” are the most frequented cited factor. This is further reinforced with 85% of main contractors and 77% of clients, stating the 80% of contracts are awarded to the lowest contactor, although private clients show a greater variance.

Generally the data shows that there is a inconsistency between the level of service expected by clients, that actually being delivered by contractors. Of the 18 categories stated, nearly all scored between 6.2 and 7.6, showing a high degree of indiscriminate marking by clients. Further supporting the assertion that clients have an inability to fully differentiate between aspects of service; calling into question their ability to make strategic judgements.

A disparity exists between the client ratings given for project success against those used in the selection of an m&e contractor. From a list of 27 factors, quality issues dominated the top 5 responses, with quality installation (9.0), good quality of workmanship (8.8), low number of defects (8.7) and work to specification (8.5) being listed. Good safety record (8.7) was the fifth factor. The disparity exists mainly with the factors for time – rated as of the most important project factor, is rated 11 (8.0) for contractor selection, while completing work to budget, is rated 18 for contractor selection.

It is inconclusive as to the reasons behind this disparity. Although two possible conclusions could possibly be drawn; Either that client's do not make the link between project success and the modalities needed by contactors to fulfil them. Or clients are able to divide the specifics need for the overall project, with those of a successful building services installation.

Preferred procurement arrangements vary between client classifications. Serial procurers prefer the two arrangements of traditional and design/build (39% and 34% respectively). Regular and occasional procurers favour the traditional arrangement (57% and 47% respectively), with design and build being much less (13% and 16% respectively). Construction management and management contracting were favoured only 5% and 8% respectively by all of the sector groups. Interestingly "other" procurement routes were favoured 24% of the time by occasional clients, which is much greater than the other two groups (average 16%). However public sectors still favoured traditional routes 80% of the time.

Conclusion

It would be fair to begin the conclusion of any research into the nature of building services procurement by firstly acknowledging the paucity of research and lack of attention this subject has received in academic thought. However what is evident, and attentively observed by Tookey (et al 2001), is that current academic thought does not appear to be inline with developments in industry, nor does it appreciate the complexity of both the marketplace or the actual decision that must be made.

The other major factor that appears to affect procurement, but is neither researched or fully understood within current literature is the idea of value propositions. The work of BSRIA shows that clients are not able to differentiate between service aspects, nor do they procure in a strategic fashion.

Despite the call for specialist contractors to be engaged within the project process, no constructive approach has been put forward. To ensure this idea is sustainable, the offered value must be equal or greater than the required value. If not, then value for money is not achieved.

References

Barton, P.K., (1976) Co-ordinating Services Sub-contractors: a systems approach, *Building Technology and Management*, October 1976

Gunning, J, G and McMullan, J (1996) *Procurement Practices in Building Services Engineering in Northern Ireland*, Conference Proceedings, North Meets South: Developing Ideas, University of Natal, Durban, South Africa, January 14-16

Ireland, V. (1984) *Virtually Meaningless Distinctions Between Nominally Different Procurement Methods*

Lam, K.C., Gibb, A.G.F., Sher, W.D. (1997) *Quality Building Services - Co-ordination from Brief to Occupation*, Conference Proceedings; CIBSE Virtual Conference, London

Pasquire, C, (1994) *Early Incorporation of Specialist M&E Design Capability*, Conference Proceedings, East Meets West, Hong Kong, December 4-7 1994

Price, G.M. and Gibb, A.G.F (1996) *Management of Specialist Contractor Design for Mechanical and Electrical Works*, The Organization and Management of Construction: shaping theory and practice, Vol. 2, pages 492-501

Rowlinson, S (1998) *A Definition of Procurement Systems, in Procurement Systems; a guide to best practice*, E&FN Spon, London

Sheath, D.M., Jaggar, D., and Hibberd, P (1994) *Construction Procurement Criteria; a multi-national study of the major influencing factors*, Conference Proceedings, East Meets West, Hong Kong, December 4-7 1994

Shoesmith, D.R. (1996) A Study of the Management and

Procurement of Building Services Work, *Construction Management and Economics*, Vol. 96, pages 93-101.

Shoesmith, D.R. (1995) *Whither Nominated Subcontracts for Building Services*, Conference Proceedings; Changing Roles of Contractors in Asia Pacific Rim, Hong Kong,

Swaffield, L M and Pasquire, C L. (1997) *Defining the Quality of M&E Services During the Early Design Stages: A Value Engineering Approach*

Tookey, J.E., Murray, M., Hardcastle, C and Langford, D., (2001) Construction Procurement Routes; redefining the contours of construction procurement, *Engineering, Construction and Architectural Management*, Vol. 8, Issue 1, pages 20-30

The Sustainability of Vernacular Built Heritage

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Abstract

This paper examines the significance and role of vernacular built heritage in sustainable development regarding cultural, social, economic and environmental issues. Caution about unnecessary effort to 'reinvent the wheel' applies to the sustainable design of buildings and thus to the lessons that can be learned from vernacular built heritage. The aim is to develop a framework for assessing these aspects of vernacular architecture, and for integrating the results into new building design and development projects. The framework is based on sustainability principles of public participation, cultural equity and futurity. It also includes an assessment of the global (national) and local (community) economic impact of vernacular built heritage.

Key words: built heritage, sustainability, vernacular

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Introduction

The International Council for Research and Innovation in Building and Construction (CIB) emphasises that successful improvement strategies for sustainable construction will have to be compatible with climate, culture, building traditions, the stage of industrial development and nature of the building stock (CIB, 2000). This draws attention to the significance of research and the preservation of the built heritage, and especially vernacular architecture, for future sustainable building design. In the seminal work *Encyclopedia of Vernacular Architecture of the World*, Oliver (1997) offers the following definition of vernacular architecture: "Vernacular architecture comprises the dwellings and all other buildings of the people. Related to their environmental context and available resources, they are customarily owner- or community-built, utilizing traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating the values, economies and ways of living of the cultures that produce them". Since the majority of the people in the world still live, work and worship in vernacular buildings, which are responsive to local environmental, social and economic conditions, research about vernacular architecture can significantly contribute to finding solutions to the problems of sustainable design and construction of the built environment in different regions, societies and economies.

Research into the sustainability of vernacular architecture

draws upon studies which have already dealt with some aspects of design, construction and the relationship with the surrounding landscape, and studies which aim to establish principles of good practice, e.g. *Tomorrow's Architectural Heritage* (Fladmark et al, 1991) and regional building design guidelines (Scottish Office 1991, 1993, 1994a, 1994b). However, the design and construction of the built environment can benefit from more comprehensive research in the sustainability of vernacular heritage, which will include and further develop the existing methods for assessing the sustainability of inherited built environment and new development plans. The aim of this paper is to propose a framework for such a comprehensive sustainability assessment of the vernacular heritage within the planning policy. The paper examines existing sustainability assessment methods, their scope, and ways in which these methods can be applied to the vernacular heritage.

Assessing the sustainability of the built environment

Assessment scope

The scope of sustainability impact assessment (SIA) is the built environment, which comprises all architectural and civil engineering artefacts together with their natural and man-made environment. Within this scope the concept of built heritage has been continually broadened in the last few decades throughout the world as proposed by the International Council on Monuments and Sites (ICOMOS). The first definition stated that "the concept of an historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or an historic event" (ICOMOS, 1964). The concept of built heritage was further widened to include historic gardens (ICOMOS, 1982), historic urban areas (ICOMOS, 1987), archaeological findings (ICOMOS, 1990), underwater cultural heritage (ICOMOS, 1996a), and *built vernacular heritage* (my emphasis) (ICOMOS, 1999). The concept of built heritage has thus evolved from that of a "monument", which can be limited to signify a specific aesthetic value or historical importance of an element of the man-made environment, to a much broader concept which embraces all built artefacts bearing ethical and spiritual values of human communities.

Research on the built heritage is being further extended in order to improve our understanding of the values which are promoted by different cultures or by social groups within the same culture. This has two significant effects on the evaluation of the built heritage. First, the scope of the assessed built heritage is widening, and second, the assessors are not only the professionals in the field of built heritage but the concerned social groups who have the right to participate in the decisions about the built heritage. This right was affirmed at the

ICOMOS meeting in Stockholm in 1998, when it was declared "that the right to cultural heritage is an integral part of human rights considering the irreplaceable nature of the tangible and intangible legacy it constitutes" (ICOMOS, 1998). In 1996, the ICOMOS explored the meaning of authenticity in preservation, and concluded that the cultural values of the majorities and the minorities must be recognised "without imposing a hierarchical predominance of any one culture and its values over those of others" (ICOMOS, 1996b). Thus, in the process of defining the assessment scope for the built heritage, ICOMOS has also integrated sustainability principles of public participation, cultural equity and futurity.

