NATSPEC// Construction Information

TECHreport TR 06

October 2025

# Procurement: Past and present

This TECHreport outlines the major procurement systems used in the construction industry today, and the basic principles and reasoning behind these methods. It also includes an outline of how procurement has evolved from past methods and the directions it is heading.

# CONTENTS

# 1 USING NATSPEC IN THE CONTEXT OF EACH PROCUREMENT DELIVERY SYSTEM

## 1.1 Introduction

NATSPEC is a master specification system principally formulated to suit a descriptive specification format, to support design documentation in the context of the single contracting delivery system. In its standard format, it is not organised in traditional trade packages. However, as it is modular in nature and each worksection provides baseline quality requirements, it can be adapted easily to suit various procurement methods.

Worksections can be grouped together to create construction specifications for individual trade packages or be edited to suit the other specification methods. For each method, the classification, subsections, formatting and structure of each NATSPEC worksection may be retained.

## 1.2 Specification methods

Specifications are written statements that can be classified by project stage or method. The different specifying methods include:

- **Descriptive (detail) specification**: Describes in detail the exact properties of the materials, quality of work, and methods required for installing, building or manufacturing a product/asset.
- **Proprietary specification**: Describes a product, material, equipment or assembly by naming the manufacturer, brand name, model or type designation.
- **Performance based specification**: Describes the functional and performance criteria for the desired equipment, material or product/asset.
- **Reference specification**: Describes a product, material or equipment by referencing a published standard, e.g. Australian standards, by title or number. The provisions of the standard become part of the specification.

Table 1.1 (on the following page) summarises implications and risk/responsibility allocation for the different construction specification methods in the context of various contract types and management systems.

Figure 1.1 summarises the brief, design, documentation and specification format required by each contract type at different stages of the project life cycle.

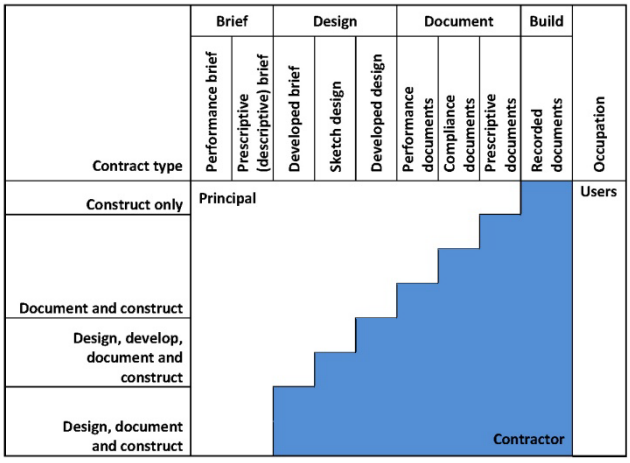


**Figure 1.1: Contract type, participants and documentation requirements**

Source: Adapted from *Specifying Architecture - a guide to professional practice*. [1]

