PROCUREMENT SYSTEMS AND CONSTRUCTION TIME PERFORMANCE

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Construction procurement methods, productivity, client influence

Summary

During 1993 a detailed study was undertaken of 33 construction projects built in Melbourne over the last 5 years. The objective of the study was to gain an understanding of why some buildings are constructed faster than others by identifying risk factors, how builders coped with them, and how they structured their organisation and management resources to cope with identified risks.

Results revealed that contract type does not significantly affect speed of construction and that several client related factors proved more significant, particularly how well clients relate to the project team. These results pose an interesting insight into the nature of the client/project team relationship and throws some light onto conclusions drawn by others that non-traditional form of procurement achieve better construction time performance (CTP) results than that of a traditional approach.

Introduction

A number of researchers in construction management have suggested that success outcomes dependent upon procurement methods and project and client characteristics. Recent research (Walker 1994) reveals interesting insights into the procurement process and client or client representative (CR) characteristics.

The impact and influence of the client upon CTP will be explored and discussed in this paper. The discussion starts with an analysis of the literature regarding client influence over CTP so that the impact of this influence can be appreciated and placed in context with other factors identified in this work. The investigation proceeds with reference to work undertaken on determining types of clients generating construction work so that a better understanding of their influence and impact can be gained. Contractual arrangements are also investigated and explored with reference to how they may or may not affect CTP. Finally conclusions are drawn with reference to findings from a recent survey of 33 Melbourne projects to shed light on the scope of influence and impact that clients may have on CTP.

Client sophistication and CTP

The client is the entity which identifies the market need and starts the process that forms the genesis of the construction process. Project objectives are defined by the client independently, or in conjunction with advisers. Shaping a project's scope and complexity, therefore, lies very much in the hands of the client project inception team.

The client commissions principal consultants and will also have input into the approval of sub-consultants. The melding of a project team into a cohesive entity that can achieve shared objectives has been identified as having an important influence on project success. In a recent report of five case studies in the USA, shared objectives of project team members was cited as an important factor influencing project success. This illustrates the significance of owners being clear in their goals and that communication of project goals and alignment of these goals for all team members is of critical importance (Rowings et al. 1987).
The relevance of clear goal definition to management success has been identified by others (McGregor 1960) (Hersey and Blanchard 1982, p117-118). If the client has clear well enunciated goals which are effectively communicated in the briefing and team selection process then a better climate exists for goal congruence and, as a consequence of this, there is a better chance of project success. The client needs a clear idea of key project team members' expectations and reputation to effectively build a project team that has a promising chance of successful goal congruence.

Clients can perform a useful role in ensuring that the brief is properly and clearly given, that appropriate consultants are commissioned, and that an appropriate management structure for the management of the project and the construction process is established. Sidwell's work (1982) demonstrates that sophisticated clients (those having built projects before) and specialised clients (repeated similar buildings) have a better chance of success with their projects than novices. More than 15 years ago Ferry (1978, p8) observed that "the uninformed client has an unrealistic idea of what he is letting himself in for". The NEDO report's research findings (1988, p53) has more recently demonstrated the key influence of the client on the outcome of building projects which is mirrored by the client's skill in: "clearly expressing project objectives in terms of building requirements, cost and time budgets; defining the procurement strategy and the input that the client can make to the project; bringing together a - possibly unique - configuration of specialist to work as a team; and determining the level of service expected from each member of the project team."

Sidwell (1982) observed that public clients (who may well, as an organisation, have much experience of commissioning buildings and may also have commissioned many similar buildings) can experience higher cost and time blow-outs as compared with privately funded clients. He explains this in part by drawing attention to bureaucratic procedures that publicly funded and some privately funded clients are subject to. Client organisations may be highly experienced, but individuals acting in the role of project sponsor/client may be inexperienced or overloaded with work. Sidwell remains convinced that clients should participate actively and supportively throughout the project life cycle to facilitate project success.

