Literature Review
Value Alignment Process for
Project Delivery

Report 2001-003-C-04

The research described in this report was carried out by

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Research Program C:
Delivery and Management of Built Assets

Project 2001-003-C:
Value Alignment Process for Project Delivery

Contents

ABBREVIATIONS

ACA	Australian Constructors Association
APCC	Australian Procurement and Construction Council
BCA	Business Council of Australia
CIDA	Construction Industry Development Agency
CQ	Construction Queensland
CRC	Co-operative Research Centre
OECD	Organisation for Economic Co-operation and Development
PCA	Property Council of Australia
NatBACC	National Building and Construction Committee
NEDO	National Economic Development Office (UK)
NBCC	National Building and Construction Council
NPWC	National Public Works Conference

Introduction

The objective of the project "Value Alignment Process for Project Delivery" is to provide a catalyst and tools for reform in the building and construction industry to transform business-as-usual performance into exceptional performance. The outcomes of this project will be beneficial to not only the construction industry, but to the community as a whole because a more sophisticated industry can deliver more effective use of assets, financing, operating and maintenance of facilities to suit the community's needs.

The research project consists of a study into best practice project delivery and the development of a suite of products, resources and services to guide project teams towards the best approach for a specific project. These resources will be focused on promoting the principles that underlie best practice project delivery, rather than on identifying a particular delivery system. The need for such tools and resources becomes more and more acute as the environment within which the construction industry operates becomes more and more complex, and as business and political imperatives shift to encompass or represent diverse stakeholder interests.

To this end, this literature review looks at why it is essential to achieve transformation in the Australian construction industry in the context of its importance to the Australian economy. It seeks to investigate the concepts of 'alignment' and value' as they pertain to construction industry processes and relationships. It comprehensively reviews drivers of project excellence and best practice project delivery principles and looks at how clients approach selection of project delivery systems. It critiques existing project delivery strategies and gives an overview of recent best practice initiatives.

The literature review represents a milestone against the Project Agreement and forms a foundation document for this research project

1.0 The need for performance improvements in the Australian construction industry

The construction industry has an integral role within the Australian economy. Almost every other industry in Australia depends on building and construction at some stage of its activities. Timely and efficient completion of building and construction projects, preferably in a non-confrontational environment, is sought by the industry's customers and stakeholders. It is now well established that these outcomes depend on co-operative attitudes between the parties involved in projects.

During the late 1980's, a trend towards increased disputation and litigation in the Australian construction industry, and accompanying changes in attitudes which promoted increasingly aggressive and confrontational relationships, were seen as adversely affecting the efficiency and well-being of the industry.

In 1990 a Joint Working Party formed by representatives of both government and private construction industry organisations (NPWC and NBCC) published *No Dispute*. The objective was to develop proposals for changes in the practices of the building and construction industry which would lead to improved practices, and better quality work, with the over-riding aim of achieving a reduction in claims and disputes. The Joint Working Party identified that the factors which promote efficient performance of projects are also the factors which eliminate or minimise the incidence of claims and

disputes, and made recommendations in the following areas: equitable allocation of obligations and/or risks, selection of contractors and sub-contractors, quality of documentation, clearly defined roles of the parties, early involvement of contractors and specialist sub-contractors to ensure buildability, responsibility for industrial relations, cost management, realistic time frames, effective communication between parties, management of variations, dispute resolution, claims administration, quality assurance, alternative contract strategies, and training of industry professionals involved in project delivery.

Since then, numerous inquiries have been conducted into the efficiency of the building and construction industry (Gyles 1992, CIDA 1994, Latham 1994, Egan 1998). Though some of the most publicised inquiries (*Constructing the Team* Latham 1994, *Rethinking Construction* Egan 1998) were conducted in the UK, their findings have resonance here in Australia because the processes and organisation of the Australian industry and the cultural attitude to the industry is similar. Generally these inquiries have concluded that the characteristics of the industry which inhibit its effectiveness are:

- functional fragmentation, where a project organisation is typically made up of disparate groups.
- Lack of co-ordination and communication between the key parties,
- Adversarial contractual relationships,
- Focus on price rather than value,
- Reduction in skills,
- Industrial relations and
- Lack of focus on the industry's customers.

The Gyles Royal Commission into Productivity in the Building Industry in New South Wales sought to encourage a cultural shift in the New South Wales construction industry by carrying out a pilot study on partnering. Gyles recommended that since the success of projects depends far more on co-operation between contracting parties than the terms of the contract, the construction industry ought to investigate the USA's experience of partnering as a way of addressing that market's own tendency towards litigation. In the UK, Latham challenged the industry to increase productivity by reducing costs by 30% and adopting non-adversarial arrangements and dispute resolution methods. Ireland's (1994) theoretical study modelling the building process known as the T40 Report, identified potential savings of 40% of the overall time duration of construction projects.

However, a major turning point was the Egan Report (1998), which provided a framework for the industry to do things "differently" rather than simply "better". The report made specific recommendations in areas such as supply chain development, product development, customer focus, processes, management skills, quality and the need to develop long-term relationships.

Most recently the Cole Royal Commission (2003) examined industry practices and their affect on productivity and efficiency. In contrast to the Gyles Royal Commission, Cole focussed more on industry work practices and the influence of the unions. The commission concluded that structural reform was required in four areas:-

- Structural changes in bargaining to focus at the enterprise level rather than pattern bargaining
- Greater clarity on what constitutes unlawful industrial action and responsibility for subsequent loss
- Adherence to the rule of law in disputation rather than the application of industrial and commercial pressure

- The establishment of an independent body to ensure compliance with industrial, civil and criminal law.

Cole believes that structural change is a necessary precursor to cultural and attitudinal change. Criticised by sectors of the industry, principally the unions, Cole has put his finger on the single characteristic of the Australian construction industry that distinguishes it from all other western economies. His proposals for change include the establishment of a Building and Construction Commission which will have responsibility for monitoring conduct in the industry and bringing forward prosecutions with the power to restrain unlawful industrial action. Clearly these moves are dependent upon political will, and given Australia's governmental structure there will be interesting times ahead, which will significantly challenge the major contractors in the industry and inject additional risk factors into the project delivery process.

1.1 Analysis of the Australian construction industry

The Australian Department of Industry Science and Resources (ISR 1999) prepared the *Building for Growth* report for the National Building and Construction Committee (NatBACC). As well as acknowledging the characteristics traditionally inhibiting the industry, the ISR report also identified structural impediments which the industry needs to overcome in order to capture new opportunities:

- the focus on short-term business cycles, and
- a project-to-project culture.

The report cautioned against complacency and a "business-as-usual" mindset in the building and construction industry. It warned that such a mindset would lead, over time, to the industry losing ground to its international competitors. The report asserts that because the building and construction industry is integral to many other segments of the economy, lack of competitiveness in this key industry would negatively impact on Australia's economy. The report indicates that if the industry uses its resources better and raises its efficiency by reducing construction costs and time, Australian industry as a whole will be more competitive (ISR, 1999)

The report asserts that the industry will need to make the transition from being a craft-based industry to an advanced manufacturing industry by integrating its supply chains, benchmarking its performance and adopting new methods to deliver projects to replace current processes which have evolved from traditional adversarial models. This is based on the assumption that new management methods can raise the bar on performance.

1.2 International comparisons

Building for Growth also summarised the results of the International Cost of Construction study[1]. The study evaluated the performance of seven countries' construction industries (Indonesia, People's Republic of China, Singapore, United Kingdom, west coast of the USA, Germany, and Australia). Australia was placed behind UK, USA and Germany on purchasing power parity, but when a range of non-monetary contextual factors including quality, labour productivity, site location and the general performance of the built project, was examined to determine their impact on performance, the gap between Australia's construction industry and those of the other countries, was not seen as significant. These findings also indicate that efficiency improvements could most significantly be made through the re-organisation of the industry and changes to the procurement process of construction.