Environmental impact assessment

New, if not yet definitive, approaches in the assessment of the environmental impact of buildings are being developed. Life Cycle Analysis (LCA) is one such method for assessing the total environmental impact of building materials. However, reliable details on the environmental effects of building materials and certain technical operations are not readily available (Anink et al, 1996). Environmental Preference Method (EPM) (Anink et al, 1996) has been developed as a pragmatic alternative to LCA. EPM is based on the information which is available about the environmental impact of building products and it offers three ordered preferences and gives advice about products which are not recommended. The Green Guide to Specification (Howard et al, 1998) is a similar guide for selecting building materials with reference to their environmental impact. Concerning the use of these environmental impact assessment methods on the built heritage, it is necessary to complement them with analysis of the impacts of traditional local building materials used in vernacular architecture, which are being used for restoration works and for new buildings.

Apart from building materials and building components, extensive research has been undertaken in the field of energy conservation, the use of renewable energy sources and energy related design concepts. Some technological solutions to the use and management of buildings which were built in the recent past rely on extensive use of energy. The oil crisis, concerns about finite natural resources and pollution created by some energy production processes, have prompted designers to look back to design solutions which were used in the past and which did not require the use of energy. Analysis of such examples from the built heritage is a valuable contribution to the sustainable design of new buildings.

Environmental assessment methods aiming to capture the total environmental impact of buildings have been developed in several countries, e.g. BREEAM 98 (Baldwin et al, 1998), BEPAC (Cole et al, 1993), GB Tool 98 (Cole and Larsson, 1998). These environmental impact assessment methods could be adapted for the assessment of the environmental impact of vernacular buildings.

Economic impact assessment

Environmental economics assesses the economic importance of environmental degradation, examines the economic causes of degradation, and proposes economic incentives to slow, halt and reverse that degradation (Turner et al, 1994). The established methods for assessing economic impacts of proposed developments are the following:

- cost-benefit analysis which evaluates alternative developments regarding relevant social costs and benefits,
- cost-effectiveness analysis which selects alternatives with the lowest monetary cost,
- fiscal impact assessment which focuses on changes in revenues and costs,
- logical framework analysis which tests the logic of a plan of action in terms of means and end,
- input-output analysis which assesses the secondary, or indirect, impacts of development,
- multiple-criteria analysis which seeks to make a multi-dimensional evaluation of expected impacts (Barrow, 1997).

These methods can be combined (van Pelt et al, 1995) in the assessment of the global (national) and local (community) economic impact of the preservation and re-use of architectural heritage. On the macro level of the economy of countries, cultural tourism is recognised as a substantial source of revenue, and this needs to be emphasised in the economic impact assessment. However, the economic concerns for tourism revenue cannot be allowed to be the overriding criterion in a site's conservation and interpretation. This is especially true when the authenticity of fabric and its context, and of the site's broader values and message are altered, diminished, or threatened (ICOMOS, 1996b). On the local community level, the preservation and re-use of vernacular buildings supports continuity of local building crafts and other employment opportunities related to the re-use of buildings and improvement of the built environment.

Social and cultural impact assessment

There are numerous definitions of social impact assessment (Barrow, 1997), and one of the most concise defines the social impact assessment as 'a process examining proposed projects, programmes and policies for their possible effects on individuals, groups and communities' (Buchan and Rivers, 1990). Concerning the built heritage, social impact assessment should especially examine the impact of proposed projects on cultural identity, cultural equity and related human rights. It has been recognised that there is a need for promoting the role and importance of the built heritage, particularly in the light of the need for cultural identity and continuity in a rapidly changing world, since they represent an important element of stable and humane social life (UN, 1996).

Judgements about values attributed to cultural properties as well as the credibility of related information sources may differ from culture to culture, and even within the same culture. Thus, it is not possible to base judgements of values and authenticity within fixed criteria, but the respect due to all cultures requires that heritage properties must be considered and judged within the cultural contexts to which they belong (ICOMOS, 1994). Respect for the values embraced by different social groups and local communities demands their active involvement in the assessment process, because "historic research and surveys of the physical fabric are not enough to identify the full significance of a heritage site, since only the concerned communities that have a stake in the site can contribute to the understanding and expression of the deeper values of the site as an anchor to their cultural identity" (ICOMOS, 1996a). The consequence of such an approach is that an assessment of the built environment should include its social significance for the concerned communities.

A framework for SIA of the inherited built environment

A proposed framework of SIA of the built environment (Table 1) includes the base-line for the assessment of the development plans (e.g. appraisal of inherited built environment) (Column

1), the objectives (environmental, social, economic), the principles (public participation, equity – intragenerational and intergenerational, futurity – long term value and impact), the scope, the stakeholders, the assessment criteria and scoring system, the assessment results, the conclusions and recommendations to decision makers. The assessment identifies positive and negative impacts of the proposed developments (or no development) in relation to the environmental, social and economic characteristics of the existing built environment.

Application of the principles of public participation and equity in the appraisal of existing built environment is checked in Column (2). Development goals are provided as brief statements and indicators in Column (3). Proposed development options (e.g. Options 1 and 2) and a non-development option (Option 3) are assessed against the appraisal of the existing built environment, and development goals regarding added economic, social and environmental value (EV), equity (E) and futurity (F). Public opinion is sought regarding local economic impact and social/cultural values, and it is presented together with experts' assessment. Expert assessment is only provided for the national economic impact, lifecycle cost of buildings, and environmental impact, because of the necessary specialist knowledge about assessment methods.

The scoring system awards +1 or +2 points for positive impact, 0 (zero) points for no change in relation to the base-line, and –1 or –2 points for negative impact. In a hypothetical example negative points are awarded for Option 3 (no development) regarding the futurity principle in the national and local economy, life cycle costs of buildings, and environmental issues. This means that without further development the long-term effects on the national and local economy, building value, natural resources, energy conservation and prevention of pollution would be negative. Expert assessment is presented in Column (7) and public assessment in Column (8) as the options which obtained the highest positive score. In this hypothetical case public perception of cultural identity and equity in the proposed developments differs from expert opinion. The final decision is presented in Column (9) giving advice for improvements which will meet public requirements.

Conclusions

In order to examine whether the existing built environment and planned developments contribute to sustainable development it is necessary to assess their environmental, social and economic impacts. Since vernacular buildings represent a significant part of the existing built environment, it is especially important to include them in the sustainability assessment. This is necessary not only because of the human rights issues related to cultural

Table 1. A framework for SIA of development proposals with a hypothetical example of SIA process

(1) Economic, social and environmental appraisal of development area (base-line for SIA)		(2) Application of sustainability principles in the appraisal		(3) Develop-ment goals	(4) Development Option 1			(5) Development Option 2			(6) Option 3: No development			(7) Expert assess-ment	(8) Public assess-ment	(9) Final Decision
		PP	E		EV	E	F	EV	E	F	EV	E	F	Option	Option	Option
Economic Appraisal	National significance	N/A; EA	✓	Defined goals	+2	+2	+2	+1	+2	+1	0	0	-1	Opt. 1	N/A; EA	Option 1, but with improvement regarding cultural identity and equity to meet public requirements
	Local significance	✓	✓	"	+2	+2	+2	+1	+1	+1	0	0	-2	Opt. 1	Option 1	
					+2	+2	+2	+1	+2	+1	0	0	0			
	LCC of buildings	N/A; EA	✓	"	+2	+2	+2	+1	+1	+1	0	0	-1	Opt. 1	N/A; EA	
Social and cultural profile	Cultural identity	✓	✓	"	+2	+2	+2	+1	+1	+1	0	0	0	Opt. 1	Option 2	
					+1	+1	+1	+2	+2	+1	0	0	0			
	Cultural and social equity	✓	✓	"	+2	+2	+2	+1	+1	+1	0	0	0	Opt. 1	Option 2	
					+1	+1	+1	+2	+2	+2	0	0	0			
	Other issues of importance for community	✓	✓	"	+2	+2	+2	+1	+1	+1	0	0	0	Opt. 1	Option 1	
					+2	+2	+2	+1	+1	+1	0	0	0			
Environ-mental audit	Natural resources	N/A; EA	✓	"	+2	+2	+2	+1	+1	+1	-1	-1	-2	Opt. 1	N/A; EA	
	Energy conservation	N/A; EA	✓	"	+2	+2	+2	+1	+1	+1	-1	-2	-2	Opt. 1	N/A; EA	
	Prevention of pollution (outdoor and indoor)	N/A; EA	✓	"	+2	+2	+2	+1	+1	+1	-1	-1	-1	Opt. 1	N/A; EA	

PP – public participation
E – equity (intragenerational, intergenerational)
EV – environmental value, i.e. added economic, social and environmental value
F – futurity (long term value and impact)
N/A – not applicable; EA – expert assessment

Scoring system:
Positive impact: +1 to +2
No change: 0
Negative impact: -1 to -2

and social aspects of vernacular buildings, but also because of the lessons that might be learned and transferred to the design of new buildings with regard to their social, economic and environmental impact.

The proposed SIA framework provides a checklist of sustainability issues and sustainability principles in the decision making process. It allows for the inclusion of expert reports and public opinion. Other components of economic, social and environmental appraisal can be included to meet the specific local and national requirements.

In order to engage the public in the proposed SIA, it would be necessary to provide succinct information about the principles of sustainable development, the appraisal of existing built environment, the defined development goals and the development options. This information should include a comparative list of economic, social and environmental indicators regarding the existing built environment, development goals, development options and the case of no development. Within the SIA, the built heritage, including the vernacular buildings, is assessed as an integral part of the built environment. This approach ensures that sustainability aspects of the vernacular built heritage are assessed and integrated into new developments.