The characteristic of experience, therefore, may be personal and not organisational (though if an organisation has built up experience then that body of knowledge and expertise is available). As Sidwell (Sidwell 1984, p90) observes "Clients who get the quickest results are those who provide the building team with well defined specialised needs and are able to become closely involved with the building process." Bresnen et al. (1988, p18) found no significant links between client experience, project type and typicality from a sample of 138 projects studied, though they state that client control and alternative contractual arrangements suggest an influence upon client satisfaction of project outcomes. They imply (though their evidence is not strong) that client sophistication, in terms of the capacity to be involved in the process, has an impact on project performance. Naoum (1991, p18) presents evidence to suggest that experienced clients were more satisfied than others in respect to construction time (where experience was measured as the number of similar buildings they had commissioned in the past).

Clients express their brief in a variety of ways ranging from highly developed requirements such as specific extension or expansion plans for manufacturing plants to vague impressions of shortcomings in an existing facility.

The NEDO (1988, p63) report suggests that it is not essential that a brief be detailed so long as instructions were defined, stating the client's priorities in terms that could be responded to by the consultants involved in the development of the brief. Many specialists may be required to contribute their expertise to both the briefing and design development phases.

The NEDO report (1988, p64) also demonstrates the central importance of a well-managed connection between design and construction for project success. In a recent analysis of 20 major Australian projects (BCA 1993a, p3) the following conclusions were drawn which pertain to client generated delays. The report highlights: "a need for a greater assumption of the responsibility by the client for a firm brief; a realistic timing of commitment and a comprehensive analysis of project delivery needs and methods, and the creation of a climate in which the parties can operate efficiently and the supply of clear decision making". In another report (BCA 1993b, p3) further requirements for success are specified including the need for definition of project roles, detailed expression of client needs and ensuring accountability and responsibility by assigning sufficient power to individuals or units that have the capacity to bring needed results. The BCA (1993a, 1993b) and NEDO (1988, p64) reports stress the importance of the client dealing with the design brief and design development in a unified and coherent manner. Confusion and delay were reported to have occurred in cases where diffused briefing from inside a client's organisation had occurred.
This may, in part, explain why publicly funded clients have attracted a poor reputation for their projects achieving good CTP. If a hospital board, for example, comprises disparate interests of doctors, specialists, medical research and teaching interests and the board bureaucratically constrains its project representative, then appropriately quick approval for many low level decisions may be inhibited. More generally, if a disparate group control the decision-making process in any project, then a strong likelihood of confusion, decision reversal and untimely decision making may ensue with its attendant problems of generating temporary holds on construction work and contract variations which have been shown to inhibit good CTP.

At this point it is worth drawing upon the NEDO (1988) study to illustrate examples of the actions taken by 'very professional' clients and their approach to the development of the brief, design and construction process. These customers were typically supermarket and chainstore developers who had standard briefs which defined their requirements succinctly. Instructions included distribution of responsibilities between the project team members, lists of preferred suppliers and specialist contractors and even proposed design concepts and construction techniques. The brief also committed principal consultants to produce a plan of key decisions required of the customer and a timetable of decisions required of specialist consultants, subcontractors and suppliers as well as planning the design development phase to the extent of detailed design and shop drawing production. The NEDO (1988, p65) report states: "In the study, this extent of initial effort was vindicated by the success of the projects and the confident spirit in which it was achieved. It demonstrated the usefulness of defining at the outset a comprehensive strategy for the project and a firm context for the responsibilities and contributions of participants."

Lessons learned from research cited can be summarised as follows.

Clients with a detailed and firm idea on what needs to be done and how this can be achieved in a well planned and appropriately controlled manner can be viewed as sophisticated and will probably assist in a successful project outcome.

Clients who are novices or unsure of how to brief principal consultants may be successful if they know the limits of their expertise in this matter and know how and when to ask for appropriate assistance.

Clients must be firm in the statement and direction of their objectives and they must speak with one voice. This need has lead to the rise of the role of the project manager (to be discussed later);

Clients should remain involved in the whole design and construction process to ensure that work is being undertaken effectively and that they can contribute positively throughout the process.

**Client sophistication and building procurement systems**

A bewildering array of procurement systems exist to realise a project from inception to completion. Opinions vary as to the most effective procurement system available. Knowledge based expert systems (KBES) have been developed to assist in appropriate selection of a project delivery system including PASCON (Mohsini and Botros 1990) and ELSIE (Brandon 1990, p330-333) though as Brandon indicates, problems with this type of application include being subject to: fashion, personal expertise, prejudice, disagreement between experts, not being verifiable as optimal and based on a combination of possibilities.