[1] Commissioned by the Department of Industry, Science and Resources (1997)

1.3 Change agents in the construction industry

Building for Growth notes that the construction industry in Australia faces ongoing challenges to improve competitiveness especially when:

(1) most firms operating in the industry are micro-businesses, and
(2) involvement in the industry is very broad.

As well as contractors directly involved in the construction process, the industry also encompasses the client base, which plays an integral role in the sustainability of the industry. The industry also includes the professional and consulting services sector, the building materials sector, various levels of government and the institutions which regulate the industry, as well as the institutions which educate and train the participants and which undertake research and development. However, there are many firms, associations and government agencies which have sufficient influence within the industry to act as agents of change (for example, it is significant that thirty percent of expenditure in non-residential and engineering construction is in the public sector) and it is the interaction amongst these key players which appears to be the key to raising the industry's performance.

These players (for example, Australian Constructors Association, Australian Procurement and Construction Council, Business Council of Australia, Construction Queensland, Property Council of Australia) have begun to address the elements which traditionally inhibit the performance of the construction industry and are seeking to adopt responses which optimise project outcomes for all stakeholders by better focus on customer requirements, better communication and integration of supply chains, a collaborative approach to problem solving rather than an adversarial approach, and so on.

One of the major recommendations of the NatBACC was the establishment of a Cooperative Research Centre for Construction. This was perceived as one way of bringing together the different sides of industry in a non-competitive environment focussed on research. The CRC for Construction Innovation (CRCCI) was established at Queensland University of Technology in 2001 and has 19 partners across industry, government and research providers. CRCCI has three research programs in:

- Business and Industry Development - to improve the long-term effectiveness, competitiveness and dynamics of a viable construction industry in the Australian and international contexts.
- Sustainable Built Assets - to drive healthy and sustainable constructed assets and optimise the environmental impact of built facilities.
- Delivery & Management of Built Assets - to deliver project value for stakeholders for the whole-of-life, from business need, design and construction through to ownership, asset management and reuse.

2.0 Concepts of value and alignment

2.1 Value and cost

Gann and Whyte (2003) note that the construction sector has become more conversant with cost and time than with other parameters of concern to customers, end-users and society at large, including value and design quality. order for the construction industry to become more customer focussed, it needs to provide customers with information about the industry's performance in terms of what represents value to the customer, rather than in terms of the industry's own internal measurements. A client is likely to be interested in the cost of designing and constructing a capital facility in terms of its unit of output. They may be interested in

capital costs, running and maintenance costs, time from the customer's decision to procure a new facility to moving in, or in the case of civil engineering projects, to the time it is open to traffic. Customers measure quality in terms of a range of performance standards, and in terms of the incidence and costs of remedying defects. (Bennett, personal email June 6, 2002).

It is widely accepted that a successful product or service must meet both quality and cost criteria if it is to provide value (Sheehy, Bracey and Frazier, 1996). However, value is not influenced by cost. Value is a measure of outputs and cost is a measure of inputs. The ratio between value and cost is thus a measure of efficiency for organisations, or projects (Bennett, personal email June 6, 2002).

As construction firms recognise and track the movement of value in the construction industry (for example the emerging emphasis on energy efficiency and environmental sustainability) they need to ensure they can meet customers' requirements by providing core competencies, core processes, product and service offerings, innovations in strategies and so on. Value adding knowledge enables service providers to engage with the customer and become an extension of the customer's business. Adding value and exceeding customer expectations will take preference over slashing costs (Sheehy et al, 1996). However in order to achieve this focus on delivering value, projects must provide construction firms with a fair profit. Customers who recognise the value which can be achieved by investing in an efficient and fair construction procurement process can take advantage of the value adding services provided by the construction industry.

2.2 Value and stakeholders' interests

In the course of adding value, the best interests of all stakeholders are served, as long as these interests are kept in balance.

"Stakeholders are those persons or organisations whose views, interests, and/or requirements can impact on, or are impacted by, the initiation and/or formulation and eventual implementation of the project solution." (Kagioglou, Cooper, Ghassan, Hinks, Sexton, Sheath, 1998) Stakeholders are numerous and can include both "traditional" and "emerging" stakeholders (Elkington, 1997). In projects involving the construction industry the list may include the client (including individual executives within a client organisation) and shareholders, financiers, insurers, consultants, contractors, sub-contractors and suppliers, various levels of government policymakers and regulators and the end-users. Emerging stakeholders include special interest groups, employees and unions, competitors and the end-users' customers. However, most stakeholders do not have the authority to impose objectives on the client organisation. When objectives relating to particular stakeholders are included in a project business plan, it is because explicit statement of such objectives will be beneficial to the client over its strategic planning horizon (Langston, 1997).

Elkington (1998) notes that by improving understanding of value all in stakeholders' terms rather than in terms of the 'paying' client specifically, greater appreciation of the full value that projects deliver can be recognised. Broadening the definition of value to encompass a wider circle of concern such as social and environmental objectives, may reveal opportunities for capturing latent enthusiasm from diverse stakeholders as well as providing opportunities for reducing negative pressures that various stakeholders can exert upon projects.

2.3 Alignment

A typical construction project brings together individuals representing a wide variety of functional groups with diverse priorities, expectations and requirements. Eggleton (2001) characterised the 'business as usual' attitudes of client and contractor as a misalignment of objectives. In Table 1, Eggleton describes the entrenched attitudes prevailing in the construction industry as focussing on costs rather than value, thus heightening the potential for confrontation and conflict in the construction delivery process. It follows that if the parties to construction projects want to move beyond 'business as usual', they need to adopt a process which allows them to align objectives.

Table 1. Business as Usual Attitudes

CLIENT	CONTRACTOR
We are the client and shall use the contract to obtain the maximum amount of scope for the cheapest possible cost, within the timeframe. We reserve the right to make any changes regardless of the cost and time implications for the Contractor and will use the contract to pay as little as possible for this change.	We are the contractor and shall use the contract to provide the minimum amount of scope for the maximum level of cost recovery. The risk of any time delays shall be passed onto the client via extension of time claims and we are entitled to a profit regardless of our performance in delivering the result.

Eggleton (2001)

The engagement of stakeholders and the importance of aligning their objectives is a recurring theme in management literature. Labovitz and Rosanksy (1997) found that the "alignment" concept enables organisations to establish a climate and culture that results in breakthrough levels of customer satisfaction, employee loyalty and financial return. They refer to alignment as both a state of being and a set of actions. This recognises that alignment refers to the integration of key systems and processes, and responses to changes in the external environment to maintain a state of alignment.

Management author Peter Senge identifies building shared vision and team learning as vital dimensions in a learning organisation. In a discussion on team learning, Senge (1992) notes that when a team becomes aligned, there is a commonality of purpose, a shared vision, and understanding of how to complement one another's efforts. By contrast, the fundamental characteristic of the relatively unaligned team is wasted energy because individuals may work extraordinarily hard, but their efforts do not efficiently translate to team effort. When a team is aligned, the relationships between parts of a team become as important as the parts themselves.

Griffith and Gibson (1997) define alignment as it applies to construction projects as "the condition where appropriate project participants are working within acceptable tolerances to develop and meet a uniformly defined and understood set of project objectives." They go on, "alignment is the process of incorporating all of those distinct priorities and requirements into a uniform set of project objectives that meet the business needs of the facility".

Griffith and Gibson's report "Team Alignment During Pro-Project Planning of Capital Facilities" for the Construction Industry Institute (1997) demonstrated that the level of alignment of stakeholders during pre-project planning positively contributes to the ultimate success of the project. They established that in order to enhance alignment, "management" must ensure the following actions are carried out:

- Stakeholders are appropriately represented on the project team.
- Project leadership is defined, effective and accountable.