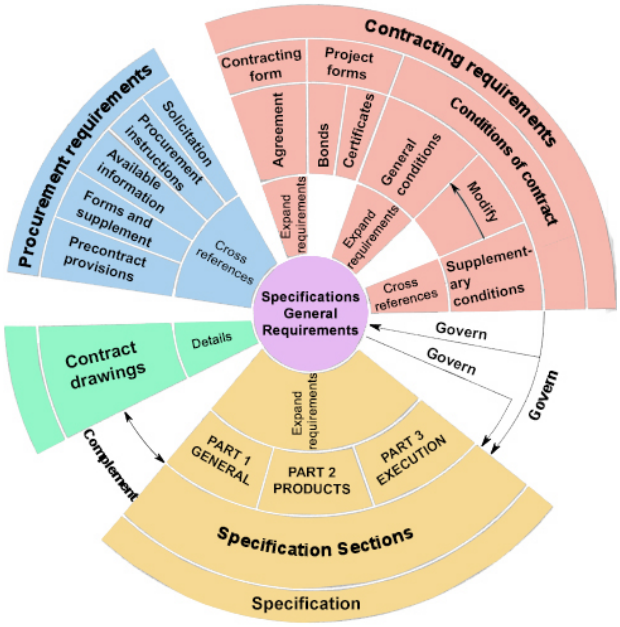


**Figure 1.2: Specification within the context of procurement and contracting requirements**

# PROCUREMENT: PAST AND PRESENT

| Specification methods and management system | Designer's responsibility | Contractor's responsibility | Notes |
|---|---|---|---|
| Descriptive specification | *100%* | *100% for compliance with descriptive specification.* | May use custom-written text or may reference a standard. This ratio applies as far as the description itself goes – it may be incomplete; some selections are left to the contractor. Substitution is possible but unlikely. |
| Proprietary specification – substitution is allowed, if approved | *100%*<br>The original or any approved substitution is fit for purpose. | *0%*<br>However, the contractor at least has room to move in terms of suggesting alternatives. | Approved for substitution means that the contractor retains the right to select substitutions. The specification should at least require notice of substitution, ideally at tender, at least for major (identified) items. The basis for assessment is unclear and open to argument. There is risk that the contractor's decision may be arbitrary. |
| Performance specification | *100%, for performance base.*<br>Performance, if met, will provide a fit-for-purpose solution (e.g. meets the brief). For construct only contracts, the designer cannot properly delegate design responsibility to the contractor. The designer also remains 100% responsible for the solution. | *100%, for solution base (where the design and construct contract is used).*<br>The solution meets the performance specification. The contractor has plenty of scope in devising a cost-effective complying solution. | May use custom-written text or may reference a standard. The specification must state that the contractor must demonstrate (e.g. through type-test or project test reports) that the proposal meets the performance specification. There are no other grounds for rejection, so the performance specification needs to cover all important issues. Substitution, using different criteria or pass/fail points, is possible but rare. |
| Reference specification (is often a mix of performance and prescriptive (descriptive)) | *100% for appropriate and correct reference.*<br>That the standard is relevant, and defaults and options selected will lead to a solution that is fit for purpose. | *100% for solution's compliance with reference specification.* | The specification must state how the contractor is to demonstrate compliance with the reference specification. For some products and services this may be through third-party certification or, if this does not exist, through submission of test reports (tests may be in separate standards cited in the referenced standard). There are no grounds for rejection, so the reference specification needs to cover all important issues. This method assumes that all parties are familiar with the reference specification. Substitution is possible for work overseas, where the contractor may be more comfortable with local standards. |

**Table 1.1: Specification method in the context of different contract and management systems.**
Source: Adapted from *Specifying Architecture - a guide to professional practice.* [2]

### 1.3 General guidance, applicable to all delivery systems and contracts

- NATSPEC Paper – *Specification writing*: This paper provides a general guideline for writing specifications.
- NATSPEC TECHnotes and TECHreports and AUS-SPEC TECHguides: These are free technical publications which may be downloaded at www.natspec.com.au upon registration.
- *TG101 Guidelines for compiling documentation for contracts, TG102 Guidelines for Principals – standard contracts, TG103 Guidelines for Principals – period supply and service contracts*: These AUS-SPEC TECHguides provide guidance on conditions of contracts, lump sum arrangements, dispute resolution procedures which may be incorporated in the conditions of contracts, contract responsibilities and management of contract documentation. These TECHguides also provide guidance in tendering procedures and documentation which may be adapted to suit individual project requirements.

### 1.4 Using NATSPEC in the context of each procurement delivery and contracting system

| Procurement system | Contracting systems which may be used | Specification method | Design responsibility | How NATSPEC can be used to suit the procurement system |
|---|---|---|---|---|
| Single contracting system<br>Alliance contract delivery system<br>Direct labour delivery system<br>Early contract involvement (ECI) | Construct only | Descriptive | Designer (appointed by the client). | • NATSPEC worksections: All worksections, including the various *Preliminaries* worksections can be edited to compile a descriptive construction specification to suit project requirements.<br>• NATSPEC TECHnote GEN 003 – *Multiple contracts and "work by others"*: This TECHnote provides guidance on writing specifications for both single and multi-prime contract arrangements. |
| Multiple contracting system | Construct only is generally used, but other contracting systems such as Design and Construct (D&C) type contracts may also be used. | Descriptive, unless D&C type contracts are used.<br>For D&C type contracts, specification methods will be like those used for the PPP system. | Designer, unless D&C type contracts are used. | • NATSPEC worksections: All worksections can be edited to compile a construction specification for each package. Worksection *0138 Multiple contracts* facilitates interfaces between contracts and provides a framework for defining boundaries of responsibilities of the client and the contractor.<br>• NATSPEC TECHnote GEN 020 – *Commissioning*: This TECHnote provides guidance on commissioning strategy, including for multiple contracts. |
| Public Private Partnership (PPP) | Design and Construct (D&C),<br>Design Development and Construct (DD&C),<br>Design, Construct and Operate (DC&O),<br>Design Development, | Performance based briefing specification for the design components. Descriptive specification for some construction components may be included. | Contractor. | • NATSPEC TECHreport TR03 – *Specifying Design and Construct for Mechanical services*: This TECHreport provides guidance on using NATSPEC worksections to compile a design performance based briefing specification by the client to use as a tender document. This may be achieved by retaining the classification, subsections, formatting and structure of each NATSPEC |