Increasing project complexity resulting from using complex technologies, management structures, team relationships and legal responsibilities require greater risk sharing. The traditional building contract was originally designed for straightforward conventional projects where design was completed before construction commenced and where limited involvement of the builder in the design process was the norm. In recent decades greater overlap of design and construction has emerged and with it alternative forms of contractual arrangements.

It is not intended to detail all possible forms as this is not considered necessary in this paper. Clients require an appropriate form of project delivery system that allows for appropriate flexibility for all parties and that risk is distributed in a way that engenders a successful project outcome. Primarily this means that risk should be devolved to the point at which it can most effectively be controlled. Appropriate distribution of risk between parties that can best control that risk appears to be the best criteria for selection of a procurement system. Others have written widely on this topic. Barnett (1988/9) identifies four basic types of project manager and nine variations on that theme discussing their legal relationships with the client based on risk sharing ranging from adviser to entrepreneur project manager. Ireland (1987, p188) has also developed a useful taxonomy of contractual forms illustrating the risk to be accepted by the contractor and client.
One of the alternative project delivery systems commonly used in the UK is Management Contracting which can be considered as the same as either Direct construction management (CM) or Agency CM. The effectiveness and nature of Management Contracting has been widely researched (Sidwell 1983), (Elton 1985), (Franks 1984), (Naoum and Langford 1984). The choice of any particular form of project delivery system will not automatically guarantee fast project completion. This paper is confined to CTP and not overall project completion from conception to completion. Ireland (1983, p71) indicates that overlapped or fast-track construction can shorten the overall project delivery time but may increase the construction period. Others conclude that project delivery system is not a dependant factor in determining construction speed (Barnes and Partners 1984), (Sidwell 1984, p90).

The main advantage of involving the builder early in the design process is that advice can be given on buildability and a practical design can be achieved which enhances CTP and reduces unnecessary costs (Ward et al. 1991, p202). The challenge of the builder taking on a consulting role has been documented as being patchy in its success (Naoum and Langford 1987). The principal problem identified is a difficulty that some builders have in responding to the demands of being a constructive critic of the design concept and detail. This difficulty should reduce over time as more builders operate within this function and more graduates of building undergraduate and postgraduate degrees enter senior positions in building firms engaged in this kind of work.

In a recent Australian study (CIDA 1993, p20) pre-construction activities involving the client accounted for 66% of perceived factors influencing construction performance. The client influence upon the choice of project delivery system can be crucial if it opens up greater possibilities for informed advice on the design to be adopted, construction methods to be proposed and organisational structures to be developed to manage the project. The rise of alternative modes of project delivery has highlighted shortcomings in the traditional approach and the client can, if aware of advantages and disadvantages of available systems, make a positive contribution to the decision of an appropriate contractual form.

A body of opinion, supported by much case history research, demonstrates the existence of a crucial link between client characteristics and project success. Recent work in Australia supports this view (Walker 1994, CIDA 1993, CIDA 1994). Key influences upon good project success can be summarised as follows:

A client may have a highly complex project need (in terms of scope, function or organisational decision-making complexity) to be satisfied which may be translated into a simple solution given sound and perhaps innovative design and/or construction action;

A client may have a relatively simple need to be satisfied, however, the design team may pursue a highly complex and perhaps, difficult-to-build solution;

A client's need may be translated into a relatively simple design solution, however, the builder may be unable to build the facility as designed in an efficient manner.

These influences show that a client must either have sufficient expertise and knowledge about how to manage the briefing stage or seek advice from others to ensure that a design solution meets the objectives of the brief and is capable of being constructed within appropriate time and cost budgets.

Clients have a role in the development process namely:

select the appropriate principal consultants;

choose the most appropriate contractual arrangements for carrying out the construction work;

accept the appropriate level of risk and ensure that risk is allocated to those who are best able to control identified risk;

control their own propensity for making changes to the design solution which adversely affect construction time and cost performance.

Given the clients role described above and the design and construction risks highlighted, client sophistication or experience with the design and construction process may not be a causal factor of likely success rather, client attitude and ability to positively contribute to the process probably provides a more reliable causal factor for project (time) success.