- The relative priorities amongst cost, schedule, safety, and required project features are clear.
- Communication within the team and with stakeholders is open and effective.
- Team meetings are timely and productive.
- The team culture fosters trust, honesty and shared values.
- The pre-project planning process includes sufficient funding, time and scope to meet the project objectives.
- The reward and recognition system promotes meeting or exceeding the project objectives.
- The teamwork and team building programs are effective.
- Planning tools (eg simulations, and work flow diagrams) are effectively utilised.

Griffith and Gibson (1997) stress that alignment of objectives must be in multiple dimensions simultaneously and must also be maintained longitudinally. Throughout the project life cycle, alignment with the project objectives and priorities should be

- Top-to-bottom within each stakeholder organisation, and cross-organisationally between functional groups within organisations.
- Between each of the organisations with a stake in the project.

Labovitz and Rosanksy (1997) describe the alignment process adopted by Fluor Daniel. The process begins with a shared understanding between Fluor Daniel and their clients about the purpose of a project and they assign seven deliverables that ensure this purpose is met.

1. Shared project values.
2. A purpose statement summarises expected results.
3. Key result areas (KRA's) : objectives.
4. Measurement: mechanism to measure the KRAs.
5. Critical activities: the actions necessary to achieve the KRAs.
6. Role clarification: clarification of the team's roles and responsibilities.
7. Path Forward.

The adoption of alignment processes such as the foregoing adds value to projects by giving participants (including the client) the means to work collaboratively rather than confrontationally towards the common goal of meeting the client's business needs.

3.0 Clients and their needs

As the current research is concerned primarily with achieving exceptional performance through best practice project delivery principles, it is necessary to identify who the industry's products are aimed at, how their needs are being met, what best practice procurement systems exist and how they are currently selected and implemented.

McGeorge and Palmer (1997) point out that the dominant message from both Latham's final report and Gyles' Royal Commission report, is the key role of the client in activating a cultural shift in the industry through the adoption of modern management concepts. Latham (in McGeorge and Palmer,1997) states that 'implementation begins with clients. Clients are at the core of the process and their needs must be met by industry'.

However, the industry's customer base is widely diverse, and their needs are complex and varying. Masterman (1992) summarises the various categories of clients as follows. Clients can be either public or private organisations. They can be categorised as either experienced or inexperienced, according to their experience of

implementing building projects. Clients can also be categorised according to their business needs. For example, clients whose main business activity and primary source of income derives from procuring projects for sale or lease and so on, or clients who require buildings or other facilities to house and undertake their main business activities and whose expenditure on construction represents a small proportion of their annual turnover.

Clients' criteria are often conflicting and need to be accounted for by using appropriate delivery strategies. The following are examples of various criteria for project satisfaction which depend on the individual client's priorities.

- Certainty of completion date.
- Shortest design and construction duration (for example to minimise disruption to existing operating facility).
- Lowest possible price.
- Preference to deal with a single service provider for project delivery.
- Desire to be actively involved and informed during implementation of the project.
- Flexibility to change the design during construction.
- Need to keep any existing facility operational during construction work.
- Design that is inventive and innovative.
- Design that is routine problem-solving.
- Public accountability.

Despite different priorities determined by the client's business case, clients generally have the following needs in common. According to Masterman (1992) customers not only expect certainty of performance in time, cost and quality criteria, but they are also seeking:

- Functionality of their built project.
- Value for money.
- A durable and easily maintainable facility with affordable running costs, no latent defects, and easy rectification of any minor problems.
- Clear allocation of responsibilities amongst members of the project team with minimal exposure to risk for the client.
- Early indication of a firm price for the project and comprehensive information on any future contractual claims.
- Minimal interference from external sources such as regulatory authorities.
- A non-confrontational business relationship with the contractor.
- Guarantees and good 'after sales' service.

Various customers determine project success by various criteria which represent value to them, whereas the construction industry tends to measure performance in terms that customers want to be able to take for granted, such as completion on time, staying within the customer's budget, and high standard of quality without latent defects (Bennett, personal email 2002).

Readers are also commended to the paper prepared for this CRC-Construction Innovation project by Chan entitled "Framework for measuring success of construction projects" which is available on the Construction Innovation intranet project page.

4.0 Drivers of project excellence

The CII research project "Exceptional Projects and Methods of Improving Project Performance" (CII 1999a) looked at thirty projects in the USA which were executed with exceptional results in terms of time objectives, to determine what made them different from projects of the same scope and complexity which were procured by traditional methods. Commonly it was found that a united focus, a common goal, and an atmosphere which supported the need to get the project underway, existed on exceptional projects.

Generally these projects were driven by a crisis situation such as rebuilds caused by catastrophic events, or market conditions that mandated a significant reduction in project duration. It was found that strategies that were designed to speed the project time frame had beneficial impacts on the project cost and quality as well. The type of contract was primarily negotiated, and there was a mix of cost plus (66%) and lump sum projects (33%). The following organisational factors were found to have established the environment for success on these projects:

- Team environment was supportive and positive,
- Team members were empowered to get the job done,
- Team members were relieved of their normal organisational role,
- Strong commitment by owners to achieving a successful project,
- Experienced personnel were selected to carry out roles,
- Rules were allowed to be broken, changed, or removed,
- Process was allowed to be changed,
- Amnesty (team members were allowed to move "outside the square").

These factors required owners, managers and companies to change their business processes, and work processes by relinquishing some amount of control, and being dedicated to approaching the process in a lateral manner (CII, 1999), through aligning their objectives. Latham (1994) confirmed the value of teamwork, based on the commitment and proactive attitudes of all project participants, in boosting performance levels.

Several researchers in the Australian market have also identified the factors that are critical to achieving project success. Crow and Barda (2001) used case studies of twenty-eight projects which all achieved more than the client expected at the outset, based on the industry's normal performance, to identify the key driver of project success. The twenty-eight projects researched were all one-off projects for experienced clients. Crow and Barda provide a list of clients' business related needs, including reduced operating costs, increased revenues, increased functionality and improved morale of operating staff. In relation to client expectations, their findings were that "clients understand that successful projects depend on construction firms making better than normal profits. Clients want to involve the local community and the people who will use the new facility. They expect risks to be designed and managed out of projects so they deliver what was promised." (Crow and Barda, 2001)

The keys to excellence Crow and Barda identify are:

- a cooperative, non-confrontational environment,
- teamworking,
- a clear project strategy and
- a focus on users' needs.

They found that the main driver of project excellence was client leadership in creating a trusting and motivating team environment.

Construction Queensland (CQ, 2001) also sees the client as central to an equitable project delivery system. It says clients need an organisational culture which is

focussed on quality and value for money, clients need to lead the process, need to share risks equitably, and need to align their understanding of the project with the main construction firms involved. If these client characteristics do not exist, or cannot be implemented, the opportunities to increase project success will be limited. (CQ 2001)

Sidwell, Kennedy and Chan (2002) also identified the importance of the client's qualities in their study of re-engineering the construction delivery process. The researchers selected ten projects to identify actions taken by the project teams to achieve improvements in performance. The case studies included building and civil projects, not all of which were successful, and a range of innovative delivery processes. Fifteen factors[2] which influence project success were identified and four of these were noted as critical in explaining project performance, irrespective of the contract strategy adopted:

- co-operative project teams,
- client's competency and commitment,
- continuity of key personnel,
- equitable risk allocation.

The Australian Constructors' Association (ACA 1998) surveyed thirty-four of the industry's major private/public sector clients on utilising project delivery strategies based on closer alignment of client and contractor goals and a better understanding of risk-sharing. The survey identified the project delivery issues which clients agree must contribute to successful project outcomes:

- Clear project goals,
- Clear definition and understanding of the project scope,
- Clear understanding and appropriate allocation of risks,
- Agreed risk/reward arrangement,
- Appropriately skilled project staff, and
- Well-defined communications through all levels of the contracting parties with proper empowerment for decision making.

