A value driven procurement decision tool

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ABSTRACT

The Co-operative Research Centre for Construction Innovation (CRC-CI) is funding a project known as *Value Alignment Process for Project Delivery.* The project consists of a study of best practice project delivery and the development of a suite of products, resources and services to guide project teams towards the best procurement approach for a specific project or group of projects. This paper describes the development of a Decision Support Tool (DST) to assist clients in making procurement decisions based on the alignment of values and objectives as the drivers of project success. The DST will guide clients and project teams towards more effective and efficient delivery methods. It is designed to become progressively more robust through a continuous feedback loop, building on existing knowledge of successful actions which represent best practice. The usefulness of the tool to clients and their advisors will be apparent both at the 'front end' pre-procurement phase, and throughout the procurement phases of construction projects. The project profiling approach taken in this tool looks at projects as patterns of a series of dimensions: project size, complexity, predictability and objectives.

Keywords: Construction, procurement, decision support systems

INTRODUCTION

The advent of partnering, alliancing and other forms of relationship contracting is turning attention towards decision tools that support the selection of procurement strategies incorporating concepts of value and stakeholder involvement. Clients have traditionally selected from a reasonably short list of possible procurement methods largely divided into three groups of lump sum/firm price, design and construct, and management methods. However relationship style contracting and joint ownership arrangements demand more sophisticated approaches concerning the coalescence of motives and attitudes of the various parties. In Australia traditional adversarial methods were pushed to the limit in the 1980s with very high levels of claims and disputes. A turning point was the Gyles Royal Commission into Productivity in the Building Industry established in 1989 by the NSW government. Research by the Royal Commission identified typical cost and time overruns of up to 30% in the industry, of which a major portion was due to industrial disputation and the adversarial nature of the industry. Gyles (1991) pioneered the introduction of partnering from the United States, on the Macquarie Hospital in Sydney and partnering was subsequently adopted quite extensively by the NSW government, though to a lesser extent by other state governments. Perhaps further influenced by the Construction Industry Development Agency (CIDA, 1994) which was established in 1991 by the Hawke federal government to promote reform in the industry and strong interest by agencies such as the Property Council of Australia and the Australian Procurement and Construction Council, the 1990s saw improvements in cost and time performance and a reduction in disputation. Many clients were turning to new procurement strategies to promote value and collaboration rather than litigation. Although there have been some notable projects which have been problematic, such as the Altona Oil refinery in Victoria, the Melbourne Sports Stadium, and Federation Square, there have been correspondingly prominent successes such as the third runway at Sydney Airport, the Homebush Olympic Stadium and alliance projects such as the Acton Peninsula Project (National Museum of Australia) and the Awoonga Dam in Central Queensland.

This paper describes research aimed at developing a decision support tool to assist clients and others make informed choices about procurement systems, based on a set of variables that are focused on issues of value and team alignment. The project is one of a number in the area of Project Delivery under the aegis of the Cooperative Research Centre for

Construction Innovation (CRC-CI) based at the Queensland University of Technology in Brisbane.

APPROACHES TO PROCUREMENT SELECTION TOOLS

Previous guides to procurement selection

Recent reports in Australia on procurement and project delivery in the Australian building and construction industry, have confirmed that decisions on what procurement method to use are based less on critical risk analysis than on what has been used before that is, familiarity (APP 1998), a phenomenon also noted by Masterman (1992). The APP report concluded that most clients and other stakeholders only use one or two delivery methods and are usually strong advocates for the methods they are familiar with. The report found that while clients admit that a system has problems there is a tendency to prefer problems they know, to the potential of problems they do not know. Further report findings were that most industry commentary as to delivery system and procurement failures was related to the actions or lack of action of project personnel with many contract claims being the result of people taking action within a delivery system without understanding or appreciating the consequences.

Masterman (1992) has also observed that to be worthwhile, a guide to the selection of procurement systems must be user-friendly and incorporate a means of prioritising client-project criteria and relating these to the suitability of the various procurement systems. In a review of methods current at the time, he found the selection method proposed by Bennett and Grice (1990) provided the most accessible and useful guidance, because it combined the multi-attribute technique of the BEDC (1985) model with Skitmore and Marsden's (1988) work on measures of suitability to tabulate the strengths and weaknesses of various procurement systems. The system formulated by Bennett and Grice also provides an opportunity for clients to weight various criteria in order to reflect their priorities. Another review of research into procurement selection methods by Alhazmi and McCaffer (2000) observed that though the selection methods took various approaches such as operational, statistical or electronic, several difficulties were associated with some or all of the models:

- All models seemed to ignore some important factors.
- Some models' databases were limited in the options available for consideration.
- Some models are conditional and therefore not widely applicable.
- Some models require the use of advanced mathematical techniques which are not user-friendly and time consuming.
- Some models adopt a primitive approach and limit the options to be considered.