A client with little or no experience but a positive and intelligent attitude may better fulfill the role described above more effectively than an experienced but inflexible client who remains closed to creative problem solutions or appropriate alternatives to stock-standard methods and problem solutions.
It is probable that the following client involvement will lead to a better chance of project success and good construction time performance. The client will:

- have clear well enunciated and effectively communicated goals;
- ensure that the client speaks with a clear and unequivocal single voice;
- build a strong, imaginative and effective design team which seeks and positively responds to buildability advice;
- ensure that risk is appropriately distributed to those who can best control that risk;
- take responsibility, when required, for providing timely, clear and responsible decisions;
- engender an atmosphere where cooperative problem solving within the team can be achieved;
- ensure that proper accountability of team members is maintained without introducing or maintaining a legalistic mind-set of team members;
- view the client as a contributing team member and not a disinterested bystander.

A client who is experienced and sophisticated (in terms of project management) may choose to take the initiative and lead the process. In many instances the client is a corporation, government department or syndicate of joint-venturers. In these circumstances it is usual to appoint a project manager, this can be accomplished in a number of ways (refer to the work of Barnett (1988/89) or Ireland (1987) for complete discussion of these organisational forms). The client or client representative often chooses to allow other team members to take much of the initiative, e.g. the architect or a construction management consultant.

The client, however, must not relinquish ultimate control and responsibility. If the client suspects that other team members are pursuing their own objectives over the project objectives, then a stand must be made and authority exercised to ensure that project goals are pre-eminently pursued. In this way it can be seen that strength of conviction and adherence to project goals is a vital client characteristic.

Client-builder relationships

It has been suggested that the client indirectly but strongly influences CTP throughout the project definition phase as well as through the team building processes and by maintaining a capacity to supervise builders - requiring of them adequate project control procedures to ensure that project goals are achieved.

CTP success is linked to both client involvement and client control (direct or indirect) in the procurement and construction process (Walker 1994). Researchers cited above tend to agree that traditional forms of procurement restrict client involvement in the construction process and builder involvement in the design development process.

A recent report produced by CIDA (1994, p3) provides useful data on a survey of 108 companies involved in the construction industry of which almost half were contractors. The issue of customer focus was particularly revealing. Customer service was ranked most important to their competitive strategies by consultants and subcontractors and second by contractors. Achieving project schedules was ranked first by contractors, second by subcontractors and third by consultants. Some 89% of the firms surveyed never or seldom conduct formal customer surveys of client perceptions. Another interesting finding is that only 21% of the firms surveyed developed systems which allowed their clients to have a high or very high involvement in quality improvement activities. This suggests that builders may need to shift their priorities and perspective to be more customer focussed to enable better quality relationships of mutually equality between client and builder. The CR/builder working relationship has been shown to be a significant factor affecting CTP (Walker 1994).

It is clear from the CIDA (1993) survey that attitudinal inhibitors are present to minimise the impact that the client or CR may have upon CTP through team involvement. Signs of attitudinal change are growing with the emergence of partnering, adoption of best practice and companies engaging in benchmarking exercises.

Results from the Walker (1994) Research work

During 1993 a series interviews was undertaken with 33 managers of construction projects using a structured questionnaire of about 172 questions which took, on average, 2.5 hours to complete. Projects were drawn from a population of non-residential, non-engineering sector of the construction industry. The construction team leader, as
the most effective repository of knowledge about the project's construction performance, was considered to have unique insight into what happens on-site and be well placed to judge the effect of circumstances affecting CTP.

Data gathered from the research questionnaire was used as input into a multiple regression model (with a 0.9987 $R^2$ value) to derive a trend-line predicted construction time. This was then compared to actual construction time and an index derived. Project one for example has a predicted duration of 262.183 workdays but an actual observed duration of 273 workdays. The CTP index for project one is, therefore, 0.960376. This statistic indicates that project one's CTP is 96.04% of trend, i.e. below trend. A total of 102 variables were tested using one-way analysis of variance (ANOVA). Correlation analysis (Pearson’s product moment and Spearman Rank order) was also used to test hypotheses and develop models. Most of the data gathered is ordinal and interval data has been transformed into ordinal categories which allowed use of Spearman Rank Correlation to construct a 102 by 102 correlation matrix using a PC-based software package (STATGRAPHICS). ANOVA testing was conducted at the 95% confidence level, to determine which factors affect CTP. This provides details of factors contributing to each hypothesis tested and the degree of association with answers to the questions asked.