The foregoing suggests a degree of concurrence amongst industry groups and client groups that key drivers of project excellence include:

- clear focus on owner's business needs,
- strong commitment by owners to equitable risk allocation
- co-operative and motivated teams and,
- experienced or appropriately skilled key personnel.

Thus the elements of successful project delivery are viewed in terms of alignment of objectives and agreement of value. The Decision Matrix developed by Sidwell et al (2002) described a set of guidelines which should be applied by project teams in the pursuit of these drivers of excellent project outcomes. The guidelines, to be applied throughout the project development process are listed as:

1. Value to parties.
   Seek high levels of value for all the project participants and stakeholders.
2. Alignment of objectives.

[2] Fifteen principal success factors identified through ten case studies:
co-operative project teams, client's competency and commitment, continuity of key personnel, equitable risk allocation, well-defined project brief, complexity, regular monitoring of key objectives, effective communication process, availability of suitable contractors, consultant selection criteria, mechanism for reward and penalty, clear reporting lines, client's preparedness to absorb risk, shared responsibility to project problems, selection of supply chain.

Break the cycle of mistrust currently at work in the industry. Adopt relationship management techniques to eliminate manufactured, institutional or psychological causes of conflict.

3. Holistic process-lifecycle.
   Adopt a whole of life approach to project outcomes, including a long-term approach to shareholder value if applicable.
4. Value driven selection.
   Use a value driven selection process for all service providers rather than a purely price-driven process.
5. Eliminate duplicated effort.
   Eliminate ambiguity or confusion about roles or responsibilities, particularly about responsibility for the coordination of documentation.
6. Process not contractual arrangement.
   Achieve high standards in key performance measures by using fundamental processes rather than through existing contractual arrangements.

In a recent report[3] which is also a deliverable for the current Value Alignment Process research project, these guidelines have been transformed into a set of actions which may be applied to achieve 'value alignment' in the project delivery process. These are:

- Agreeing the project objectives taking account of the project stakeholders' values and the need to improve over industry norms.
- Selecting team members on the basis of the value they add to the team.
- Aligning team member's interests.
- Ensuring the financial arrangements support team-working.
- Agreeing the processes to be used including how decisions will be made and how the team will be integrated.
- Agreeing how team performance is to be measured.
- Ensuring team members have feedback driven control systems.
- Agreeing the design strategy to take account of life cycle costs.
- Agreeing the construction strategy to take account of life cycle costs.

These actions do not collectively describe a particular project delivery system but form the basis of an approach to best practice project delivery, for exceptional results, based on the concept of value alignment.

5.0 Project delivery systems and contract strategies

A project delivery system defines the relationships, roles and responsibilities of project team members and the sequence of activity required to design and construct a construction project (CII, 1999b). Thus, the project delivery system, or procurement system incorporates the organisational structure and processes adopted by the client for the management of the design and construction of a building project.

Appropriate systems and contract strategies are needed to help achieve optimal solutions in terms of project objectives. Currently, prospective construction clients are presented with a multiplicity of potential arrangements for procuring design, construction, management and financial services for the realisation of the building or infrastructure project which will deliver the services they require and which will take account of their specific priorities for the project, the actual project attributes, and external conditions.

[3] Sidwell, A.C. Kennedy, R.J. Budiawan D. *Report on the development and validation of the best practice decision matrix. CRC-Construction Innovation Report 2001-003-C-03.* http://internal.construction-innovation.info

Kumaraswamy and Dissanayaka (1998) identified several sub-systems of the "typical" project delivery system including "contract strategy", "work packaging", and "participant selection methods". Decisions on appropriate work packaging can be crucial to achievable economies and efficient management of many projects. For example complex or large projects may be broken up to keep them within the capabilities of local construction organisations, or may be designed to be large enough to attract international interest. Methodologies for selection of project participants may be open tenders, or based on pre-qualified short-lists, depending on the project requirements. Selection criteria may be purely price-oriented or include appropriate non-price criteria.

The contract strategy takes account of how the design, construction and management functions interact; and prescribes procedures for payment and contractual conditions (Kumaraswamy and Dissanayaka, 1998). In recent decades the construction industry has developed a range of contract strategies to overcome the perceived inefficiencies of the traditional process to deliver on projects with increasingly complex parameters and priorities. However, a familiar catchcry in the industry is:

"There is no one strategy that suits all projects and all Principals." (NBCC, 1990)

5.1 Contract Strategies

Masterman (1992) categorised typical contract strategies according to the critical interaction between the design and construction processes. Each strategy places different demands, risk allocation and responsibilities on everyone involved and different cash flow profiles on the client.

- Where the responsibilities for the design and construction aspects of the project are the responsibility of separate organisations as in conventional systems such as traditional lump sum or schedule of rates, the functional groups are separate or co-operative, with project stages being sequential.
- Where design and construction become the responsibility of one organisation, usually a contractor, and the client has only one organisation to deal with, as in Design and Construct, Project Alliances, and BOOT projects. These are described as integrated strategies.
- Where the emphasis is placed on the overall management of the design and construction of the project, with the latter element usually being carried out by works or package contractors and the management contractor having the status and responsibilities of a consultant, as in Managing Contractor. These are management-led strategies.

5.2 Typical Project Delivery Systems

Tucker and Ambrose (1999, in CQ Implementation Guide 2001) identified the variables of project delivery systems generally as:

- Time management,
- Cost control,
- Quality control,
- Extent of documentation complete before commencement of construction,
- Appropriate allocation of risks,
- Client management/co-ordination responsibility,
- Tendering process,
- Level of constructor input into design,
- Level of team focus and commitment to non-adversarial relationships, and
- Variations to scope which can be tolerated.

The following tables attempt to clarify the compatibility of procurement routes with project attributes and preferred consequences. Table 2 compares three typical contract strategies in terms of the procurement variables they are addressing.

Together, the contract strategy and the procurement variables, make up a typical project delivery system. It is assumed that linkages exist amongst the project attributes and environment, the procurement system adopted, and project outcomes. Table 3 describes the profile of projects which are generally compatible with these typical project delivery systems. These include attributes such as scale, size, complexity and risks of the project, and desired outcomes.

Table 2. Comparison of contract strategies by procurement variables.

Procurement Variable Tucker and Ambrose (1999, in CQ, 2001)	**Traditional Contract** ***(Separated system)***	**Design and Construct (D&C)** ***(Integrated system)***	**Managing Contractor** ***(Management-led system)***
Time management	▪ No potential for early start on construction phase – not suited to fast track. ▪ Fixed completion date. But likelihood of significant time extensions for scope changes, documentation errors, breaches of contract, wet weather, industrial action. Liquidated damages clause for time overruns.	▪ Key parties are involved early. ▪ Construction can commence before documentation completed. ▪ Low likelihood of significant time extensions. ▪ Liquidated damages	▪ High certainty of contract time because of limited scope for extensions of time. ▪ Low likelihood of significant time extensions. ▪ Potential for early works packages. ▪ Potential for overlapping sequence of design, documentation and construction.
Cost control	▪ Budget is limited to the contract costs and a small contingency ▪ Final cost – high likelihood of significant increase.	▪ Lump sum ▪ Low likelihood of significant cost increase.	▪ Bonus sharing between Owner and Contractor for actual costs of construction under GCS. ▪ Actual costs audited by Principal's cost consultant. ▪ Reimbursement of non-owner participants on the basis of management fees and actual cost of labour and materials. ▪ Formal alignment of the commercial interests of the respective participants. ▪ Performance-based reward structure.
Quality control	▪ High quality of documentation must be achieved. ▪ Short Defects/Maintenance period.	▪ Project Brief provided by owner (& consultants). ▪ Owner's ability to control design and quality is low. ▪ Longer maintenance period transfers future costs from client to contractor.	▪ Ability for owner to control design is high. ▪ User group input sought and managed. ▪ Opportunity for Incentive bonuses for design and outstanding quality, early completion, public relations ▪ Defects maintenance – 12 months.
Extent of documentation complete before construction commences	▪ 100% complete	▪ Construction can commence before documentation completed.	▪ Design/documentation/construction overlap.
Allocation of risks	▪ Design risks remain with owner. ▪ Construction risks transfer to contractor.	▪ Contractor warrants construction in accord with design and design is fit for purpose; warrants	▪ Managing Contractor accepts some risk and reward on cost outcomes.