| Procurement system | Contracting systems which may be used | Specification method | Design responsibility | How NATSPEC can be used to suit the procurement system |
|---|---|---|---|---|
| | Construct and Operate (DDC&O),<br>Design, Construct and Maintain (DC&M),<br>Design Development, Construct and Maintain (DDC&M),<br>Design, Construct, Operate and Maintain (DCO&M). | | | worksection. The worksections may then be edited to accommodate general, design, functional and performance requirements, with allowances for criteria such as design verification.<br>• *0010 Quality requirements for design*: This worksection specifies requirements for design which may be included in the design brief. The requirements covered include design planning, design inputs, design outputs, record and document controls, and review and verification requirements.<br>• AUS-SPEC TECHguides *TG401 Guide to parks and open space maintenance system and documentation, TG403 Guide to the building and facility maintenance management system and documentation* and *TG405 Guide to road reserve maintenance system and documentation*. These TECHguides provides guidance on using NATSPEC for creating specifications for maintenance and management of parks and recreation areas, buildings and facilities, and road reserves. |
| Managing contractor delivery system | Construct only, where the designer is appointed by the client. | For Construct only contracts: Descriptive. | For Construct only contracts: The designer. | • For Construct only contracts: Refer to **Single contracting system**. |
| | D&C type contracts, where the managing contractor is responsible for both design and construction. | For D&C type contracts: Specification methods like those used for the PPP system. | For D&C type contracts: The managing contractor. | • For D&C type contracts: Refer to **Public Private Partnership**. |

# 2 BACKGROUND

*Good procurement practice is crucially important to reduce the overall cost of projects, to improve the economic efficiency of the construction industry and to ensure that projects, when complete, are fit for purpose, thereby securing whole life value.*[3]

## 2.1 Abstract

Over the past few decades, the role of procurement, construction and asset management has changed dramatically. Construction procurement, which has moved from tactical to strategic with procurement requirements and contracts becoming increasingly more complex (and involving many stakeholders), continues to evolve as clients demand efficiency, flexibility, innovation and risk reduction in the current economically competitive environment. The construction industry, in response to commercial and economic demands, has developed a number of different procurement systems to overcome the shortcomings of the traditional (single contracting) procurement system. This TECHreport outlines the major approaches used today, the contracts supporting these systems, and explores emerging trends in the industry.

## 2.2 Procurement in the construction industry

The process of procurement in the context of the construction industry incorporates all methods of managing the design and construction of a project. Elements such as financing, operation and maintenance may also be included in the methodology definition. It differs from procurement in other industries as it tends to deal with one-off, high value products (assets) rather than mass production. As each project is unique, procurement methodology will be driven by the objectives of the client.

The client, in the traditional project delivery system will initiate a project by engaging a designer – often an architect, who may in turn arrange for a contractor (on behalf of the client) to build the asset. In this model, the contractor will have a direct relationship with the design team and the architect will perform a coordination role. However, since the 1980s with the emergence of other procurement systems, the roles, responsibilities and relationship of the client, designer and contractor has changed to suit the requirements of each system and have sometimes become interchangeable. The focus of procurement is no longer only on organising works but has expanded to include allocating risks to different project participants. The reason for this shift is explored in greater details later in the report.

## 2.3 Key definitions

- **Procurement:** The act of agreeing to terms and purchasing goods, services, or other works from an external source. Procurement includes the processes of risk assessment, seeking and evaluating alternative solutions, and the awarding and reporting of a contract.
- **Procurement methodology:** The overall approach to procurement, including the:
  - Procurement strategy.
  - Procurement delivery system.
  - The procurement management system to suit the delivery and contract systems selected.
- **Procurement strategy**: Outlines the key means of achieving the project objectives. This includes contracting arrangements for design, construction, maintenance or operation activities and subcontract arrangements, if applicable.
- **Procurement system**: Also known as the *delivery system* or *procurement approach*. It is an organisation system developed in response to the procurement objectives and involves assigning specific responsibilities and authority to parties. It may also include definitions of construction elements and processes employed to take a project from its planning phases to completion and occupation.
- **Building contract**: The written agreement between the client and the contractor of the project. The terms of agreement may require design, documentation and construction of the project by the contractor but may also include maintenance and operation obligations.
- **Consultancy contract**: The written agreement between the client and a consultant or the building contractor and a consultant (in a design and construct arrangement) for delivery of services such as design, documentation and cost planning.
- **Specification:** Written descriptions of the required quality of the built product and its component products. A specification may also include the procedures for determining that the requirements of the specifications have been met. It may be classified by stage (different stages of the project life cycle) or method.
  Specification classified by stage include:
  - **Briefing specification**: Specification defining requirements and constraints for the project, including physical and management aspects. This is a specification where the client has direct contribution and may include spatial elements, functional, and performance requirements.
  - **Construction specification**: A document used for administering construction and execution, it includes specification of products and system performances.