Table 1 illustrates the hypotheses tested for client and CR related factors and their ANOVA significance level (a significance level of less than 0.05 results in rejection of the null hypothesis and acceptance of the alternative hypothesis). Threshold levels are indicated in the hypothesis short-hand description to indicate at what point or level the factor becomes significant. SH+ means slightly high and better, AVG+ means average and better, HI+ means high and better.

It is beyond the scope of this paper to fully discuss these results, however, the figures serve to illustrate the statistical approach adopted. Factors NOT affecting CTP are as interesting as those affecting CTP which fall into three clusters - project and environmental characteristics, CR characteristics and performance, and CM performance.

<table>
<thead>
<tr>
<th>HY</th>
<th>Hypothesis (Short-hand) Description - In Significance Order</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>SH+ the project design team’s confidence in the CR contribution</td>
<td>0.0040</td>
</tr>
<tr>
<td>88</td>
<td>SH+ CR and CM team communication effectiveness for decision making</td>
<td>0.0043</td>
</tr>
<tr>
<td>17</td>
<td>HI+ client/CR's time minimisation objective</td>
<td>0.0136</td>
</tr>
<tr>
<td>28</td>
<td>SH+ ability of the CR to contribute ideas to the design process</td>
<td>0.0137</td>
</tr>
<tr>
<td>32</td>
<td>HI+ the construction team's confidence in the CR's contribution</td>
<td>0.0142</td>
</tr>
<tr>
<td>18</td>
<td>client/CR's quality performance objective</td>
<td>0.0151</td>
</tr>
<tr>
<td>89</td>
<td>SH+ CR and design team communication effectiveness for decision making</td>
<td>0.0237</td>
</tr>
<tr>
<td>36</td>
<td>AVG+ CR's willingness to contribute effective and positive ideas</td>
<td>0.0267</td>
</tr>
<tr>
<td>49</td>
<td>SH+ impact of CR/CM working relationship</td>
<td>0.0468</td>
</tr>
<tr>
<td>29</td>
<td>SH+ ability of the CR to contribute ideas to the construction process</td>
<td>0.0489</td>
</tr>
<tr>
<td>From the regression model</td>
<td></td>
<td>Regression Sig. 0.0011</td>
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</tbody>
</table>

Table 1 - CR Factors Affecting CTP

The above 11 reasons why CTP is affected by CR factors falls into three broad groups.

*HY-17 and 18 indicate a client with well defined goals (indicating client sophistication);*  
*HY-88, 28, 89, 36 and 29 indicate a CR that is closely involved with the management of the project and contributes to its overall management (indicating CR sophistication);*  
*HY-30, 32 49 and 70 indicate a CR who works well with project teams and has their respect and cooperation (good CR/team relationship and mutual understanding).*
The ANOVA tests reveal (at the 95% confidence interval) that procurement method (with a significance level of 0.0681) does not affect CTP, however, at the 90% confidence level it does. All three design and construction projects (with an average CTP index value of 1.08) and five out of the six construction management projects (with an average CTP index value of 1.15) performed above the trend-line index, whereas only 10 of the 11 traditional projects (with an average CTP index value of 0.94) performed above trend-line value of 1.00.

It is also interesting to reflect upon the correlation of factors affecting and not affecting CTP. If we look at the significant correlation results (i.e. those equal (rounded) or above 0.50) for hypothesis 88, the following is revealed for data item: 'CR & CM team communication for decision making' (moderate correlation appears in italic and strong correlation appears in bold type):