		completion time and cost of offered solution.	
Client management/co ordination responsibility	▪ Owner contracts separately with a designer and a constructor. ▪ Sequential design process. Owner's consultants provide schematic design to project brief, design development and construction documentation, and co-ordinate tendering.	▪ Owner contracts with a single entity to perform both design and construction. ▪ Co-ordination responsibility lies with contractor.	▪ Principal contracts with Managing Contractor to provide input into the design, co-ordinate production of documentation and to manage the construction. ▪ Principal develops project brief and schematic design with consultants.
Tendering process	▪ Wide range of tender options e.g open/pre-qual ▪ Competitive tender – generally lowest price for specified work awarded the contract.	▪ Tender Process – Contractor tenders design solution and lump sum cost Generally competitive tender. ▪ Generally pre-qualification or short list of 3 maximum. ▪ Tender evaluation criteria to be sufficiently developed to assess alternative 'fit for purpose' solutions within a price competitive context. ▪ Two stage or select tender process recommended because level of effort required of tenderers & consultants to provide a design solution.	▪ Two stage tender process: ▪ 1. Principal provides a Target Construction Sum. Calls competitive tenders for design fee, documentation fee, construction fee. Tenders evaluated mostly on non-price criteria. ▪ 2. Managing Contractor appointed. Principal's consultants novated to Man. Con. MC and consultants complete Design Development. MC offers a Guaranteed Construction Sum (GCS). ▪ Principal's option – if GCS is not less than Target then may seek other tenders.
Level of constructor input into design	▪ Generally no input	▪ Contractor provides design by using external or 'in house' consultants ▪ Integration of design and construction (buildabilty)	▪ High buildability input – contractor coordinates design
Level of team focus and non-adversarial relationships	▪ Potential for adversarial relationships between principal, contractor and superintendent.		▪ Fosters a team approach though the novation may force together an incompatible mix of consultants and contractor, leading to difficulties.
Tolerance of variations to scope.	▪ No flexibility for scope change ▪ High level of variations expected	▪ Little opportunity for scope change by owner.	▪ Potential for significant works to be **added** at competitive tender rates. (But no scope for change)

Table 3. Attributes of projects compatible with typical project delivery systems.

Traditional Contract *Separated*	**Design and Construct (D&C)** *Integrated*	**Managing Contractor** *Management-led*
▪ Well-defined scope ▪ No unusual time constraints ▪ Firm price required – funding is limited to contract costs and small contingency. ▪ Smaller or less complex, repetitive projects, or, ▪ Larger more complex projects where scope and risk are well defined. ▪ Well-documented ▪ Risks well understood ▪ Known site conditions ▪ Not politically/socially sensitive	▪ Principal able to define scope clearly and specify performance, technical and quality criteria. ▪ Areas where specialist D&C contractors exist. ▪ Smaller less complex projects. ▪ Not politically sensitive. ▪ Firm price required. ▪ Firm completion date required.	▪ Projects requiring early commencement on site, and faster completion times than may be achievable when using other systems. ▪ Projects where high user group input required

The three typical project delivery contract strategies described above take account of various procurement route attributes and each incorporate many possible variations. The integrated approaches, BOOT and Public-Private Partnerships are described in Appendix A. However, Tables 2 and 3 serve to illustrate the multiplicity of variables that need to be considered in the selection of an appropriate procurement approach.

6.0 Best Practice initiatives

Given the wide acceptance of the need to make significant improvements in the performance of the Australian Construction industry, the next issue to consider is the most effective way of achieving improvements. The most significant improvements in project delivery systems have concerned changes to the way design and construction processes are organised. Improvements in process issues follow to support the organisational structure. The next section is a brief review of these changes.

6.1 Review of project delivery improvements to date

In recent decades the industry has developed a range of contract strategies to overcome the perceived inefficiencies resulting from inherent fragmentation and differentiation in the traditional process. Construction management was developed in the 1960s by the US construction industry to try to fast track the process, and was very popular on the North Sea Oil projects during periods of high inflation in the 1970s. Management contracting was a hybrid of construction management. This strategy, which took advantage of the contractor's management ability while retaining competitive bidding for sub-contractors, was first developed by Arup Associates for the John Player factory in the UK in 1968. Design and Construct (D&C) places the accountability for the entire process firmly in the hands of one party, usually the contractor. Novation was introduced to provide considerably more design control for the client, whilst keeping both the design and construction risk with the contractor (RAIA, 2001). Most of these initiatives were not widely used in Australia until the 1980s.

As two ways of introducing management to the construction industry, D&C and construction management are generally applied to fundamentally different kinds of projects. Design and construct is mainly used for small and medium sized projects using well developed designs and technologies, while management construction and construction management tend to be used on large, complex, individually designed projects often using innovative technologies. In both situations, the introduction of

management results in lower costs and faster completions than are achieved by the traditional approach. (Bennett, 2003)

The Egan Report's (1998) advocacy of lean production is in effect a plea for the methods developed in Japanese car manufacturing to be applied in the UK construction industry. The report recognises that the construction delivery process needs fundamental change and so the report is called "Rethinking Construction." The practical actions recommended by Egan are generally called partnering in the UK and USA.

Project Alliancing is the most recent contract strategy development which integrates design and construction in a collaborative way. Other initiatives, namely partnering and relationship contracting, are not contract strategies but management strategies.

6.2 Project Alliancing

Alliancing is a co-operative form of working, defined by Walker, Hampson and Peters (2001) as a joint commitment where parties agree their contribution levels and required profit beforehand and then place these at risk. If one party in the alliance under-performs then all the other alliance partners are at risk of losing their rewards (profits and incentives) and could even share losses according to the agreed project painsharing / gainsharing model. The alliance agreement is structured such that it is in all the parties' business pecuniary interests to work co-operatively. The success of the alliance depends on a culture of mutual trust and respect, with all committing themselves to achieve common objectives and outcomes. Alliances foster innovation and encourage flexibility, as the alliance requires participants to move away from fixed roles within the project and to deploy expertise where it can get the best results Hutchinson and Gallagher (2003).

Until the procurement of the Acton Peninsula Project using a project alliance (Walker, Hampson and Peters, 2000) this form of delivery had been used to deliver major construction and engineering projects. The project marked a radical departure from business as usual in both delivery and outcomes for building projects. The alliance approach required project participants to embrace both attitudinal change and innovative pricing and cost structure methodology through commercial drivers such as incentives to reward outstanding results, rather than achieving only the minimum required to avoid penalty. Though alliances are not likely to be appropriate for all projects, the adoption of the principles will help businesses in the construction industry to develop closer and more cooperative relationships with customers and suppliers (ISR 1999).

Project Alliancing has been recommended for complex projects where design risks cannot be quantified because of some, or all, of the following project attributes:

- At the outset, the owner cannot specify its needs clearly enough for a lump sum tender to be made.
- The owner needs flexible access to the contractor's resources during construction.
- State of the art technology is required to be integrated.
- Meeting tight timelines is crucial.
- Meeting limited budgets is crucial.
- Project has a long term with further development arrangements.
- Project where owner/industry capacity is limited.
- Projects where technology transfer is desirable.
- High profile projects where improved outcomes may be generated through alliancing.