  Refer to **Section 1** for definitions of specifications classified by method.

## 2.4 Objectives of the procurement methodology

A procurement methodology provides a strategy for seeking tenders from the market and managing the project to suit the delivery system. It defines and dictates the key processes for achieving the objectives of a project, including:

- Producing tender documents and setting the contractual framework.
- Inviting and evaluating tenders.
- Selecting and engaging contractors.

- Delivering the procured asset.
- Operating, maintaining and disposing of the procured asset.

## 2.5 Procurement methodology selection criteria

In the construction industry, the procurement method employed is generally based on the following criteria or requirements:

- Risk management: Allocation of risks and reducing the level of risk to which the client is exposed.
- Financing and accounting system.
- The expected quality.
- Asset ownership.
- The level of involvement of the contractor in the design process, as required by the client.
- Client resources and financing required by the level of client involvement in the project.
- The capacity of the client to make design changes and the level of flexibility provided by the procurement system in accommodating design changes arising from unforeseen external forces.
- The ability to support a collaborative approach.
- The ability to incorporate innovation.
- Project characteristics, e.g. the complexity of the project deliverables, the site, the uniqueness of the project, project constraints, whether quality of design is a key feature and other client requirements.
- The speed or time required from inception to completion.
- Certainty of costing required for each stage and the whole project. Where price certainty is required, the design needs to be completed before construction commences.
- Resource requirements, e.g. personnel required by the contractor or designer to support the delivery system.

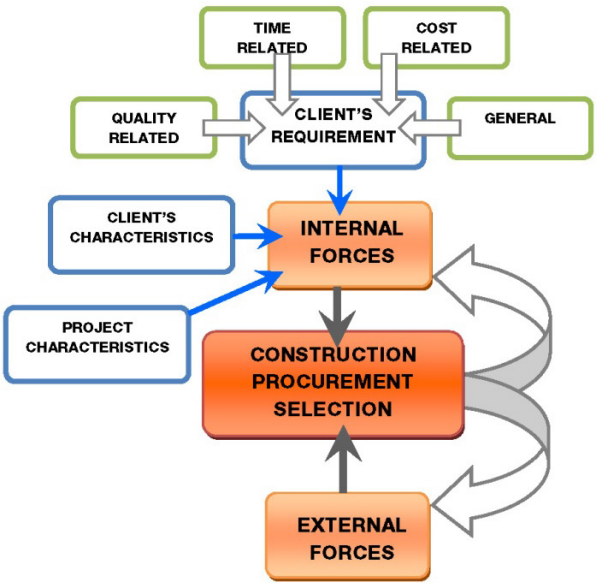


**Figure 2.1: Procurement methodology selection criteria**

## 2.6 Procurement and quality

In construction, quality may be defined by the following aspects:

- Client concerns with image and style – overall design quality.
- Level of finishes and fittings to be achieved.
- Quality standards required in terms of materials and workmanship.
- Quality assurance procedures involved.

The factors which govern the quality (or performance) of a project include:

- The project brief: A design brief generally includes details of function, quality and intended life. A statement of standards required needs to be clearly defined and unambiguous.
- The original design: Incorporating the following items:
  - Components selected for the project.
  - Components and system interfacing.
  - Mechanical, hydraulic and electrical systems.
- Design completion: The level of design completion and resolution prior to start of construction.
- Construction specification: In Australia, there is no automatic requirement for construction and products to conform to Australian standards, unless required by the National Construction Code (NCC). Thus, a well-written specification is critical in achieving quality standards. This factor needs to be considered by the client, as some procurement systems are prone to specification minimisation. A construction specification functions in the following capacity:
  - Converts quality standards required by the project brief and design drawings into written statements, outlining the standards to be met.
  - Sets out criteria for measuring completed work, e.g. through the reference of standards and codes of practice.
- The quality control system: These are control mechanisms applied to on-site execution and include contractor supervision, and procedures for testing and rectifying defective works.
- The inspection system: Design team verification procedures for completed works, including witnessing tests, commissioning plants and systems, defect rectification and handover.
- Australasian Procurement and Construction Council (APCC): The APCC consists of Australian and New Zealand government agencies with responsibility for the disciplines of procurement, construction, asset management and property management policy and practice. The APCC website includes many publications on procurement practice. See www.apcc.gov.au