References

Anink, D., Boonstra, C. and Mak, J. (1996) *Handbook of Sustainable Building: An Environmental Preference Method for Selection of Materials for Use in Construction and Refurbishment*, James & James (Science Publishers) Limited, London.

Baldwin, R., Yates, A., Howard, N. and Rao, S. (1998) *BREEAM 98 for Offices: An Environmental Assessment Method for Office Buildings*, Construction Research

Communications, Watford.
Barrow, C. J. (1997) *Environmental and Social Impact Assessment: An Introduction*, Arnold, London.
Buchan, D. and Rivers, M. J. (1990) Social impact assessment: development and application in New Zealand. *Impact Assessment Bulletin,* **8**(4), 97-105.
CIB (2000) *Proposal for an Action Plan to Implement the Agenda 21 on Sustainable Construction*, www.cibworld.nl/pages/begin/Pro2.html , 20.6.2001.
Cole, R. J. and Larsson, N. K. (1998) *GBC'98 Assessment Manual: Volume 1, Overview*, Natural Resources Canada, Ottawa, Canada.
Cole, R. J., Rousseau, D. and Theaker, I. T. (1993) *Building Environmental Performance Assessment Criteria: Version 1 – Office Buildings,* The BEPAC Foundation, Vancouver, Canada.
Fladmark, J. M, Mulvagh, G. Y. and Evans, B. M. (1991) *Tomorrow's Architectural Heritage: Landscape and Buildings in the Countryside*, Mainstream.
Howard, N., Shiers, D. and Sinclaire, M. (1998) *The Green Guide to Specification: An Environmental Profiling System for Building Materials and Components*, BRE, Watford.
ICOMOS (1964) Venice Charter, www.international.icomos.org/e_venice.htm, 20.6.2001.
ICOMOS (1982) Florence Charter, www.international.icomos.org/e_florence.htm,
20.6.2001.
ICOMOS (1987) Washington Charter, www.international.icomos.org/e_towns.htm,
20.6.2001.
ICOMOS (1990) Charter for the Protection and Management of the Archaeological Heritage, www.international.icomos.org/e_archae.htm, 20.6.2001.
ICOMOS (1994) The Nara Document on Authenticity, www.international.icomos.org/naradoc_eng.htm, 20.6.2001.
ICOMOS (1996a) Charter on the Protection and Management of Underwater Cultural Heritage,

www.international.icomos.org/under_e.htm, 20.6.2001.
ICOMOS (1996b) The Declaration of San Antonio, www.international.icomos.org/san_antonio.htm, 20.6.2001.
ICOMOS (1998) Declaration of ICOMOS marking the 50th anniversary of the Universal Declaration of Human Rights, www.international.icomos.org/e_stocdec.htm, 20.6.2001.
ICOMOS (1999) Charter on the Built Vernacular Heritage, www.international.icomos.org/VERNAC-ENG.htm, 20.6.2001.
Oliver, P. (Ed) (1997) *Encyclopedia of Vernacular Architecture of the World*, Cambridge University Press, Cambridge.
van Pelt, M.J.F., Kuyvenhoven, A. and Nijkamp, P. (1995) Project appraisal and sustainability: the applicability of cost-benefit and multi-criteria analysis, *Wageningen Economic Papers*, Faculty of Economics of the Wagenigen Agricultural University, Netherlands.
Scottish Office (1991) *Siting and Design of New Housing in the Countryside*, SO.
Scottish Office (1993) *Farm and Forestry Buildings*, SO.
Scottish Office (1994a) *Fitting New Housing Developments into the Landscape*, SO.
Scottish Office (1994b) *Timber Framed Housing in the Countryside*, HMSO.
United Nations (1996), Istanbul Declaration on Human Settlements and the Habitat Agenda, www.undp.org/un/habitat/agenda/index.htm, 20.6.2000.

A Model For Supporting Inter-Organisational Relations

Peter E.D. Love[1]

Abstract

The construction industry is highly fragmented and adversarial in nature, which has resulted in it being criticized for its poor project performance and lack of innovation. To improve performance, particularly inter-organizational relations, organizations need to consider the formation of alliances with their project partners. Some construction organizations are beginning to initiate short-term alliances with their customers and suppliers as part of a supply chain management strategy. However, such short-term alliances inhibit feedback, which in turn supports learning and the development of mutual trust and cooperation. It is proffered that construction organizations should consider developing long-term alliances, so as to enable parties to form learning alliances (i.e. a strategic cooperation that is based on creating an environment that encourages mutual and reflective learning between supply chain partners). The implications of forming different types of strategic alliances/partnering in construction are discussed. A learning framework that is founded on the principles of Total Quality Management (TQM) is presented. The proposed framework supporting the formation of cooperative alliances between parties in the construction supply chain is then discussed. A case study is used to demonstrate that cooperative relationships can be used to cultivate a culture for reflective learning and mutual trust, beyond merely project-specific performance improvements.

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Keywords: Construction, strategic alliances, partnering, learning, TQM

Introduction

Many organizations are unable to remain self-sufficient in today's turbulent and changing environment where focus and flexibility are highly demanded by customers. The traditional mode of operation that is inflexible and unresponsive to changes in customer needs and demands is no longer effective in today's competitive environment (Love *et al.*, 2000a). To acquire a competitive advantage many organizations, such as those in manufacturing have formed alliances with other organizations as part of a strategy to enhance their production processes and service delivery (Bronder and Pritzl, 1992). Pursuant to the manufacturing industry, which incidentally has taken the lead in developing closer business relationships with customers and suppliers, the construction industry as a specific form of manufacturing, has also embraced strategic alliances. Instead of using the term "strategic alliance", the construction field refers to such a close relationship as "partnering" (CII, 1991; CIB, 1997; Barlow *et al.*, 1997; Holt *et al.*, 2000).

Since strategic alliances are becoming an important means of survival for organizations operating in the manufacturing industry, relevant theories have been proposed during the past decade (Lindsay, 1989; Spekman and Sawhey, 1990; Wood and Gray, 1991). Similarly, research on partnering in construction has been ubiquitous (Abudayyeh, 1994; Larson, 1995; Matthews *et al.*, 1996; Brooke and Litwin, 1997; Cheng *et al.*, 2000a; Li *et al.*, 2000a; Bresnen and Masrhall, 2000). As these two terms are often seen as being synonymous (Cheng *et al.*, 2000a), it is suggested in this paper that further effort should be put to relate the relevant literature in the two, but with different work practice areas (construction and manufacturing). According to Cheng *et al.* (2000) strategic alliances can improve project performance (in terms of cost effectiveness and improved quality), and overall customer-supplier satisfaction. When forming a strategic alliance, construction organizations should be aware of the following changes that may be imposed on their organization (Li *et al.* 2000; Holt *et al.*, 2000):

- self-governance (i.e. understanding its own capabilities relative to demand);
- responsiveness (i.e. able to recognize those changes in demand that will have an adverse impact on its operations as soon as possible); and
- flexibility (i.e. able to respond to changes in customer needs and demands).

In order to address these demands effectively, construction organizations should strive to become learning organizations (Ford *et al.*, 2000; Love *et al.* 2000b; Holt *et al.*, 2000). According to Borzsony and Hunter (1996), a learning organization should recognize the needs for changing the way it conducts its business and has the ability to change. In fact, the key to strategic alliances lies with the ability of construction organizations to form "learning alliances" (Morrison and Mezentseff, 1997; Holt *et al.*, 2000). Many construction organizations are however often left in the quandary on how best to strive to become a true learning organization (Love *et al.*, 2000a; Morgan and Brightman, 2000; DeVilbiss and Leonard, 2000; French and DeVilbiss, 2000; Knuf, 2000; Ford *et al.*, 2000). In fact, Morgan and Brightman (2000) have made the following observations about change in the context of organizational learning:

change is non-linear and is often no clearly defined from beginning to end - Learning organizations might be viewed as organic in the sense that their learning is a continuous process;

effective change interweaves multiple improvement efforts - Organizational learning needs to be motivated not only by improved financial performance but also by increasing the focus on the customer, improving and managing work processes and strengthening employee involvement;

driving change through both end of the continuum - The need to develop into a learning organization needs to be motivated through change that is driven from the top down to create vision and structure. However, there also needs to be a bottom up drive, which encourages participation and involvement. Fundamentally, the creation of a learning organization needs to be the shared responsibility of everyone in an organization;

human side of learning and change - The development of a learning culture might impact an organization in such a way that it requires employees to reexamine their own values and beliefs. Clearly, unless employees are able to articulate change from a personal dimension, then it is questionable whether they will be able to do so from an organizational perspective; and

benchmarking performance - Measurable performance indicators need to be in place, which in turn should be able to support the business in pursuit of its goals (Knuf, 2000).

This paper discusses the implications of forming different types of strategic alliances/partnering in construction. A learning framework, based on Senge's (1990) five learning dimensions, the work of Morrison and Mezentseff (1997) and the principles of total quality management (TQM), for forming of cooperative alliances between parties in the construction supply chain is then presented and discussed. A case study is used to demonstrate that cooperative relationships can be used to cultivate a climate for reflective learning and mutual trust, beyond merely project-specific performance improvements.