Projects procured by project alliancing depend on these critical success factors:

- Skills and attitudes of people involved.
- Commercial drivers must exist for the Contractor to see entering an alliance as strategically advantageous.
- Focus on performance – not reasons for non-performance.
- Focus on co-operation for the mutual benefit of the participants.

This approach was pioneered in the UK's North Sea oil and gas industries where it initially led to improvements to what was a very low level of performance. In a cautionary tale Bennett [4] notes that the explicit provision for failure is a hang over from traditional practice and attitudes. In the North Sea oil and gas industries and in building projects where similar financial arrangements were used, projects degenerated into adversarial methods as partners made claims and counter claims when projects failed to deliver the anticipated rewards.

6.3 Partnering

Partnering is a formalised but non-binding arrangement which can be superimposed on project delivery systems. Recent UK partnering practice deals with the financial arrangements in ways that avoid the problems experienced in the North Sea projects, and concentrate the efforts of project teams on working out how to succeed rather than providing for failure.

Partnering was first used in construction in the USA. Partnering requires people to think differently from the way experience in the traditional construction industry has taught them. It requires the professionals who form the project team to take joint responsibility for decisions and project outcomes. Their work is coordinated by cooperative team-working. They use management techniques and flexible tools as an integral part of team-working.

Partnering in UK construction as described in Bennett and Jayes (1995) initially relied heavily on the American approach. However, it has been widely used in UK practice and has developed rapidly, no doubt due to its explicit support in both the Latham (1994) and Egan Reports, so that Bennett and Jayes (1998) describe a distinctive and remarkably effective approach. The purpose of partnering is to improve efficiency so that project teams are more productive. "The productivity improvements may be used to provide lower prices, higher profits, fewer defects, faster completions, better buildings, safer construction or any other benefit the team chooses." (Bennett, 2003)

6.4 Relationship contracting

The point of improving construction industry performance through better project delivery strategies is to align the interests of the parties in order to achieve win:win outcomes for both owners and contractors, customers and service providers (ACA 1999). Relationship management can reduce many of the potential problems with the traditional form of contract. Traditional risk transfer strategies often fail due to poor risk allocation. Relationship contracting provides the approach whereby the various project risks are allocated to the party best suited to manage them.

The Australian Constructors Association (ACA 1999) in a survey of 30 major clients found that clients are generally supportive of the concept of sharing risks and rewards/losses. However, some clients remain cynical about the contractors' willingness to share in any losses noting that "contractors tend to become adversarial

[4] Bennett, J. *Decision Matrix compared with partnering. CRC-Construction Innovation Report 2001-003-C-02.* http://internal.construction-innovation.info

in such circumstances". Anecdotal evidence suggests that clients also tend to revert to the adversarial mechanisms in contracts when things do not go their way.

6.5 Work processes

The CII study (1999a) into exceptional projects also identified numerous work process changes which were implemented during the thirty exceptional projects investigated. 65% of process changes occurred in the early project phases. No single work process change was identified as a sole cause of significant impact on project performance but the cumulative impact of some changes did provide discernible impacts on project schedule. In some cases these were similar to work processes adopted by the alliance partners for the delivery of the Australian National Museum at Acton Peninsula, Canberra. ACT, summarised by Kennedy (2002) as follows:

- Design and documentation were carried out at an on site office.
- Information technology was used extensively to share information amongst owners, designers, suppliers, contractors and so on.
- Although additional costs are involved in placing designers in the field, the net cost on the project is improved.
- Single virtual organisation team included design, constructor and client personnel.
- Professionals involved in the project were relieved of other organisational responsibilities.
- Suppliers were incorporated into the project team immediately after selection.
- Empowerment of workers, trades people, professionals at the project site through a negotiated Project Agreement with relevant unions.

Some changes to work processes are common sense, for example, "frequent testing of equipment in supplier shops to reduce rejection and site modifications". But others such as "use preferred sub-contractors and suppliers to eliminate bidding", cannot be adopted by public clients where policy requires competitive bidding, or "multi-tasking was done by craftsmen" is likely to cause industrial relations disputes. Again, work processes are closely linked with the parameters and priorities surrounding projects. Lateral approaches to procurement routes may allow changes to entrenched processes, in order to take advantage of the benefits of better ways of working.

6.6 Process Protocol

The Process Protocol Guide developed by Kagioglou et al (1998) sought to overcome typical problems which exist in the process of construction works:

- The difficulty of coordinating the parties involved in project teams especially when everybody involved operates in a different way.
- Client requirements are constantly changing, but they are not communicated to the whole project team. This leads to non-conformities and costly changes at the construction phases.

The guide establishes a common framework for managing and controlling projects that supports a collaborative way of working and consistent procedures for all parties to work toward the common goal of meeting the client's business needs. The framework is based on a number of key processes adopted in the manufacturing industry.

- Adopt a 'whole project view' so that all issues are considered from a business and a technical point of view to ensure informed decision making at the front-end of design and construction development process.
- Apply the 'stage-gate' approach to the progressive fixing of design information throughout the process. This allows for increased predictability of construction works.
- Apply a consistent approach to performance measurement, evaluation and control in the process.

- Identify stakeholders and their needs early in the process to enable effective decision-making.
- Support teamwork by making sure the right people have the right information at the right time.
- Eliminate duplication of effort through effective co-ordination between project team members.
- Record, update and use an archive of project experiences to ensure lessons are learned from success or failure.

7.0 How clients select project delivery systems

Though there has been no comprehensive study to identify accurately how much of the construction market is procured by alternative methods, anecdotal evidence suggests that the traditional approach generally remains the prevalent way of organising construction work in the Australian construction industry and continues to hold relevance in today's climate. As the process separates design and construction activities and awards the construction contract to the lowest-priced tenderer, the clarity of the traditional delivery method is particularly attractive to clients who need to demonstrate probity. In the highly competitive environment of contracts based upon lump sum tendering, the ability of tenderers to innovate and seek alternative solutions and smart engineering in the construction process delivers competitive advantage to contractors at the tender stage.

The client's level of experience determines their approach to all aspects of implementing a construction project. Masterman, (1992) found that the decisions to use any particular methods of procuring construction services are largely dependent on past experience of similar projects. The Report to DISR and NatBACC (APP 1998) on procurement and project delivery in the Australian building and construction industry, 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. The Report noted 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 by project personnel. Many contract claims were the result of personnel (Principals or Agents) taking an action within a delivery system without understanding or appreciating the consequences.

These findings point to the need for clients and their advisors to obtain objective advice on the selection of the most appropriate procurement system for their particular needs, including comprehensive advice on appropriate actions and their intended impacts. The imperative for clients of the construction industry to both seek and heed advice regarding approaches to project delivery is an ongoing challenge for construction management research.

A number of researchers have attempted to develop a methodology for choosing a best contract strategy, in which, in a given situation, the benefits outweigh the disadvantages (NEDO 1985, Skitmore and Marsden 1988, Franks 1990, Love, Skitmore and Earl 1998). However, the pros and cons are viewed as absolute rather than from a contingency theory viewpoint of procurement systems (Rowlinson 1999). Ireland (1984) and Rowlinson (1999) are of a view that management variables, organisational issues and project context rather than project delivery contract strategy, have the most effect on project performance.

Based on research with 138 experienced clients, Bresnen and Haslam (1991) found that there is no significant association between the contract strategy used and project performance. No one contract strategy will help guarantee improved performance or greater satisfaction. The assumption that a particular contract strategy can be the best solution is by no means failsafe (Murray, Tookey, Langsford, and Hardcastle, 2002)

From a contingency theory perspective of procurement systems, researchers, such as Walker (1994) and Chan (1996), have identified contingency factors on construction projects and assessed their impact on project performance. They found that the contract strategy is not a determining factor but that the use of an appropriate contract strategy for a particular set of project attributes and environments, together with the most suitable management strategies would have a significant effect on project success.