# 3 GENERAL HISTORY OF PROCUREMENT

## 3.1 Ancient Greece to the Middle Ages

Records of procurement in the construction industry can be traced back to Ancient Greece, where, depending on the size and complexity of the project, either single or multi-prime contracting was employed. Multi-prime contracting involves employing multiple contractors rather than a main contractor and subcontractors. This system seems to have been commonly used on prominent construction projects, including the Erechtheion (at the Acropolis) and the prostoon of the Telesterion (at Eleusis). This combination of single and multi-prime contracting continued through to the Middle Ages. However, with the royal courts being the main employer for major construction work throughout this period, which often had to span wars and changes in the crown, many projects had no contracts. The master-of-works was responsible for all procurement activities, including securing all goods and services necessary to complete the construction. The design was mainly carried out by the master mason or craftsman and the construction by other contractors, e.g. carpenters and masons. The master-of-works acted as the equivalent of today's project manager.

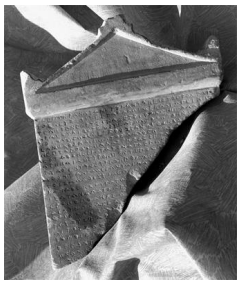

**Figure 3.1: Telesterion at Eleusis**

Contract for the transport of fourteen column capitals for the prostoon of the Telesterion, from Mt. Pentelikon to Eleusis.

(333-307 BC)

**Figure 3.2:**

Specifications for finishing fourteen capitals of the prostoon of the Telesterion.

## 3.2 St Paul's Cathedral

The construction of St Paul's Cathedral (1675-1711) was a turning point in construction procurement. It was the first English cathedral to be completed within the designer's lifetime. Christopher Wren (with some involvement by Robert Hooke) was responsible for the plans, specifications, project management and developing a rolling works program for the project. It was essentially a design and construct project by today's definition with Wren being the contractor. This system of procurement is probably the oldest system still in use in the United Kingdom (UK) today. Other characteristics of the project included techniques such as fast-tracking and the employment of multiple contractors which allowed the building to be finished in 35 years.

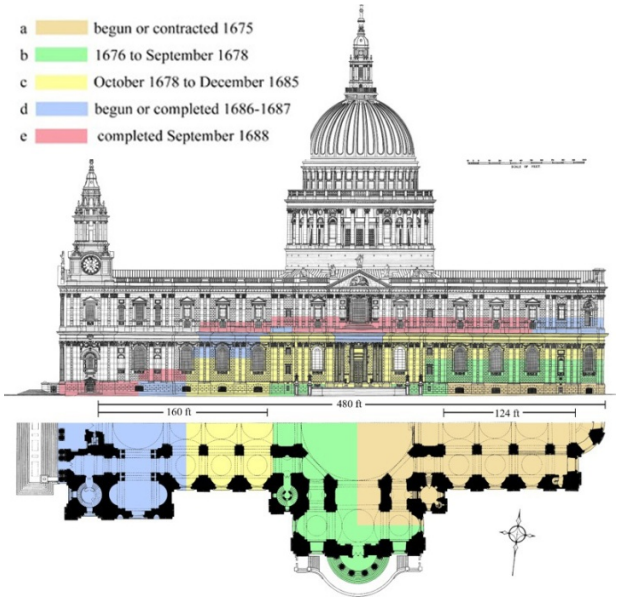


**Figure 3.3: St Paul's Cathedral: Elevation and half-plan showing phases of construction from 1675-1688.**

## 3.3 Emergence of General Contracting

The practice of General Contracting emerged with the population explosion of 1800-1830 in London, and increasingly replaced trade contracting by master craftsmen. This procurement system emerged as activities required under the practice of trade contracting, such as tendering and managing on-site starts and finishes, had taken up too much of the designer's time. Competitive lump sum tendering, where the general (main/lead) contractor took over the designer's role as the construction manager, became increasingly popular as it was more efficient and by the mid-1800s this practice had spread to the United States and Australia. Under this system, the general contractor was employed by the client on the advice of the designer.

A consequence of this system was the separation of the designer from the executor of works. The general contractor became the intermediary between the designer and tradesman, so written or descriptive documentation was required to compensate for this loss of contact with the designer. The specification, previously integrated with the contract, was now a separate document addressed to the general contractor, who would then pass it to the subcontractor. It had evolved from a document addressing one trade per contract to a multi-trade specification with chapters to facilitate subcontracting and the inclusion of preambles (preliminaries) for all trades.

General contracting continued to be a popular system until the mid-1980s, when supplier relationship and strategic planning management emerged and gained popularity. The last forty years has seen procurement move away from general contracting back towards multi-prime contracting with a managing contractor involved.