Strategic Alliances Versus Partnering

Numerous definitions of strategic alliances have been proposed (Takac and Singh, 1992; Bronder, and Pritzl, 1992; Mason, 1993; Dowsing *et al*., 1994). For example, Lamming *et al*. (2000) and Walters and Lancaster (2000) have suggested that a strategic alliance exists when the value chain between at least two organizations with compatible goal structures are combined for the purpose of sustaining and achieving significant competitive advantages. The *leitmotif* however with all definitions is that an inter-organizational relationship is established for a specific purpose where all involved parties are engaged in collaborative behavior. The term collaboration has become very fashionable in the social science and management literature (Kanter, 1994; Mintzberg *et al*., 1996). Yet, according to several prominent authors such as Hamel (1989), Bronder, and Pritzl (1992) and Morrison and Mezentseff (1997) alliances can be either collaborative or cooperative in nature. In other words, collaborative strategic alliances refer to parties working together for the short-term and cooperative strategic alliances for the long-term.

In the construction literature, two types of partnering tend to predominate *strategic* and *project* (Li *et al*., 2000; Cheng *et al*., 2000). Project partnering (a relationship established for a single construction project) focuses on short-term benefits, while strategic partnering (a long-term relationship beyond a discrete project) seeks gains for the long-term. Cowan (1992) defined project partnering as a method of transforming contractual relationships into a cohesive project team that comply with a common set of goals and rely on clear procedures for resolving disputes in a timely and effective manner. CII (1991) defined strategic partnering as a long-term cooperation between two or more organizations committed to achieve specific business objectives by maximizing the effectiveness of each participant's resources.

Figure 1 presents the relationships that exist between the two different types of strategic alliance and construction partnering. Long-term alliances refer to a cooperative relationship between at least two organizations, which is established for achieving long-term goals and objectives, for the purpose of achieving a competitive advantage. More specifically, long-term alliances are a manifestation of inter-organizational cooperative strategies, and entail the pooling of skills and resources through the cooperation of organizations aiming to achieve common goals, as well as goals specific for individual partners. In such instances, intellectual capital and organizational intelligence might be seen as suitable motivations for developing long-term partnerships (Morrison and Mezentseff, 1997; Joia, 2000). Short-term alliances, on the other hand, are collaborative and established between two or more parties who strive for short-term project-related benefits. Usually, parties in short-term alliances have clear alliance objectives - these being project-or-business-specific. However, as these objectives may not be compatible (perhaps even conflicting) with each individual parties, internal organizational objectives, mutual trust and commitment cannot be easily developed.

Figure 1: Long-term and short-term alliances

Collaborative strategic alliances and project partnering can provide opportunities for parties to work together and create value rather than a basic commercial transaction (Williamson, 1991; Bronder, and Pritzl, 1992; Voordijk *et al.*, 2000). It is proffered however that organizations that look for short-term benefits may inhibit learning and the ability to critically analyze and improve themselves. Therefore, the type of relationship formed between construction organizations may influence the structure, objectives and learning capabilities of the parties involved in the supply chain partnerships (Voordijk, 1999; Voordijk, 2000). In other words, cooperative strategic alliance or strategic partnering should be the means for establishing a learning alliance in a supply chain.

Short-Term Alliances

As the construction industry is dominated by one-off projects, it appears that short-term alliances will likely take the leading role in promoting a closer relationship in construction projects (Matthews *et al.*, 1996; Cheng *et al.*, 2000; Li *et al.*, 2001). Hamel (1989) suggests that organisations that enter into short-term alliances are aware that their partners are capable of 'disarming' them by acquiring knowledge about work practices. Furthermore, Hamel (1989) states that acquiring skills and knowledge from their partners is not a devious act, rather it can enable organisations to examine what their competitors are doing best and therefore benefit from the knowledge acquired. Short-term alliances not only provide an opportunity to internalise a partner's skills but, can be used as an mechanism to de-stabilise a partner who does not understand the risks inherent in such arrangements (Bronder, and Pritzl, 1992; Morrison and Mezentseff, 1997). In addition, short-term alliances can encourage competition between organisations; for example an alliance between a contractor and sub-contractors may lead to competition in both learning of new skills and refining of organisational capabilities in their products and processes.

Organisations entering into collaborative relations initially looking for reduced complexity of their environment and more control over environmental factors may suffer from increased environmental complexity and turbulence due to the creation of new dependencies (Wood and Gray, 1991). They further argue that increases in complexity may increase transaction costs, the need to manage bilateral and multilateral relations, and the need to develop new skills. Minzberg *et al.* (1996) argue that joint learning may occur through interaction without partners conceptualising it as such, and without a collaborative agreement in place; therefore, the best collaboration may be the one least recognised. It is noteworthy that alliances formed for discrete construction projects may not be useful due to the lack of joint learning, which is established by the short-term work environment.

Long-Term Alliances

As stated previously, long-term alliances encourage partners to commit their resources to the development of a relationship based on mutual learning (Bronder, and Pritzl, 1992; Morrison and Mezentseff, 1997). With a sense of less competition, partners may feel more committed to work together and exchange their knowledge and resources. In the area of construction, Ellison and Miller (1995) used the term synergy to explain such a long-term intimate relationship. A synergistic relationship is to develop core competence in pursuing corporate and business strategies. Organizations that rely on cooperation have been found to obtain lower costs for as long as they maintain trust – internally among employees, and externally among members of their network (Ketelhom, 1993; MacBeth and Ferguson, 1994; Holt *et al*., 2000; Black *et al*., 2000).

Cooperation generates a reflective and mutual learning environment, encouraging the effective transfer of knowledge, and acts as a mechanism for stimulating mutual satisfaction as well as improving the competitive advantage of partners (Hamel, 1989). Notwithstanding, the success of the strategy is dependent on an organisation's ability to evolve and learn. A learning alliance is crucial to a cooperative environment where learning is encouraged and reflective in nature and through which participating parties will strive together to meet the objectives of the relationships (Morrison and Mezentseff, 1997). Moreover, Minzberg *et al.* (1996) suggests that within some cooperative arrangements, partners may begin to lose their competitiveness and vision once they have become dependent on the capabilities of other parties. If this occurs in the relationship, the less reliant and well sufficient partner may cause a threat to their alliance partner(s) by becoming a direct and powerful competitor. To avoid this derived barrier of cooperative alliances, its structure should include a learning framework that enables alliance partners to openly reflect their knowledge and information whilst retaining the visions for the alliance as well as their individual organisation. According to Morrison and Mezentseff (1997) this mechanism should be integrated into the relationship to allow all parties to benefit from the shared knowledge. The sharing of knowledge may stimulate learning, which is considered to be the fundamental ingredient for continuous improvement within strategic alliances (Bronder and Prizl, 1992).

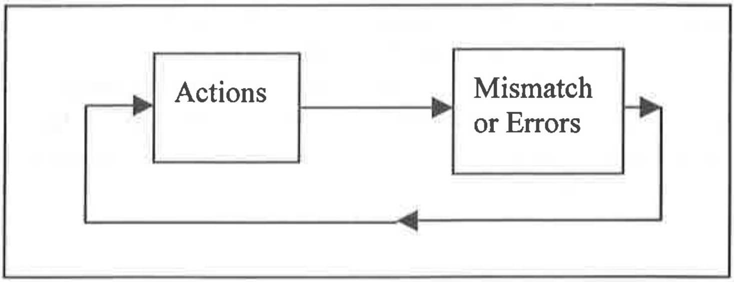


Figure 2. Single-loop learning (Argyris, 1990)

Learning And Unlearning In Construction

Long-term alliances are constructed in order to transfer knowledge, skills and resources to involved partners. This entire process relies on a learning mechanism to complete this cycle. Without a learning environment to encourage the effective and accurate transfer of information, the benefits to the formed alliance are minimal. Cooperative learning is more intense and evacuative in comparison to those that are collaborative in nature. Senge's (1992) definition of a learning organisation addresses the issue of cooperative learning. Similarly, Crossan and Inkpen (1995) emphasise that the ability of alliances to extract knowledge and skills from each other is important for survival. Crossan and Inkpen (1995) have noted from their research that the process of learning is based on single loop learning as illustrated in Figure 2. They found that learning opportunities are not typically exploited in a form consistent with their initial learning objectives. Consequently, the primary barrier to learning is considered to occur at an individual level where learning opportunities are not exploited because the alliance experience conflicted with the existing set of managerial beliefs.

Double loop learning, as illustrated in Figure 3, can help overcome such problems stated by Crossan and Inkpen (1995). Double loop learning incorporates a high level of evaluation and analysis of information into knowledge that enables changes to be made accordingly. It also leads to the development of creativity in the problem solving process, which Argyris and Schön (1978) refer to as *deutro-learning*, that is, learning about learning. Essentially, deutro-learning occurs when organisations learn how to carry out single-loop and double-loop learning simultaneously.