Broadly speaking, previous approaches to develop selection methodologies have attempted to cross-reference project variables with systems existing in the marketplace, thus attempting to shoe-horn one-off projects and their particular parameters, priorities and external conditions into off-the-shelf delivery systems.

A new approach to selecting a procurement path

The approach described in this paper is fundamentally different and is based on previous research by Sidwell, Kennedy and Chan (2002) which developed six generic actions for aligning the interests of the parties and designing the project procurement strategy. These generic actions are fundamentally oriented towards achieving alignment of the parties by addressing key issues which have traditionally got in the way of collaboration and mutually beneficial project processes:

- *Value to parties.* Seek high levels of value for all the project participants and stakeholders.

- *Alignment of objectives.* Break the cycle of mistrust currently at work in the industry. Adopt relationship management techniques to eliminate manufactured, institutional or psychological causes of conflict.
- *Holistic process-lifecycle.* Adopt a whole of life approach to project outcomes, including a long-term approach to shareholder value if applicable.
- *Value driven selection.* Use a value driven selection process for all service providers rather than a purely price-driven process.
- *Eliminate duplicated effort.* Eliminate ambiguity or confusion about roles or responsibilities, particularly about responsibility for the coordination of documentation.
- *Process not contractual arrangement.* Achieve high standards in key performance measures by using fundamental processes rather than through existing contractual arrangements.

The consideration and application of these generic actions is not limited to the pre contract stage in the process since each may have influence at any stage in the delivery process. The identification of the steps or stages through which a construction project passes is essential if improvement is to occur. Kennedy (2002) explains the development of the actions into a decision matrix with five basic project phases, namely idea and feasibility, planning and design, construction, commissioning, and operation giving a model illustrated in Table 1, the best practice Decision Matrix. The matrix has been applied to a series of case studies of completed projects to determine its application. The example in Table 1 gives a quick graphic illustration of the areas and actions where parties were aligned or non-aligned.

Table 1. The best practice decision matrix

Objective **Phase**	**Value to parties**	**Alignment of objectives**	**Holistic process**	**Value-driven selection process**	**Eliminate Duplicated effort**	**Process not contractual arrangement**
Idea	✔	✔	✔	✔	✔	✔
Planning & design	✔	✔	✔	✔	X	✔
Construction	✔	X	✔	X	✔	✔
Commissioning	✔	✔	✔	✔	✔	✔
Operation & maintenance	✔	X	✔	✔	X	✔

Framework for measuring project success

In order to achieve the goal of outstanding performance, it was first necessary to define success and measures of performance. A literature review (Chan, 2002) of leading journals revealed that cost, time and quality remain the three basic and most important performance indicators in construction projects. Other measures, such as safety, functionality and satisfaction are attracting increasing attention. The indicators developed by various researchers, take into account macro and micro viewpoints, process dimensions in the delivery stage, and system dimensions and benefits in the post delivery stage. Shenhar, Levy and Dvir (1997) proposed that project success is divided into four time-dependent dimensions. The first dimension is the period during project execution and immediately following project completion. The second dimension can be assessed after a short time, when the project has been delivered to the customer. The third dimension can be assessed after a significant level of sales has been achieved (one to two years). Finally the fourth dimension can only be assessed three to five years after project completion.

Atkinson (1999) in a similar pattern defined project success in three stages: the first stage is 'the delivery stage: the process: doing it right'; the second is 'post delivery stage: the system: getting it right' and the last stage is 'the post delivery stage: the benefits: getting them right'. Lim and Mohamed (1999) believed that project success should be viewed from different perspectives of the individual owner, developer, contractor, user, and the general public and so on. Two categories: the macro and micro viewpoints of project success were proposed. The macro viewpoint of project success included time, satisfaction, utility and operational indicators, whilst the micro viewpoint looked at time, cost, quality, performance and safety indicators on completion of the project. Sadeh, Dvir and Shenhar (2000) have yet another perspective on project dimensions. The first dimension is "meeting design goals", and refers to the contract that was signed with the customer. The second dimension is "the benefit to the end user"; it refers to the benefit to the customers from the project end products. The third dimension is "benefit to the developing organisation" which refers to the benefit gained by the developing organisation as a result of executing the project. The last dimension is the "benefit to the national technological infrastructure", as well as to the technological infrastructure of the firm that was engaged in the development process. The combination of all these dimensions gives the overall assessment of project success.