### 3.4 A brief history of procurement post 1945 (World War II) to the present

After 1945, in response to increased frustration with poor performance within the industry and demands placed on the building industry in terms of workload and complexity, the variety of procurement systems available in the construction sector expanded. In the next decade, systems such as Negotiated Tenders and Design and Construct procurement began to be used, but to a limited extent, by the private sector.

In the 1980s, shifts in the industry increased demands for efficiencies and on-time completion, such systems as labour only subcontracting and client sector in-house management of large projects emerged. Clients with large complex projects began to formulate individual systems of procurement to satisfy their objectives more efficiently.

Following on from this trend, the greater employment of such systems as Design and Construct, collaborative and alliance procurement approaches has continued to the present day. The popularity of these systems is a result of increased demand for competitive consultants' fees, and clients wanting to simplify their relationship with the project team and to allocate risks. To prevent such issues as disputes arising at different stages of the project, these procurement methods incorporated the advantages of having a single point of responsibility, avoiding separation of design and construction issues/risks. A consequence of this is that contractors are generally required to have higher professional indemnity insurance.

As procurement continues to be used as a competitive tool, clients must be more active and sophisticated, and supply chain members (e.g. contractors, designers, consultants) have to adopt a more collaborative approach to projects. Strong controls such as litigation and contract enforcement have to a certain extent replaced reliance on professionalism and craftsmanship.

# 4 THE MAJOR DELIVERY SYSTEMS CURRENTLY IN USE

## 4.1 Single contracting (also known as the traditional system)

This system involves appointing a single head contractor on the completion of design documentation through a tendering process. In building construction, it is generally a lump sum contract arrangement, but this may not be the case for civil works. All documents, including construction specifications, are addressed to this one contractor. This system can be summarised as involving three sequential processes – design, procure, and construct. Once appointed, the head contractor assumes responsibility for construction of the entire project; this includes subcontracting, supply arrangements, site coordination, cost and time consequences, and quality requirements.

This system is suitable for projects where:

- There is enough time available for design completion and there isn't a need for fast-tracking.
- One contractor can most efficiently manage the works or contract.
- Project budget needs to be validated and evaluated prior to commencement of construction.
- The whole scope of works can be agreed, readily defined and documented in the timescale allocated for design development.

Advantages of the system:

- There is minimum management by the client as there is only one contractor to manage.
- There is minimum risk to the client as most of the risk is passed onto the contractor.
- A more competitive market-based project tender can be obtained as there is generally a larger pool of tenderers to choose from.
- The client has direct access to the designer which may facilitate a higher level of functionality and improved quality in the overall design.
- Transparent and fair competition can be achieved, as all contractors bid on the same basis.
- A more reliable price may be obtained for the project before construction starts as the design is resolved.

Disadvantages of the system:

- The brief and design documents, including construction specification, must be comprehensive and clear for the whole project to avoid any conflict, as any design change after the contract has been awarded will create additional costs. This may require longer lead time to produce the tender documents and a subsequent period to analyse, compare and clarify tenders.
- It is not as flexible as other delivery systems, as the program will be controlled by the one contractor. Requirements such as staging, acceleration, and early completion after the contract has been awarded may incur large costs.
- Relationships may become adversarial between parties when issues develop as the only contractual relationship is with the client.

Implications for achieving quality under this system:

- The designer is directly accountable to the client and design processes are required to be complete before commencement of procurement and construction, enabling a high level of design quality and functionality.

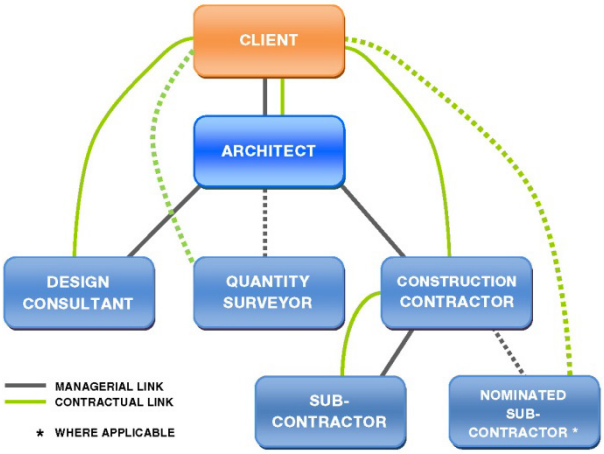


**Figure 4.1: An example of traditional procurement system managerial and contractual links**

## 4.2 Multiple contracting (also known as multi-prime, package contracting)

This is where more than one contractor is involved on the one project, and the works are awarded as a number of packages. The packages can be tendered separately and may be initiated progressively, which may involve documentation being prepared out of sequence from a designer's point of view. Each package contractor has direct contact with the client and is responsible for its own trade contracting and supply. Where a construction manager is involved, they will act as the client's representative within the project team and may be required to actively coordinate and manage all trade contractors on the project.