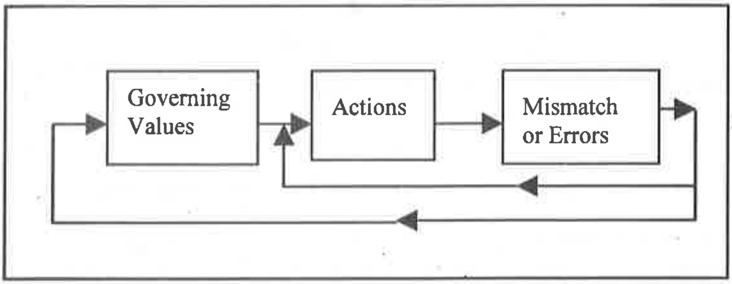


Figure 3. Double-loop learning (Argyris, 1990)

Long-term alliances aim to incorporate a learning environment that encourages mutual understanding and benefits from the relationships. With this in mind, such alliances should essentially be viewed as learning alliances as the relationship appears consistent with those of a learning organisation (Morrison and Mezentseff, 1997).

As well as learning, Nystrom and Starbuck (1984) suggest that organisations must also unlearn to survive. Noteworthy, however, unlearning is not the opposite of learning. Unlearning involves breaking with current behaviours/and or mental modes, while learning can either lead to a whole new ways of understanding and acting, or build on those that exist. Hedberg (1981) defines unlearning "as the process through which learners discard (previous) knowledge (that is outdated)". Hamel and Prahalad (1994) note that unlearning must take place before learning can begin. McGill *et al.* (1992) further stated that much of the basis for productive learning resides in unlearning. Whether we can actually ever erase outdated knowledge as if we were deleting files from a computer hard drive is a contentious issue and its discussion is outside the scope of this paper. In practice, unlearning is an important element of strategic renewal and organisational transformation (Talwar, 1994; Love *et al.*, 2000a). For construction organisations to adopt and learn new approaches to work and management, they must first begin to unlearn (Love *et al.*, 2000a). For example, implementing inter-organisational or cross-functional teams may well mean that traditional definition of boundaries, roles, responsibilities and authority have to be abandoned. Fundamentally, it is suggested that before construction organisations consider forming a strategic alliance, a degree of unlearning must take place. That is, current modes of operation should be disregarded so that a different behaviour can be encouraged and induced, which can subsequently lead to the formation of an effective learning alliance.

The Learning Organisation

The notion of organizational learning is not entirely new but we can usefully differentiate between a long time interest in learning as a concept in organization theory, and the more recent focus on the idea of the learning organization. The former is concerned with enhancing the processes of learning in order to improve individual and collective organizational actions via improved knowledge and understanding. The latter focuses on the design of organizations to deliberately facilitate the learning of members and therefore improve collective adaptation (Coopy, 1995). The authors suggest that the debate concerning the anthropomorphism of claiming that organizations have memories can be set aside. Indeed, memory initially resides in individuals but can also occur in systems, structures and many dimensions of organizational culture (Walsh and Ungson, 1991). Love *et al.* (2000a) suggests that at present, there is a wide debate in the area, and while consensus seems far off, there is some overall agreement in that:

- organizational learning is more than the sum of members' learning;
- environmental alignment is vital; and
- the probability of learning is affected by the degree of environmental turbulence, the rigidity of organizational structure, the adequacy of the organization's strategy and the strength of its culture.

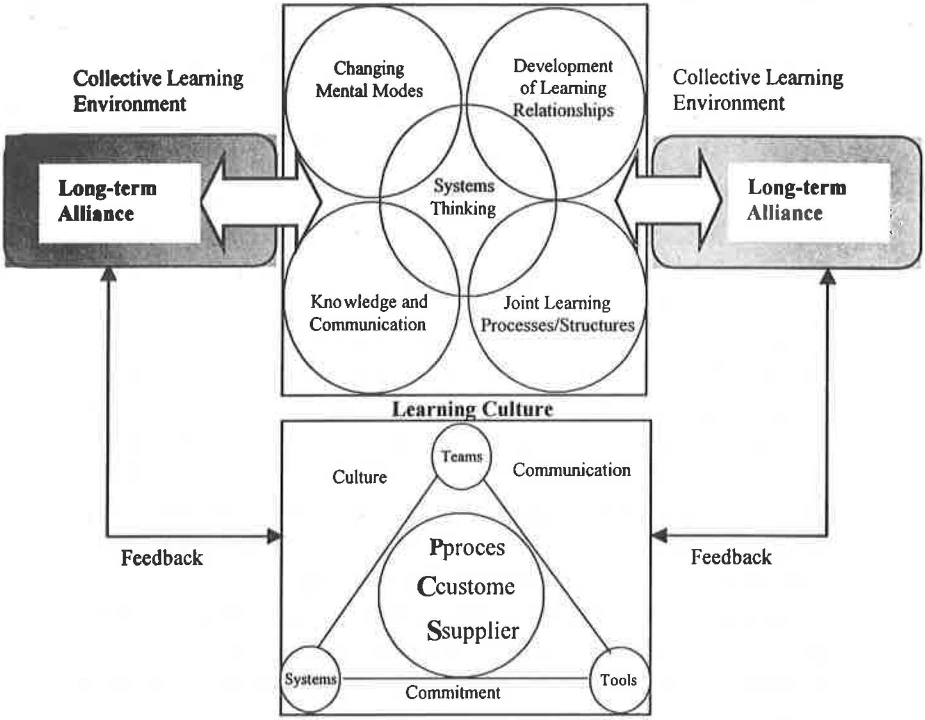
Many organisational theorists place emphasis on the systems-structural approach focusing on information systems, while others prefer the interpretive path and much less tangible dimensions of the phenomenon centred on meaning. Far less frequently are the two brought together to enhance understanding, analysis and a richer picture of this complex concern. The complexity of organisation learning grows when one considers the different types of learning that exist, ranging from adaptive to institutional experience embedded in accumulated organisation efficiencies in terms of experience and tradition. Others suggest single loop or adaptive learning;

double loop or generative learning; and triple-loop learning as dialogue (Argyris, 1993; Isaacs, 1993).

The aforementioned learning types involve incremental and adaptive learning focused on changing routines; learning pushing towards a new framework for learning and practice; and learning about learning through revealing and altering the tacit infrastructure of thought. When the different levels of learning are aggregated – individual, group and organization-wide and the problem of knowledge types – explicit and tacit – as expounded by Nonaka (1991), the problem grows. Considering the above, the authors suggest that for construction alliances to improve customer satisfaction, the involved parties must be able to learn collectively. Essentially, the concept of the learning organization provides a paradigm for collective learning. Traditional notions of the organisation see it as a place where learning takes place automatically and where individuals acquire new knowledge and/or experience. This concept, however, suggests that in a successful organization, it is itself that learns. If an individual leaves the organization, the knowledge acquired remains in it. In a learning organization, teams develop knowledge by working as a unit.

At both strategic and operational levels, cooperative alliances can be used to establish long-term relationships, which over time will enhance their capacity to provide value to customers and suppliers throughout their supply chains. As members of the alliance develop new skills and capabilities, they alter what they can do and understand in the supply chain environment. Consequently, the individuals that make up the alliance learn to learn together (e.g. inter-organizational teams). Mechanisms, such as those ingrained within the alliance (e.g. customer-supplier focus and benchmarking) can allow effective learning to take place (Hill, 1996; Nesan and Holt, 1999; Mandal *et al.*, 2000). Essentially, the organization, besides being a place where kinds of activities and operations

Figure 4. A model for construction alliances



are performed, becomes a "giant laboratory" where people at all levels are constantly experimenting with and testing new practices and techniques.

Sometimes, construction organizations can rely on other management tools to develop the "learning disciplines", which are identified by Senge (1992) - including personal mastery, mental models, shared vision, team learning, and systems thinking, that can institutionalize the learning habit (Love *et al.*, 2000a). For example, organizations that readily adopt and are committed to TQM will be uniquely prepared for the "learning disciplines" (Garvin, 1993). Yet, none of the above can be effectively applied without the constant cooperation of all persons in the involved organizations. That is why successful organizations put a special emphasis on practices such as empowerment, mobilization and motivation, making sure that they penetrate the entire workforce, from the top management down the hierarchy of authority (Nesan and Holt, 1999).

A Model For Construction Alliances

The model for construction alliance founded on TQM and an integrated supply chain is illustrated in Figure 4. As can be seen in the Figure 4, the essential components of the framework include: systems thinking; learning culture; knowledge and communication; changing mental modes; joint learning structure/processes; and development of learning relationships. These key components are described herein after.

Systems Thinking

According to Jackson and Keys (1991), most models of learning organisations are little more than descriptions of effective organisations and do not offer many solutions for solving complex problems. The underlying theme of the learning organisation models, that are genuinely different from the traditional approaches, is systems thinking (Senge, 1990; Senge *et al.*, 1994, 1999). This form of thinking has a systemic and holistic focus, and can facilitate organizational learning within alliances. This framework places emphasis on the philosophy of TQM to establish the alliance environment whereby partners attempt to become process-focused. Thus, this can enable benchmarking to be used as a feedback mechanism, with respect to alliance performance (Li *et al.* 2000b). In other words, feedback processes need to be in place to provide information about what has to be learned as well as what has been undertaken (Figure 3). Benchmarking can also be used as a mechanism for providing financial (business performance), technical (productivity measurement) and efficiency (human contribution measurement) indicators for comparing the performance of alliances over a period of time (Love *et al*., 1999). Apparently, benchmarking should be viewed as an operational process of continuous learning and adaptation that results in the development of an effective alliance (Li *et al*. 2000b).