Chan's review of project success and performance measures proposes a consolidated framework that includes and re-groups all the identified performance indicators as per Figure 1. The proposed framework can provide a clear and unambiguous definition for project performance.

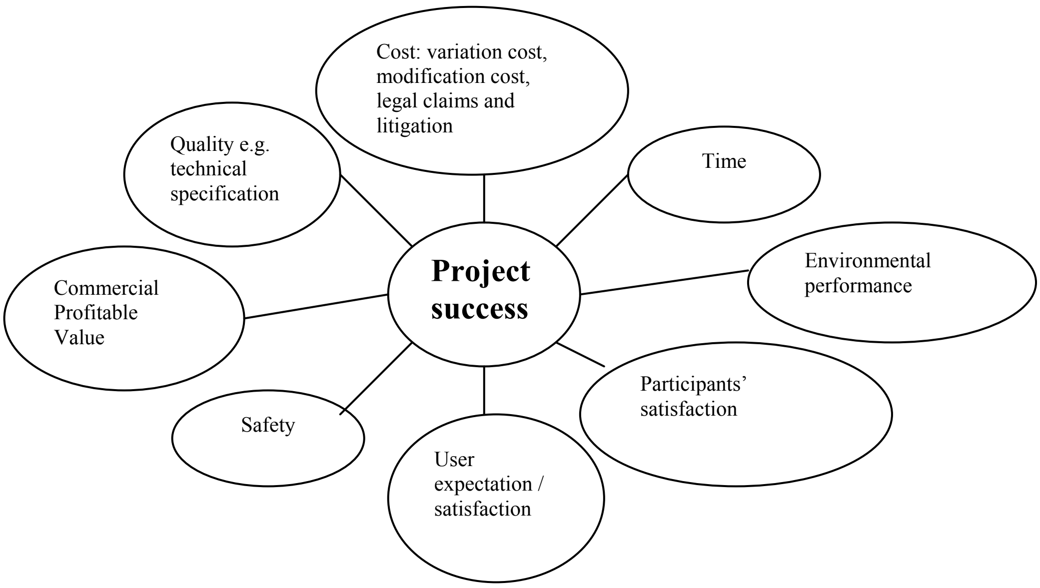

Figure 1 Consolidated framework for measuring project success (Chan, 2002)

Linked with key performance indicators (KPIs), the framework can also enhance clients', contractors' and consultants' understanding of running a successful project and set a base for them to improve the project performance. KPIs consist of both objective and subjective measures, Table 2. They are useful for benchmarking and measuring performance and allow likely project outcomes to be ascertained and assessed during construction. Measuring and collecting information in this way is useful for implementation of future projects.

Table 2. Key Performance Indicators (Chan, 2002)

Objective Measures	Subjective Measures
Construction time	Quality
Speed of construction	Functionality
Time variation	End-user's satisfaction
Unit cost	Client's satisfaction
Percentage net variation over final cost	Design team's satisfaction

Net present value Accident rate Environment Impact Assessment (EIA) Scores	Construction team's satisfaction

HOW A DECISION SUPPORT TOOL ASSISTS DECISION MAKERS

A Decision Support Tool (DST) is typically developed to address a specific problem or opportunity. In this case, the opportunity is to provide clients and their advisors the means to identify a clear route through the procurement maze. In the earliest phases of this research, it was decided to establish how a decision support tool for the procurement of construction projects could support decision-making at the executive level.

Sprague and Watson (1996) note that the decision-making process is generally considered to consist of three phases: intelligence, design and choice. Intelligence involves the identification of a problem or opportunity that requires a decision, and the collection of information relevant to the decision. Design involves the creation and evaluation of alternative courses of action. Choice is the selection of a course of action.

The primary value to a decision maker of a DST is its ability to support the design phase of decision-making. According to Sprague and Watson, the real core of any decision support system is the model base which has been built to analyse a problem or decision. The decision-maker must be able to use the DST to explore the models interactively as a means to identify and evaluate alternative courses of action. The DST supports the choice phase through 'what-if' analysis by showing the impact of a defined scenario. The perceived benefits of a DST to decision makers include an increased capability for decision analysis.

However, executive decision-making is rarely based on hard information alone. As suggested by the inclusion of a "best-practice" data base, soft information is also required. To make effective decisions on procurement strategies for potential projects, executives must understand what has happened in the past, what is occurring now and what might take place in the future. Often this is best accomplished by combining hard and soft information. For example, hard project data may show that a recent project ran behind its estimated completion date. However, commentary from other sources may describe the reasons for the delay, what corrective steps were taken and what gains were made in terms of a qualitative outcome (soft information). Presented together, the information gives the executive a much clearer understanding of the situation than the hard information alone would have provided.