This system is suitable for projects where:

- Separate components of the construction are spatially independent and there is an advantage in completing each package separately, e.g. allowing extra flexibility and allowing staging.
- There are work packages with specialist requirements or are of a complexity requiring separate attention.
- Some components are required to be completed ahead to resolve or identify any risks which are critical for works following, or works are to be programmed to suit cash flow, e.g. completion or commencement of foundation works which may affect the remainder of the construction/planning.
- The scale is large.

Advantages of the system:

- It allows for time compression and fast-tracking through early commencement of some construction ahead of full design completion.
- It allows for direct engagement of specialist contractors or direct purchasing of major plant items, which may give the client more control over the quality of the finished asset.
- It can facilitate staging to allow some packages to be accelerated, postponed or decelerated to meet cash flow requirements.
- There is more flexibility in cost control where the initial brief conditions are less certain. Work may be omitted or deleted to avoid cost/time overruns, or the quality of work may be improved where there are time/fund reserves.

Disadvantages of the system:

- As the whole project cost is not known until all contracts have been awarded, cost forecasting and control may be more difficult.
- The client bears the risks associated with coordination between contracts.
- There is less control of an overall project completion date, as this can only be determined upon the commitment of all contracts.
- There is increased possibility of disruption, delay and potential interfacing discrepancies between contracts.
- More management resource and cost is required in the preparation of tender and contract documents, tender process management, contract administration and coordination.

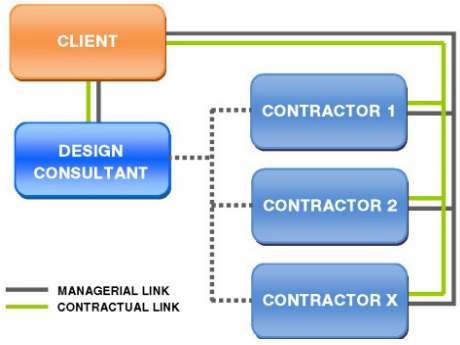


**Figure 4.2: Multiple contracting relationship arrangement**

Implications for achieving quality under this system:

- The implications are similar to those for single contracting. Many clients, when using these two systems, will also employ prequalification procedures when selecting contractors, e.g. considering the construction experience and financial capability of the contractor. This helps to assure the client that the contractor can perform the scope of work specific to the project.

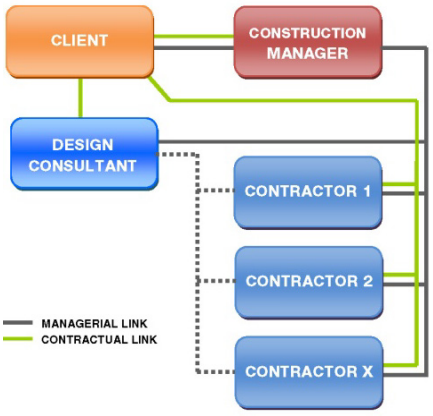


**Figure 4.3: Relationship arrangement of multiple contracting involving construction manager**

## 4.3 Managing contractor delivery system

This is where a managing contractor (*refer 5.2 Design and Construct*) is engaged early in the project life to commission, manage and assume responsibility for a team of consultants to develop the design brief, design the project works and engage a team of subcontractors to construct the project works. The client and the managing contractor generally negotiate a fixed lump sum management fee. Under this system, the design team may be appointed by the client to complete the design, or both the design and construction components may be tendered competitively, with various contract options, including Design Development and Construct (DD&C), Design and Construct (D&C), and Design, Novate and Construct (DN&C).

The managing contractor may be responsible for the following components:

- Performing all or part of the design services on behalf of the client.
- Arranging trade packages, tendering and entering trade contracts on behalf of the client and potentially perform some of the trade contract works.
- Supervising and reporting on project activities to keep the client informed on the progress of works.
- Filling the gaps between contracts, e.g. providing construction equipment such as cranes.

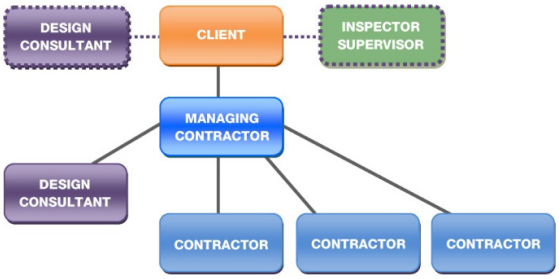


Figure 4.4: Managing contracting relationship arrangement

This system is suitable for projects where:

- There are many unknown factors that are too complex to resolve in the time available, including unclear scope.