Project managers and the like within the alliance need to have an understanding of how its sub-systems are interconnected, and how they can individually influence the quality of the final product or service. This involves the ability to see relationships between issues, events and information as a whole or as patterns, rather than as a series of unconnected parts. Systemic thinking involves adopting a holistic rather than fragmental approach to problem solving. A systems perspective concentrates on understanding how relevant factors collectively interact to give rise to the problem. Within a TQM environment, systemic thinking can be used by organisations to develop strategies for relationship building, as a primary principle of TQM is customer-supplier relationship (Oakland and Sohal, 1996). Subsequently, this strategy becomes the focus of the relationship, particularly if the alliance is formed throughout the construction supply chain. With effective leadership provided by management throughout all levels of the organisations involved in the alliance, behaviour can be guided by jointly agreeing on the goals of the relationship.

Learning Culture

It is suggested that if an alliance is to enhance its potential for learning, there is a need to build a learning culture, which is also founded on TQM. In order to foster organizational learning, it is necessary to concentrate on both individual and group skills, design of support structures and the creation of an overall organizational attitude that encourages learning. As mentioned above, managers at various levels within the alliance organisations need to create and stimulate an appropriate organizational environment for learning. Mistakes must be seen as opportunities to learn and there need to be honesty and trust within the alliance for learning to take place (Crossan and Inkpen, 1995). Essentially, the alliance must recognise that learning requires openness to new ideas. There must be a firm commitment from senior management to free up employees so they can have some time to reflect and review their actions. This approach is embedded in the process of double-loop learning. By encouraging the use of this process of learning, alliance members are required to act as change participants and advance with a dynamic relationship where the transfer of knowledge and information is intense and valuable. Such an innovative thought process may encourage successful outcomes to problems experienced by the alliance partners.

Research undertaken by Osland and Yaprak (1995) indicates that organisations that effectively cooperate with one another are better able to adapt to dynamic environmental changes and satisfy their customers. An important factor of learning is the encouragement of dialogue among alliance members. All partners of the alliance must be able to receive and disseminate information across of the boundaries of the construction supply chain and external environment. For example, advance information and communication technologies for electronic and Internet commerce can be used to improve communication, and the time to market products and services to customers. (Cheng *et al.*, 2000b). Yet, the effectiveness of the alliance will be dependent on frequent day-to-day correspondence between all members of the alliance in a supply chain environment. Again, information and communication technologies have a significant role to play in improving inter-organizational relations, as distributed information management systems can be used for constant communication between alliance partners, which can facilitate learning (Deng *et al.*, 2001)

Knowledge and Communication

Critical to organizational learning is how knowledge is communicated. Nonaka (1991) believes that successful organisations consistently create new knowledge and are able to transmit it widely through technological innovations. A critical part of the exchange between alliance partners is the ease of access to various forms of knowledge, from knowledge about people, facilities, management systems and practices, to critical information about differences in values and beliefs. Levinson and Asahi (1995) suggest that alliances can sustain joint learning structures if the following steps are integrated into the relationships:

- becoming aware and identifying new knowledge;
- transferring/interpreting new knowledge;
- using knowledge by adjusting behaviour to achieve intended outcomes; and
- institutionalising knowledge by reflecting on what is happening and adjusting learning behaviour.

Knowledge and communication are valuable components of the framework and need to be constantly monitored and extended by senior management.

Changing Mental Modes

The most significant learning that can take place in organisations involves changing mental modes (Senge, 1990; Crainer, 1998). Essentially, people have to learn how to surface, challenge and adapt their mental modes to cope with change. Mental modes concern deeply held assumptions, images and generalisations that influence how people understand the world and the actions they take. In order to move toward a learning alliance people with strategic relationships need to surface, test and share their mental modes. This process can facilitate decision-making, action and learning. Small changes in everyday mental modes, accumulating over a period, may gradually reflect on changes in long-term deep-seated beliefs.

People within the alliance should try to develop two distinct skills in order to maximise the process of surfacing, testing and sharing mental modes. Firstly, reflection, the slowing down of thinking processes, to the extent where people can become aware of how mental models are formed. Secondly, inquiry, being able to hold conversations where they can share their views and develop an understanding about people's assumptions and beliefs about the alliance.

Joint Learning Structure/Process

To support a learning climate within the alliance, joint learning structures, strategies and processes need to be developed. This should include designing reward and incentive systems that motivate both individual and organizational learning, and establish mechanisms for collecting and transferring information from within and without the alliance. Shared learning within the alliance may enable participants to develop multiple and overlapping technologies and skills into future products and services. In essence, an alliance that incorporates shared learning encourages a strong foundation for a relationship built on trust and mutual commitment.

Development of Learning Relationships

To improve the effectiveness of a supply chain, long-term alliances are needed to stimulate learning. However, to build learning relationships can be an arduous process. Individuals involved in the process may have a firm commitment to their own organisation, their own personal agenda and unique mental model of the situation. Thus, there is a need for senior management to encourage and assist with the development of the relationship. For the alliance to learn, the role of managers may need to change; that is, to become designers, teachers and stewards (Senge, 1992). It is important for managers to recognise that their main role in establishing learning relationships is that of coordinator and as a result this will require an effective management style that is able to extend across the relationship. It is envisaged that a consistent management style across the alliance will enable participants of the relationship to be focused and to provide a shared vision. The level of and the processor of the power within the alliance will, however, affect its vision and as such parties must agree on the facilitator for the alliance.

Case Study

This case study attempted to identify the major aspects and their associated key characteristics of a learning alliance from a real life project. More specifically, it uses an analytical strategy to demonstrate how a consultant organisation formed a long-term cooperative alliance with parties in a project who joined to form a learning alliance. The strategy was based on the six major aspects of the learning framework, which were system thinking, learning culture, knowledge and communication, changing mental modes, joint learning structure/process, and development of learning relations. The related key characteristics of these six aspects are shown in Table 1. In practice, these characteristics were expected to form the rules that might be able to establish the major components for a learning alliance.

To secure the confidentiality of the information provider and prevent the intent to make any guesses, the project has been disguised, the parties' and actors' names are fictitious, and narratives have been modified. However, the essence of the case was preserved to ensure the provision of real information for analysis.

Excel Consultant provides structural and architectural design consultancy in the areas of building design and civil engineering. This firm attempted to establish an informal but highly communicative relationship with parties of a large project that was successfully secured. As the project would last for a period of eight years, an alliance that would encourage teamwork was sought. Although the project has only been running for two years, the alliance team has performed well as rated by the joined parties. It has also been treated as a benchmark in the Hong Kong construction industry. It was considered that such an alliance would naturally improve project time and cost performance as well as quality.

Prior to the formation of the alliance, an external facilitator was hired to organise the formation of the alliance meetings, to promote trust and commitment as well as to focus each party on the goals and objectives of the project. An inter-organisational team was formed and members met each other during scheduled meetings to appraise alliance performance, to set progress goals, and to solve problems that arose. There were several major establishments by the facilitator that were particularly useful for initiating a learning alliance, which included:

envisaging the acquisition of knowledge – The facilitator encouraged the participating companies to learn from each other and to be aware of their competitors. Benchmarking was a word that was commonly used during meetings.

encouraging open lines of communication – Communication was treated as an important function that helped to link the parties together. He stressed that every kind of possible communication channels should be developed. New information and knowledge must be circulated within the alliance network as fast as possible. This forms a supportive structure for a learning culture.

highlighting the importance of setting up alliance goals and objectives – Goals and objectives specific to the alliance were created. As the relationship was extended beyond the formal contract between the parties, project objectives could not reflect the real performance they wanted. To

Table 1: Major aspects and key characteristics of a learning alliance and the analysis results