**Spearman Rank Correlation results for factors affecting CTP:**

- ability of the CR to contribute ideas to the construction process ($C_r = 0.5125; \text{sig.} = 0.0037$);
- the construction team's confidence in the CR's contribution ($C_r = 0.6560; \text{sig.} = 0.0002$);
- CR's willingness to contribute effective and positive ideas ($C_r = 0.6636; \text{sig.} = 0.0002$);
- impact of CR/CM working relationship ($C_r = 0.6394; \text{sig.} = 0.0003$);
- effectiveness of the construction team's monitoring and control ($C_r = 0.5147; \text{sig.} = 0.0036$);
- CM's organisational structure to manage risk ($C_r = 0.5437; \text{sig.} = 0.0021$);
- CM's communication management to facilitate decision making ($C_r = 0.6642; \text{sig.} = 0.0002$);
- CR and design team communication effectiveness for decision making ($C_r = 0.5490; \text{sig.} = 0.0026$);
- decision making communication within the CM team ($C_r = 0.5101; \text{sig.} = 0.0039$);
- CM decision making, communicating and actioning ($C_r = 0.6872; \text{sig.} = 0.0001$).

**Spearman Rank Correlation results for factors NOT affecting CTP:**

- clarity of communication of client/CR objectives ($C_r = 0.4986; \text{sig.} = 0.0048$);
- the CR's ability to mould shared project goals and aspirations ($C_r = 0.5588; \text{sig.} = 0.0019$);
- the CR's willingness to accept effective and positive ideas ($C_r = 0.7157; \text{sig.} = 0.0001$);
- the overall CR contribution to project team harmony ($C_r = 0.7743; \text{sig.} = 0.0000$);
- quality management procedures used on-site ($C_r = 0.5227; \text{sig.} = 0.0036$);
- CM's effectiveness in influencing the CR decision making process ($C_r = 0.6386; \text{sig.} = 0.0003$);
- flexibility of the CR's management style ($C_r = 0.5464; \text{sig.} = 0.0020$);
- CR's people-oriented management style ($C_r = 0.5637; \text{sig.} = 0.0017$);
- direct use of power in the CR's management style ($C_r = -0.6552; \text{sig.} = 0.0003$);
- flexibility of the CM's management style ($C_r = 0.4958; \text{sig.} = 0.0030$);
- decision making communication within the CM team ($C_r = 0.5170; \text{sig.} = 0.0062$).

This level of detailed analysis proves extremely revealing in unearthing not only superficial and expected linkages between behaviours attitudes and procedures adopted by team members, but also hidden relationships through revealing cross-factor associations. Both the CR and CM's management style, for example is moderately associated with CR and CM team communication effectiveness for decision making. Furthermore, direct use of power by the CR appears to have an adverse impact upon communication management which in turn has a very strong impact upon CTP.

**Conclusions**

Many researchers have appeared to investigate the impact of construction performance from an assumption that procedural factors are important and then have been faced with inconsistent or confusing results. Many of them have sensed that the traditional project procurement system is lacking in performance at a number of critical levels. Attempts to prove that various forms of non-traditional approaches are superior to traditional ones have met with mixed results. This is not altogether surprising as much of the literature, in explaining why statistical correlation between procurement system and project performance is inconclusive, resorts to discussion of client attitudes, actions and characteristics. Surely this is a key factor (or group of sub-factors) in explaining why performance varies. If we take heed of anecdotal evidence from those having experienced 'dream-run' or 'disaster' projects they will relate to feelings and impressions. Confidence, while very hard to measure, appears to be critical.
In the study reported upon in this paper (Walker 1994), influence of client and CR as a significant factor was expected. What was not expected, was the nature of this influence. Team confidence in the CR rather than **vice versa** reflects the difficult rôle a CR plays as link-pin between a multi-dimensional client group with conflicting goals and the project team. Greater understanding of this uncomfortable rôle needs to be forthcoming from a project team for success to follow. The CR is also required to display a positive attitude and good team interaction skills. These findings contrast sharply with the image of a successful CR being punitive, diamond-hard, and narrowly focussed - doggedly advancing the client's agenda.

To conclude, evidence presented in this paper suggests that clients should concentrate on developing a form of relationship that engenders communication and confidence. The question of risk allocation is important and provided that those accepting the risk are in a position to sufficiently control it or be adequately compensated, then better opportunity exists for confidence to develop. If the right atmosphere exists between project team groups and all are focussed upon a goal of project success, then teams will be more likely to help each other overcome difficulties instead of maximising their advantage over others. Form of procurement is irrelevant in this context.

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