8.0 Review of project delivery selection guides and tools

Procurement selection systems which have been developed to date vary from simple rating systems to complex multi-attribute approaches. Ambrose and Tucker (2000) compiled a list of some the systems available, and their basic methodologies. Chan, Yung, lam, Tam and Cheung (2001) adopted and expanded this list to include Ambrose and Tucker. Table 4 builds on the list to take into account further developments since 1999.

Table 4. Review of existing procurement selection systems

Author	Year	Description
NEDO	1985	Procurement path decision chart. Rating system using a client's priority for nine key areas.
Skitmore and Marsden	1988	Two statistical systems: a multi-attribute model based on NEDO model with a rating system and weighting of client priorities; and a discriminate analysis technique utilizing variances in procurement characteristics under certain criteria. Heavily conditioned in UK construction projects.
Brandon, Basden, Hamilton and Stockley (RICS, QS Division)	1988	ELSIE. A computer based expert system, based on project characteristics and client requirements. Relatively limited and subjective, containing five procurement options.
Franks	1990	Simple rating system based on client's performance requirements. Limited options.
Bennett and Grice	1990	Statistical system based on the NEDO and Skitmore and Marsden models. Allows clients to weight specific criteria multiplied by set utility ratings for the various systems.
Lui	1994	An organisational behaviour-based model utilising an act-to-outcome process governed by organisational goals, which in turn are subject to moderators, which determine goal/performance relationship.
Chan, Tam, Lam and So	1994	Utilises the Bennett and Grice model, but uses a different procurement category developed for the Australian construction industry
Dell'Isola, Licameli & Arnold	1998	Decision matrix-based model that rates the performance of each procurement system for selected issues and their relative importance on a client/project profile.
Tucker and Ambrose	2000	A three-dimensional interaction matrix that provides a procedure to evaluate the appropriateness of a procurement system for a particular project and the needs of the client.

Australian Constructors Association	1999	Suitability matrix – rating system - predetermined project delivery options.
Alhazmi and McCaffer	2000	Allows users to choose from a reduced number of prescribed strategies and alternative contract types. Complicated – uses operational, statistical and computerized processes to arrive at limited options.
Kumaraswamy and Dissanayaka	2000	Computerised knowledge-based expert system. Quite comprehensive in arriving at procurement decisions. Does not have scope for updating the system database.
Construction Industry Institute	2000	Project Delivery System Selection Workbook (IR 133-2) Suitability matrix. Rates critical project goals by level of importance, scores each goal and ranks three most critical metrics. 6 step guideline – operational tool – assumes experience. Limited options – describes optimum PDS. Continued over:
SRD Consulting	2000	Suitability Matrices developed for Qld Dept of Main Roads. Modelled on ACA system. Scoring and ratings pre-determine optimum PDS.
Oyetunji and Anderson, (Construction Industry Institute)	2001	DSS consisting of Excel spreadsheets. 12 Project Delivery Contract Strategies are cross-checked with relative effectiveness of 20 'selection factors' derived from project objectives and project conditions. The three PDCS alternatives with the highest aggregate scores are selected. Special factors peculiar to the owner are considered and one of the three PDCS alternatives is selected.
Construction Queensland	2001	Is not a procurement selection system but a nine step guide to designing an Asset Delivery Strategy.

(Based on Ambrose and Tucker, 2000, in Chan, et al, 2001.)

Each of the methods, apart from Construction Queensland's (2001), attempts 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.

Alhazmi and McCaffer (2000) in a review of procurement selection methods (NEDO 1985, Skitmore and Marsden 1988, Brandon et al 1988, Bennett and Grice 1990, Mohsini 1993[5], and Gordon 1994[6]) observed that though these took various approaches such as operational, statistical or computerised, 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 are time consuming.
- Some models adopt a primitive approach and limit the options to be considered.

[5] Mohsini (1993, in Alhazmi and McCaffer, 2000) presented a knowledge-based expert system (project acquisition strategy consultant), which starts by establishing the project characteristics and the client's posture towards project contral and risk taking.
[6] Gordon (1994, in Alhazmi and McCaffer, 2000) used the three drivers of project, owner and market, as well as a risk-allocation analysis and a commodity versus service analysis, to guide clients into choosing an appropriate procurement method.

Masterman (1992) observed that to be worthwhile, a guide to the selection of project delivery 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 methods which provided the most accessible and useful guidance combined a multi-attribute technique with work on measures of suitability to tabulate the strengths and weaknesses of various procurement systems. Masterman noted that a system which provides an opportunity for clients to weight various criteria in order to reflect their priorities would be useful.

Chang and Ive (2002) in a critique of the multi-attribute utility approach (MAUA) postulate that is likely to lead to some inappropriate conclusions. They agree that the approach pioneered by various researchers[7] "marked a real step forward in the development of academic work on procurement route selection. However, by default, what was originally offered as a contribution to debate has become accepted as if proved, and embedded in expert systems offered to practitioners." The basic idea underlying the MAUA is that the client selects an appropriate procurement route on the basis of priority variables. The main problem Chang and Ive identify is the relevance of the variables, to the selection of a procurement route. "In applying the MAUA, decision variables should be attributes of consequence of an action (in this case the action in question being the selection of a procurement route)." They point out that the priority variables which have a high degree of consensus in the literature, belong to three different categories. Only some of the variables are consequence variables. Others are actually attributes of the project, or attributes of particular procurement routes. The variables most commonly cited in the literature are categorised according the Chang and Ive's assessment in Table 5. Refer to Appendix B for a summary of documented priority variables affecting the client's decision on procurement systems.

Table 5. Categories of Priority Variables.

Outcomes (consequence variables)	**Project attributes**	**Procurement Route Attributes**
Delivery speed	Flexibility for scope change	Division of responsibility – project team
Completion date certainty	High quality aesthetic	
Final cost certainty	User involvement	
Quality certainty (no defects)		
Claim free (no disputes)		

Chang and Ive suggest the client should decide upon a procurement route most competent to attain their goal in the particular project context so that they can make a choice on the basis of what the procurement system is most likely to achieve, rather than make a generic selection purely on the basis of their general preferences, in particular risk aversion. They recommend exploring linkages between combinations of project attributes and the observed choice of procurement routes on particular projects.

8.1 Implications for the Value Alignment Process in Project Delivery Project

The foregoing review implies that to be of value, a new decision support system which is based on the concept of value alignment for project delivery must allow

[7] Skitmore and Marsden, 1988, Chan, 1995, Ambrose and Tucker, 2000.

clients and their advisors to obtain advice to determine the ideal fit between expectations, objectives and a procurement strategy tailored to the project.

- The Decision Support System (DSS) needs to be user-friendly.
- It needs to incorporate a means of relating the particular combination of client priorities (project attributes and required outcomes) to suitable procurement route variables, while taking into account external conditions.
- It should not be limited to narrow definitions of project delivery systems in the options it offers.
- It needs to be a knowledge-based advisory system that captures experiences from previous projects, so that decision-makers can make informed choices based on knowledge of positive and negative impacts on project outcomes of certain decisions.
- It should harness useful decision rules used by experts who have a broader overview of project delivery systems.
- It should identify compatible combinations of options by harnessing the Value Alignment actions which are essential for exceptional project performance.
- It requires a feedback loop to ensure continual improvement for the DSS itself. As a "living" system it should evolve with the industry.

The multiplicity of project variables that need to be taken into account in the selection of an appropriate project delivery approach, and the opportunity to feed back the lessons learned from the projects, point to the usefulness of an electronic tool to optimise such decisions. The feedback loop is essential because it is this knowledge which will help decision-makers to solve new problems by learning from past experiences. However, a user-friendly paper-based guide, as well providing advice to support decision-making, could be designed to incorporate lessons learned to strengthen its value to the decision-maker. It is not unreasonable to expect that a new decision support system could incorporate both a guide and an electronic tool. It is likely that the electronic tool would be a software version of the guide but with the added advantage of being able to search its data base for cases which match the details for a new case and retrieve vital information for the user.