According to Brookes (in Sprague & Watson 1996: 301) "the role that soft information can play in providing additional support to the executive decision-making processes is dependent on the close integration between the report of hard and soft information". Huber (in Sprague & Watson 1996:301) notes that "except for their systems that routinely index and store 'hard' information organizations tend to have only weak systems for finding where a certain item of information is known to the organization…What about 'soft' information? Much of what an organisation learns is stored in the minds of its members….Thus, as the friendliness and capabilities of expert systems increase, the proportion of an organisation's 'soft' and local information that is computer resident, increases."

It is assumed that the data base can be used by decision-makers to find out what activity adds unusually high value or has unusually high productivity. This presents a new and radically different view of the purpose of information: a measurement on which to base future action rather than as a postmortem and a record of what has already happened.

The development of the decision support tool

A project delivery decision support tool based on the decision matrix (Table 1) is under development. The purpose of this DST is to help clients and project teams apply practices to building or civil construction projects that will help them achieve outstanding performance in terms of their project objectives. The CRC for Construction Innovation is also undertaking a spectrum of linked research projects which are looking at (i) facilitating project culture change, (ii) selecting project team members on the basis on best value for best performance outcomes, (iii) design and documentation quality and performance, and (iv) a project diagnostic tool to keep projects 'healthy'. These projects will together form an overall decision support system.

Validation of the decision matrix over a number of pilot studies has produced a robust procurement framework within which to order information or advice for users regarding the amalgam of activities undertaken to obtain the building or infrastructure which will provide the service they need to carry on their business. A consolidated framework of performance criteria for project success and key performance indicators for measuring performance has also been established.

In contrast to methodologies advocated by previous studies (e.g. BEDC 1985, Skitmore and Marsden 1988, Franks 1990, and Love et al, 1998), which seek to make suggestions for arriving at a best contractual arrangement given a number of selection criteria, the main function of the proposed DST is to allow clients and project teams to obtain advice to determine the ideal fit between expectations, objectives and procurement strategy. Often this will be similar to existing contractual arrangements but with additional components that ensure each of the underlying principles in the decision matrix is addressed (Sidwell et al. 2002).

The fundamental elements of the DST consist of (a) project characteristics, (b) project phases, and (c) generic actions. Project characteristics serve as an input to the system, which is called project profile. This is similar to that of the previous methodologies for choosing a best contract strategy. For example, Skitmore and Marsden (1988) incorporated the selection criteria of speed, certainty, flexibility, quality level, complexity, risk avoidance and responsibility, and price competition. The proposed DST will take into account Bennett's (1991) characteristics of project tasks, on which his contingency theory of construction management is based. In summary, the system classifies projects in terms of:

- Size
- Complexity
- Predictability
- Objectives (Speed, economy and workmanship quality)

The combination of characteristics is called the project profile, and this serves to determine the inherent difficulty of the project.

As for generic actions, the DST adopts the six generic actions established above and will expand them into descriptions of specific actions, case studies of successful projects, and other information which helps clients and their project teams select appropriate delivery systems. Sidwell et al.'s (2002) case studies have provided many detailed actions that expand the generic actions into useful advice. There are many other published case studies of best practice which can be used to build up a large database of actions to support this DST however, actions included in the database must be selected and classified carefully so that advice provided by the decision tool is reliable. The best way of ensuring this is to draw on case studies of many projects where the same actions were used and they produced similarly successful results. Although the definition of whether a project is a success or a failure is not always an easy one there should at least be a framework for measuring success, such as that illustrated in Figure 1.

The way the DST works is determined by the project profile being established, which basically indicates the level of difficulty inherent in the project. The overall profile of the design and construction activities of a project determines the level of risk that the project will run into difficulties if the project team does not adopt an appropriate delivery system to coordinate the direct design and construction activities. In broad terms the more difficult the pattern of direct design and coordination activities the more coordination is needed for the project to be successful. The nature of the risk profile for a project determines the ideal delivery strategy and structure that is recommended to be used to achieve an alignment between the project initiator's objectives and the project team members' ability to deliver. The flow chart in Figure 2 describes the outline design of the DST including the query (user obtains advice) and data entry (user enters lessons learned) attributes.