Major Aspect	Associated Key Characteristics		Analysis results
Systems thinking	Rule 1.	The learning alliance adopts a holistic rather than fragmental approach to problem solving.	++
	Rule 2.	Benchmarking is used as a feedback mechanism with respect to the performance of the alliance. Feedback processes need to be in place to provide information about what has to be learned as well as what has been undertaken.	++
	Rule 3.	Collective establishment of common goals with financial (business performance), technical (productivity measurement) and efficiency (human contribution measurement) indicators for comparing the performance of alliances to achieve the goals over a period of time.	++
	Rule 4.	Emphasis on customer-supplier relationship to develop a strategy for relationship building for alliance parties. This involves the establishment of an inter-organisational team that consists of members along the supply chain.	++
	Rule 5.	Using jointly agreed goals to guide behaviour.	+
Learning culture	Rule 1.	Selecting the right people into the inter-organisational team who have the ability and the necessary skills to develop a learning culture within the team and an appropriate organisational climate for learning.	++
	Rule 2.	Design of support structures and the creation of an overall organisational attitude that encourages learning. Mistakes seen as opportunities to learn.	+
	Rule 3.	Some factors are critical to such a learning culture. For example, honesty, trust, openness to new ideas, commitment from senior management, are all critical factors to free up employees to learn.	+
	Rule 4.	Dialogue with alliance members is encouraged. Workshops or meetings are the place for experiencing the learning	++

		culture. IT such as Internet helps to receive and transmit information in a virtual environment.	
Knowledge and communication	Rule 1.	The learning alliance becomes aware of and identifies new knowledge.	++
	Rule 2.	The learning alliance is able to transfer and interpret new knowledge.	+
	Rule 3.	The learning alliance can use the new knowledge by adjusting behaviour to achieve anticipated outcomes.	++
	Rule 4.	The learning alliance can institutionalise the new knowledge by reflecting on what is happening and adjusting learning behaviour.	+
Changing mental modes	Rule 1.	The alliance team always challenges the existing practices when performance is not favourable.	++
	Rule 2.	A problem that cannot be solved in one joint meeting will be put forward to the next meeting and so on until the problem can be solved.	++
	Rule 3.	Measures are used to evaluate the performance and agenda is used to raise the issues for discussion, so those team members can study the issues independently or collectively through other possible means such as email before attending the meeting.	++
Joint learning structure/ process	Rule 1.	Setting reward and incentive systems that encourage both individual and organisational learning.	+
	Rule 2.	Establishing mechanisms for collecting and transferring information from inside and outside the alliance.	++
	Rule 3.	Shared learning is encouraged within the alliance team.	++
Development of learning relations	Rule 1.	There is a need for senior management to encourage and assist with the development of the inter-organisational team.	++
	Rule 2.	Representatives in the team are the change agents and should be empowered.	++
	Rule 3.	An independent facilitator is hired for developing shared vision and goals.	++

Note: + = partly achieved; ++ = well achieved.

create new goals and objectives is a crucial component to induce learning that aims at higher levels of performance. Figure 5 is the charter established by the parties who signed and agreed to commit. The charter consisted of ten goals to achieve.

emphasising joint problem resolution – Solving problems together is an effective means for developing learning alliance. During the problem solving process, parties joined together to understand the problem, to raise discussions, to express own opinions and ideas, to learn from each other, to find out the solution collectively, and finally to experience a collective learning process.

promoting the cooperative effort to trace performance – Tracing the performance that was to achieve the alliance goals and objectives gave a clear picture of what to improve, resulting in knowing what to learn to improve. They held meetings discussing the performance charts as well as the areas to improve.

For a more detailed analysis to test whether the cooperative alliance is able to represent a learning alliance, the rules (ie, associated key characteristics) of the six major aspects of learning alliances were tested. Ordinal measures (i.e. not achieved, partly achieved and well achieved) of the rules were sufficient to test the items established for the case study. Table 1 indicates that most of the rules were well achieved, showing that the tested alliance has developed a learning climate, similar to that of a learning alliance identified above. Findings from the case study indicate that a long-term relationship can be used to cultivate a climate for mutual learning, and enhance the development of trust, commitment and communication. Whilst remaining focused on the project objectives, such as reduced costs and improved quality, such a cooperative relationship will create a strategic and sustainable competitive advantage in today's competitive environment. It is suggested that construction organisations forming long-term alliances that incorporate the essential elements of the proposed learning framework can gain an advantage over their competitors through the implementation of a customer-supplier focus and strategic relationships.

The Charter

1. To meet or even shorten the project completion dates.
2. To accomplish the financial budgets of all parties.
3. To construct a quality product which satisfies the client's requirements.
4. To recognise the expectations of other parties in a co-operative work environment.
5. To achieve the best safety standard according to local legal practice.
6. To recognise the importance of problem resolution for minimising disputes and conflicts as early as possible, leading to no litigation.
7. To establish and sustain open communications.
8. To attain a successful project that can enhance the reputations of all parties.
9. To take ethical consideration of the social and environmental responsibility.
10. To recognise and manage inherent project risks.

Figure 5. A charter for a strategic alliance

The learning alliance has enabled the joined parties to be more reliable and durable, and highly competitive and responsive. It is noteworthy that the case also reveals the benefits provided by the long-term alliance, which include improved:

problem solving process - Previously, they solved problems individually. Presently, they solved them together so that they could think out more available solutions faster than before;

project performance - Project performances in terms of quality, time, schedule and cost have been achieved. Other performances having been stated in the charter including safety and social responsibility have also been achieved -

not to mention that other associated project issues such as rework, waste, claims, etc., were reduced when compared to other project alliance members had been involved in;

knowledge and competence of workforce - A learning alliance not only acquires updated knowledge but also improves ability of their staff. Such a workforce is considered to be more productive and less likely to make mistakes;

inter-organisational relationships - Parties are able to communicate in an open manner, which also improves coordination. While parties are mutually dependent in dealing with project matters, they are independent in running their own organisations. Thus, they are able to learn externally as well as internally; and

stakeholder satisfaction - The parties revealed that they had satisfied their stakeholders, which included clients, design consultants, contractors, suppliers and end-users. In addition, continuous improvement was fostered (improved productivity and profits) within the alliance, which has resulted in a strategic competitive advantage (when bidding for new projects), as those organisations involved in the alliance have been invited to procure additional projects.

The alliance has been in place for two years and positive outcomes have enabled the alliance team with a good foundation to improve their learning capabilities over the next six years project. The cooperative alliance is setting standards within the construction industry for its ability to foster working together in a harmonious and diligent manner. The alliance is beginning to establish the benchmarks for best practice in the construction industry.

Conclusion

This paper has demonstrated that cooperative learning alliances can create a shared vision of mutual learning. Such learning can enhance a construction organization's capacity to learn as well as improve the effectiveness of their business operations, which can result in internal and external customer satisfaction. The authors suggest that construction organisations looking for long-term alliances that incorporate the essential elements of the proposed learning framework (founded on TQM) can gain a competitive advantage over their competitors through the implementation of a customer-supplier focus and strategic relationships. The case presented in this paper revealed the relationship between a cooperative long-term alliance and the learning alliance. The findings produced indicate that cooperative relationships can be used to cultivate a climate for mutual learning, and trust whilst remaining focused on the alliance objectives. It may not only reduce costs, but can also ensure a strategic and sustainable competitive advantage in today's environment.

References

Abudayyeh, O. (1994). Partnering: a team building approach to quality construction management. *ASCE Journal of Management in Engineering*, 10 (6), 26-29.

Argyris, C., and Schon, D. (1978). *Organizational Learning: A Theory of Action Perspective*. Addison-Wesley, Reading, MA.

Argyris, C. (1990). *Overcoming Organizational Defenses*. Allyn and Bacon, Needham, MA.

Argyris, C. (1993). *Knowledge for Action: A Guide to Overcoming Barriers to Organizational Change*. Jossey-Bass, San Francisco.

Barlow, J., Cohen, M., Jashapara, A., and Simpson, Y. (1997). *Towards Positive Partnering: Revealing the Realities for the Construction Industry*. The Policy Press, University of Bristol, Bristol.

Black, C., Akintoye, A., and Fitzgearld, E. (2000). An analysis of success factors and benefits of partnering in construction. *International Journal of Project*

Management, 18(6), pp.423-434.
Borzsony, P., and Hunter, K. (1996). Becoming a learning organization through partnership. *Learning Organization*, 3(1), pp. 22-30.
Bronder, C., and Pritzl, R. (1992). Developing strategic alliances: A successful framework for cooperation. *European Management Journal*, 10(4), pp.412-420.
Brooke, K.L., and Litwin, G.H. (1997). Mobilising the partnering process. *ASCE Journal of Management in Engineering*, 13(4), pp.42-48.
Cheng, E.W.L., Li, H., and Love, P.E.D. (2000). Establishment of critical success factors for construction partnering. *ASCE Journal of Management in Engineering*, 16(2), pp.84-92.
Cheng, E.W.L., Li, H., Love, P.E.D., and Irani, Z. (2001). An E-business model to support supply chain activities in construction. *Logistics Information Management*, 19(3), pp. 171-179.
CII (Construction Industry Institute) (1991). *In Search of Partnering Excellence*. Publication No. 17-1, Rep., Bureau of Engineering Research, University of Texas, Construction Industry Inst., Austin, TX.
CIB (Construction Industry Board) (1997). *Partnering in the Team*. A report by Working Group 12 of the Construction Industry Board, Thomas Telford, London.
Coopy, J. (1995). The learning organization: power, politics, and ideology. *Management Learning*, 26(2), pp.193-213.
Cowan, C.E. (1991). A strategy for partnering in the public sector. In L.M. Chang, *Preparing for Construction in 21st Century* (Ed.), 721-726, ASCE, New York, NY.
Crainer, S. (1998). *The Ultimate Business Guru Books*. Capstone Publishing, Oxford, UK.
Crossan, M., and Inkpen, A. (1995). The subtle art of learning through alliances. *Business Quarterly*, 60(194), 68-78.
Deng, Z.M., Li, H., Tam, C.M., Shen, Q.P., and Love, P.E.D. (2001). The application of an Internet-based project management system. *Automation in Construction*, 10(2),

pp.236-246.