Conclusion

A project delivery decision support system which incorporates the value alignment actions will assist clients' key decisions regarding construction project delivery strategies. Rather than fall back on an inefficient procurement system for want of understanding, clients and the construction industry service providers will be able to explore alternative strategies for project delivery and make informed choices about course of action. Selection of procurement systems appropriate to specific projects will enable clients to make the kinds of demands on the construction industry which will allow project teams to focus on delivering value.

A decision support system consisting of a guide to best practice and a tool to assist decision-making, with a continually improving data base of case knowledge, will engender the kind of attitudes required to transform the business-as-usual situation described in Table 1 to one which produces exceptional performance. A decision support system such as this will help parties to work together, understand each others' needs, and adopt a common framework for managing and controlling a project, in order to achieve the aims of clients while working for the best interests of all stakeholders.

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APPENDIX A

BOOT

The Build Own, Operate and Transfer (BOOT) structure was developed specifically as a way of involving the private sector in the provision of new infrastructure. A private consortium undertakes to finance and construct infrastructure required by the government. The consortium owns, operates and carries end-user risk. The consortium then operates the facility for a period under a concession awarded by the government, and in this way derives revenue from the operation of the facility. Ownership is transferred to the government at the end of the concession period, which will be of such length to allow the builders and financiers to recover their outlays with a return. To guard against consortia keeping maintenance and capital replacement costs to a minimum, particularly as the date for handover draws near, predetermined performance criteria must be established for the operation of the facility and at handover at the completion of the period. Typically the BOOT method is best suited to large-scale projects exceeding $100 million. (QDMR, 2003).

The tender process involves competitive bids based on set parameters. Evaluation of tenders includes both price and non-price criteria. In terms of budget allocations, the owner usually contributes the land to the project, and may contribute to the cost of construction. Owners may also contribute to operating costs, with the consortium paying the owner a share of profits. If government policies change in the course of the operating period, the owner may be forced to buy out the consortium.

Private Finance Initiative or Public/Private Partnership Projects

Public/Private Partnerships (PPPs) are developed to deliver public services through partnerships between governments and the private sector. The private sector provides ancillary services with the core service provided by government. The government holds end user risk. PPP Projects encompass a broad spectrum of project delivery options. (QDMR, 2003) PPPs do not change government's responsibility for policy or the delivery of services to the community. They are aimed at achieving value for money, allowing the community to benefit from the innovation derived from private sector investment and skills, and the provision of new infrastructure and services that may not otherwise be available due to government budget constraints.

- Publicly-funded client bodies
- Any project for which a normal business case has been made.
- Risk transfer to supplier
- Characterised by lengthy tender and negotiations, developing ground rules, very long contractual relationships – 30+ years.

Sheil (in the AFR 24.05.02) notes that economists underline the difficulties in allocating risk in PPP projects – they say, there cannot be a transfer of risk to the private sector in these deals which provide essential services because the Government cannot afford to let them fail. Further, they are of the opinion that PPP's do not provide more finance for public infrastructure but merely allow enable governments to nominally avoid increasing their public borrowings by locking themselves into paying even more expensive long-term private rents.

APPENDIX B

Table (a). Project variables for procurement system selections according to the literature.

*Skitmore & Marsden (1988)**	*Bennett & Grice (1990)**	*Turner (1997)**	*Love, Skitmore & Earl (1998)**	*CII (1999b)*	*Chan(2001)*
Speed How important is early completion to the success of your project?	**Time** Is early completion required?	**Timing** How important is early completion to the success of your project?	**Speed** How important is early completion to the success of your project?	**Delivery speed** Your facility produces products that must get to market rapidly. The duration of design and construction time is critical to you. **Construction speed** The duration of construction time is critical to you. The schedule demands a short construction period	**Time available** How important is early completion to the success of your project?
Certainty You require a firm price and/or a strict completion date for the project before you can commit yourself to proceed with construction.	**Cost** Is a firm price needed before any commitment to construction is formed? **Certainty** Is completion on time important? Is completion within budget important?	**Price Certainty** You require a firm price for the project before you can commit yourself to proceed with construction.	**Certainty** You require a firm price and/or a strict completion date for the project before you can commit yourself to proceed with construction.	**Schedule Growth** The certainty of completion on schedule is critical. Your business obligations require occupying the facility on time. **Cost Growth** Funding is limited to the contract costs and a small contingency. The certainty of completion on budget is critical.	**Time predictability** To what extent do you require a specified completion date at the start of the project? **Certainty of Cost without Fluctuation** How important is a firm price at the beginning of construction?
				Unit Cost Final cost /sqm is critical on this project. The unit cost is critical to owner's profitability.	
Flexibility You foresee the need to alter the project (in any way) once it has begun on site.	**Flexibility** Are variations necessary after work has begun on site?	**Controllable variation** You foresee the need to alter the project (in any way) once it has begun on site.	**Flexibility** You foresee the need to alter the project (in any way) once it has begun on site.		**Ability to state clea r end user's requirements** How capable is the client of stating the employer's requirements precisely at the tender stage?

					Flexibility for changes To what extent do you expect frequent changes in design and construction once the work has begun on site?
Quality Level What level of quality, aesthetic appearance do you require in the design and workmanship?	**Quality level** Is high quality important?	**Quality level** What level of quality, do you require in the design and workmanship?	**Quality Level** What level of quality, aesthetic appearance do you require in the design and workmanship?	**Turnover quality** The facility startup process is critical to your business. Your operation cannot tolerate impacts from many callbacks. **System quality** Performance of MEP systems are critical to your business. Quality of the envelope and architecture is critical.	**Availability of Competent Contractors** How important is it to have a plentiful supply of competent contractors to work for the procurement system?
Complexity Is the project highly specialized, technologically advanced or highly serviced?	**Complexity** Is the building highly specialized, technologically advanced or highly serviced?	**Complexity** Does your building (as distinct from what goes in it) need to be technically advanced or highly serviced?	**Complexity** Is the project highly specialized, technologically advanced or highly serviced?	**Process equipment quality** The performance of process equipment is critical to your business. The layout of process equipment is critical to your business.	**Complexity** Is the project highly specialized, technologically advanced or highly serviced?
Price competition Is it important for you to choose your construction team by price competition, so increasing the likelihood of a low price?		**Competition** Is it important for you to choose your construction team by price competition	**Price competition** Is it important for you to choose your construction team by price competition	.	**Price competition** How important is it to choose your project team by price competition, so increasing the likelihood of a low price?
Risk avoidance and responsibility To what extent do you wish one single organization to be responsible for the project, or to transfer the risks of cost and time slippage?	**Risk** Is transfer of responsibility for the consequence of slippages important?	**Risk avoidance** Do you want to pay someone to take the risk of cost and time slippage	**Risk allocation** Does your organization want to limit the amount of speculative cost and design liability?		**Risk Management** To what extent do you need risk avoidance in the event of time, cost , design liability, and quality slippage?

	Division of responsibility Is single-point responsibility wanted? Is direct professional responsibility wanted?	**Management** Can you manage separate consultancies and contractor, or do you want just one firm to be responsible after the briefing stage?	**Responsibility** To what extent do you wish one single organization to be responsible for the project, or to transfer the risks of cost and time slippage?		**Responsibility** To what extent do you wish a single point of responsibility for the completion of the programme, design and construction of the project?
		Accountability Do you want professional accountability to you from the designers and cost consultants?	**Arbitration and disputes** To what extent does your organization wish to avoid disputes and arbitration?		
					Familiarity How important is it for the client to choose a familiar system to deliver a building project?

(Adopted and expanded from Chang, C., and Ive, G. 2002)

* In Chang and Ive (2002) as documented priority variables affecting the client's decision on procurement systems.