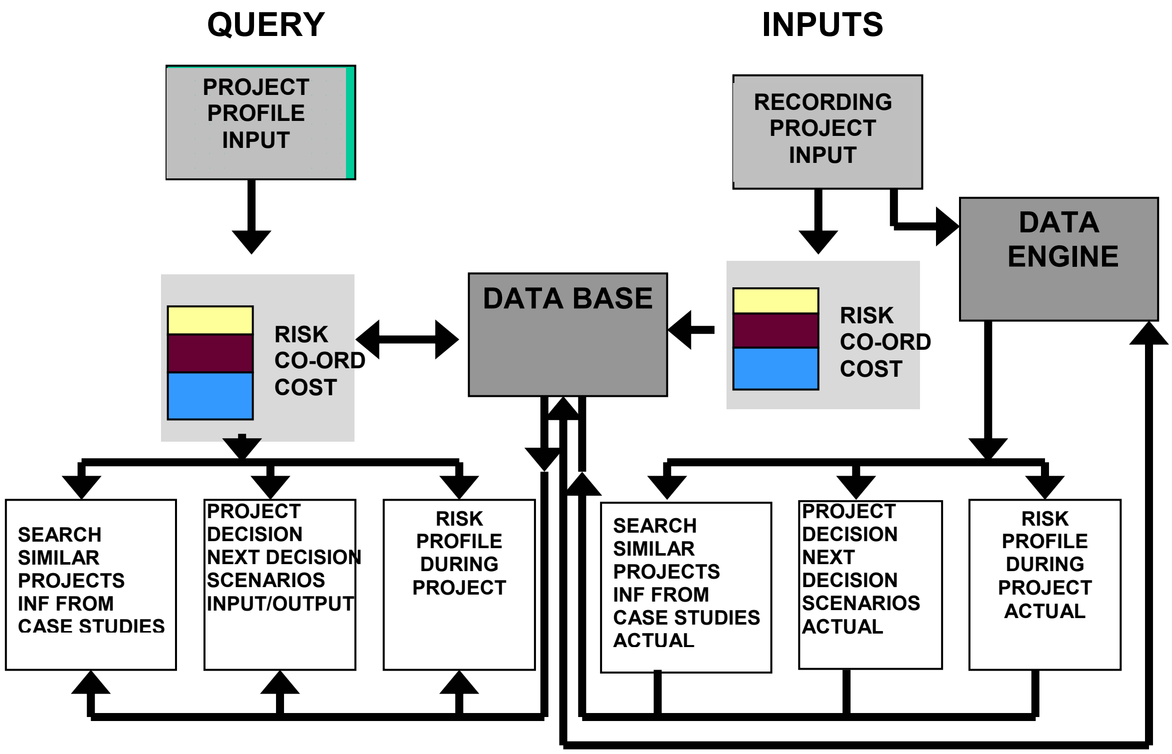

Figure 2. Flow chart describing main attributes of the DST

The system will be an interactive support system which can go on working throughout the various phases of the project detailing on the level of risk associated with the project during its life based on the profile and actions taken during project progress. As a result of the way the database is set up, the DST will allow users to explore various approaches to project delivery and make informed decisions based on alternatives and an understanding of consequences flowing from lessons learned on previous projects. The database comprises descriptions of actions associated with superior project performance. Each item describes who took an action, what the action was, and its intended purpose and the impact it had on project outcomes.

A preliminary electronic tool has been constructed to give tangible form to the DST concept. The prototype version has not employed existing decision support software, but was created with capabilities provided by *Excel* algorithms. This approach provided quick and tangible output in the early stages of development and helped in obtaining user cooperation. Rapid progress on development of a prototype resulted in positive attitudes amongst the industry members of the project team regarding the potential of the tool for providing decision support for project procurement. The next phases of the project will involve testing of the prototype for potential for development into a fully functional software tool.

CONCLUSION

The DST proposed by the current research will offer an alternative approach which addresses the fundamental drivers of delivery. This approach will require a corresponding paradigm shift in the thinking of clients and project advisors with regard to selection of project delivery strategies appropriate to projects with particular parameters and priorities. Rather than fall back on an inefficient procurement system for want of understanding, clients and the construction industry service providers will be able to use the DST to stimulate more creative and responsible decision-making.

The new tool will depart from earlier attempts in that it is intended to be an interactive electronic tool, and may be developed to operate as a web-based subscription service, with a low requirement for formal user training. The project to develop the tool has great potential to draw on a diverse knowledge base of construction industry participants nation-wide as well as globally.

The Australian construction industry has embraced non-traditional procurement methods and this decision support tool will provide a basis for improved choice of procurement method. It will help clients and their project teams identify actions that empower them to cooperate in doing their best work in the interests of everyone with an interest in the project and achieve alignment of values for each member of the team.

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