DeVilbiss, C.E., and Leornard, P. (2000). Partnering is the foundation of a learning organisation. *ASCE Journal of Management in Engineering*, 16(4), 47-57.

Dowling, P., Schuler, R., and Welch, D. (1994). *International Dimensions of Human Resources Management.* Wadsworth Publishing Company, Belmont, California.

Ellison S.D., and Miller, D.W. (1995). Beyond ADR: working toward synergistic strategic partnership. *ASCE Journal of Management in Engineering*, 11(6), 44-54.

Ford, D.N., Voyer, J.J., and Wilkinson, J.M.G. (2000). Building learning organizations in engineering cultures: Case study. *ASCE Journal of Management in Engineering*, 16(4), pp.72-83.

French, B. and DeVilbiss, C.E. (2000). Measuring systematic unity in a learning organization. *ASCE Journal of Management in Engineering*, 16(4), pp.39-46.

Hamel, G., and Prahalad, C.K. (1994). *Competing for the future*. Harvard Business School, Boston, 166.

Hamel, G. (1989). Collaborate with your competitors – and win. *Harvard Business Review*, January-February, 133-139.

Hedberg, B. (1981). How organisations learn and unlearn. In Nystrom, P.C and Starbuck, W.H (Eds.) *Handbook of Organizational Design*, 1, Oxford University Press, pp.3-27,

Hill, F.M. (1996). Organizational learning for total quality management through quality cycles. *TQM Magazine*, 8(6). 53-57.

Holt, G.D. Love, P.E.D., and Li, H., (2000). The learning organisation: A paradigm for mutually beneficial strategic construction alliances. *International Journal of Project Management*, 18(6), pp.415-423.

Isaacs, W. (1993). Taking flight: Dialogue, collective thinking, and organizational learning. *Organisational Dynamics*, 22(2), 24-39.

Jackson, M., and Keys, P. (1991). *Towards a system of systems* *methodologies*. In Flood, R., and Jackson, M. *Critical Systems Thinking: Directed Readings*, Wiley, UK.

Joia, L. A. (2000). W3E - a web-based instruction system for leveraging corporate intelligence. *Journal of Workplace Learning*, 12(1/2) 5-12.

Kanter, R.M. (1994). Collaborative advantage: Art of alliances. *Harvard Business Review*, 73(4), 96-108.

Knuf, J. (2000). Benchmarking the lean enterprise: Organizational learning at work. *ASCE Journal of Management in Engineering*, 16(4), 58-71.

Larson, E. (1995). Project partnering: Results of study of 280 construction projects. *ASCE Journal of Management in Engineering*, 11(2), pp.30-35.

Lamming, R., Johnsen, T., Zheng, J., Harland, C. (2000). An initial classification of supply networks. *International Journal of Operations and Production Management*, 20(6), pp.675-691.

Li, H., Cheng, E.W.L., and Love, P.E.D. (2000). Partnering research in construction. *Engineering Construction and Architectural Management* 7(1), pp.76-92.

Li, H., Cheng, E.W.L., Love, P.E.D., and Irani, Z. (2001). Cooperative benchmarking: a tool for partnering excellence in construction. *International Journal of Project Management,* 19(3), 171-179.

Lindsay, J. (1989). *Joint ventures and corporate partnerships*. Probus, Chicago, Illinois.

Levinson, N., and Asahi, M. (1995). Cross national alliances and inter-organizational learning. *Organisational Dynamics*, Autumn, pp.50-63.

Love, P.E.D., Smith, J., and Li, H. (1999). The propagation of rework benchmark metrics for construction. *International Journal of Quality and Reliability Management* 16(7), pp.638-658.

Love, P.E.D., Li, H., Irani, Z., and Faniran, O. (2000a). Total quality management and the learning organization - a dialogue for change in construction. *Construction Management and Economics,* 18(3), pp.321-332.

Love, P.E.D., Li, H., Irani, Z., and Holt, G.D. (2000b). Total quality management: A framework for facilitating organizational learning and change in construction. *The International Bi-Monthly for Total Quality Management: TQM Magazine* 12(2), pp.107-117.

Mandal, P., Love, P.E.D., Sohal, A.S., and Bhadury, B. (2000). The propagation of quality management concepts in the Indian manufacturing industry. *The International Bi-Monthly for Total Quality Management: TQM Magazine* 12(3), pp.205-213.

Mason, D. (1993). Strategic alliances: Partnering for success. *Management Review*, pp.10-15.

Matthews, J., Tyler, A., and Thorpe, A. (1996). Pre-construction project partnering: Developing the process. *Engineering, Construction and Architectural Management*, 3(1/2), pp.117-131.

MacBeth, D.K., and Ferguson, N. (1994). Partnership Sourcing. Pitman, London, pp.96-140.

McGill, M., Slocum, J., and Delhi, D. (1992). Management practices in learning organizations. *Organisational Dynamics*, 21(1), pp.5-17.

Mintzberg, H., Dougherty, D., Jorgensen, J., Westley, F. (1996). Some surprising things about collaboration – knowing how people make contact makes its work better. *Organisational Dynamics*, 25(1), pp.60-70.

Morgan, J.W and Brightman B.K (2000). Leading organizational change. *Journal of Workplace Learning*, 12(1/2), 66-74.

Morrison and Mezentseff (1997). Learning alliances - a new dimension of strategic alliances. *Management Decision*, 35(5), pp.351-357

Nesan, L.J., and Holt, G.D. (1999). *Empowerment in Construction: The Way Forward for Performance Improvement*. Somerset Research Series. Baldock, Herefordshire, UK.

Nonaka, I. (1991). The knowledge-creating company. *Harvard Business Review*, November/December, 96-104.

Nystrom, P.C., and Starbuck, W.H. (1984). To avoid organizational crisis, unlearn. *Organisational Dynamics*, Spring, 53.

Oakland, J.S., and Sohal, A.S. (1996). *Total Quality Management - Text with Cases*. Pacific Rim Edition, Butterworth-Heinemann, Australia.

Osland, G., and Yaprak, A. (1995). Learning through strategic alliances: Processes and factors that enhance marketing effectiveness. *European Journal of Marketing*, 29(3), pp.52-66.

Senge, P., (1990). *The Fifth Discipline: The Art and Practice of the Learning Organization*, Doubleday/Currency, NY.

Senge, P., (1994). Moving forward: Thinking strategically about building learning organizations. In P. Senge, C. Roberts, R. Ross, B. Smith, and A. Kleiner (Eds.) *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*. Doubleday/Currency, NY, 15-47.

Senge, P., Kleiner, A., Roberts, C., Ross, R., Roth, G., and Smith, B. (1999). *The Dance of Change: The Challenges to Sustaining Momentum in Learning Organizations*. Doubleday/Currency, NY.

Senge, P., Roberts, C., Ross, R., Smith, B., and Kleiner, A., (1999). *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*. Doubleday/Currency, NY.

Spekman, R.E., and Sawhney, K. (1990). *Toward a Conceptual Understanding of the Antecedents of Strategic Alliances*. Marketing Science Institute, Cambridge, MA.

Takac, P.F., and Singh, C.P. (1992). Strategic alliances in banking. *Management Decision*, 30(1), pp.32-43.

Talwar, R. (1994). *Re-engineering - a wonder drug for the 1990s*. In C. Coulson-Thomas (Eds.) *Business Process Re-engineering: Myth and Reality*. Kogan Page, London, 40-60.

Voordijk, H. (1999). Preconditions and dynamics of logistics networks in the Dutch building industry. *Supply Chain*

Management: An International Journal, 4(3), pp.145-54

Voordijk, H., Han de, G., Joosten, G-J. (2000). Changing governance of supply chains in the building industry: a multiple case study. *European Journal of Purchasing and Supply Management*, 215-227.

Voordijk, H. (2000). The changing logical system of building materials supply chain. *International Journal of Operations and Production Management*, 20(7), pp.823-841.

Walsh, J., and Ungson, G. (1991). Organizational memory. *Academy of Management Review*, 16(1), 57-91.

Walters, D., and Lancaster, G. (2000). Implementing value strategy through the value chain. *Management Decision*, 38(3), pp.160-178.

Williamson, O.E. (1991). Comparative economic organisation: the analysis of discrete structural alternatives. *Administrative Science Quarterly*, 36(2), pp.269-96.

Wood, D.J., and Gray, B. (1991). Towards a comprehensive theory of collaboration. *Journal of Applied Behavioral Science*, 27(2), pp.139 -162.

Index Of Contents By Keywords

CIB Proceedings

A compilation of papers presented at the CIB W92 Symposium held in Port of Spain, Trinidad & Tobago in January 2002. More than 50 experts from every continent addressed the issue of procurement systems and their potential impact on technology transfer, particularly the North-South flow of technology. Four days of discussion and analysis were conducted and new ideas for the direction of research and development were proposed. The working commission W92 (Procurement systems) was joined by W63 (Affordable Housing), and task groups TG36 (Quality Assurance In Construction) and TG23 (Culture In Construction) to broaden the field of discussion and provide focus on some of the specific problems of developing nations.

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