- Delivery times are tight and fixed.
- Funding is fixed and the project costs need to be fixed and agreed at commencement.
- Project risks and their management are complex.
- There are substantial, complex stakeholder interfaces and relationships which may be difficult to manage.
- Early key participant input and industry innovation is required.
- The scale is large and complex.

Advantages of the system:

- Early involvement of all key project participants allows early collective resolution of project scope and objectives.
- It provides greater potential for optimum design and efficiencies through the involvement of all participants.
- Greater flexibility to accommodate design changes, during the early design stages, reduces cost risks.
- There is the opportunity for fast-tracking through overlapping of design and construction where some construction activities can commence without waiting for full design completion. As the contractor has full control, they may commence construction activity at their own risk to reduce project time or create cost savings.
- The client's risk is minimised as the managing contractor assumes the risks and responsibility for the whole project, including coordination of design and construction.
- The managing contractor will have access to the original designer and their knowledge of the design issues.
- If the design is unique and complex, continuity in design and documentation may reduce risks associated with special designs as the contractor is able to improve on buildability issues.
- This contract allows wider scope for innovation by the managing contractor, where tenderers may be encouraged to offer alternative design concepts or details which may result in cost savings or other benefits for the client.
- Using specialist firms who have experience in such delivery systems and project types may be more economical as they are able to use proprietary designs and construction processes available, e.g. designs with functions such as transport facilities, health facilities and schools.
- Providing the client's requirements are clearly specified and no design changes are made, price certainty may be obtained before construction starts.
- If operational or maintenance requirements are included as procurement components, the advantages are as follows:
  - The managing contractor is more likely to optimise asset quality, and better address maintenance and operating needs.
  - The managing contractor's liability for defective works is extended beyond what is normally the limit by law.

Disadvantages of the system:

- There may be more contract management activities for the client.
- Inadequate contractor management may present early risk of not achieving the best value-for-money.
- Independent cost monitoring is required.
- The client needs to be informed on design/build/ cost issues.
- Poor price certainty is offered at an early stage and the potential cost commitment is usually dependent on the design team's estimates.
- There is reduced resistance to the works contractors' claims where demands are usually passed on by the managing contractor to the client.
- Where there is uncertainty in the design brief or project scope, there may be greater design risks which may result in costly variations.
- There is the risk that the contract documents are not specific enough which may lead to increased quality, outcome and cost risks.
- Tender prices may be higher due to higher premiums compensating for the additional design, operation and/or maintenance risks and the possibility of having a limited number of competent tenders.
- The tendering costs, incurred by the client, are higher, compared to other contracts due to the required preparation of tender and contract documents to cover the maintenance and operational requirements.
- The client has no direct independent relationship with the designer, thus there is increased risk of the design not meeting the client's expectations.
- Bids may be difficult to compare, as each design and project program may vary significantly between tenderers.

Implications for achieving quality under this system:

- As this system inherently demands competitive costing (and are generally tied to a guaranteed maximum price), there is a risk that design quality may be downgraded to meet budgetary objectives as the client will have less design control and involvement. Therefore, it is imperative that the design brief be specific and detailed regarding quality requirements.
- Well established standards and design manuals for design development, such as standards and best practice guidelines for details and finishes may be included in the briefing specification to make sure an acceptable level of quality is achieved.

### 4.4 Alliance contract delivery system (project alliance)

This delivery system involves an agreement between two or more entities to undertake work cooperatively, using an integrated management team and intensive relationship facility. The system is generally used for delivering major capital assets, where the public sector entity works with private sector entities. The entities may include at the very least, the designer and an alliance manager but may also include consultants,

key construction contractors and expert advisors. Alternatively, these other parties may be appointed separately. The entities are selected on the basis of their ability to deliver project outcomes, that includes value-for-money criteria. The objective is to facilitate consensus decision making as the participants work together to achieve agreed outcomes and share project risks.

However, the alliance manager has overall responsibility for the project as they will accept all remaining liability not covered by the other entities. Each integrated management team member provided by the entities is given a clearly defined role and responsibilities.

The Integrated Project Delivery (IPD) system shares similar concepts and multiparty agreements among the major procurement participants for each project.

This system is suitable for projects where:

- The project is large and complex and may be high profile.
- Improved outcomes are sought through extra relationship facilitation.
- Better management of risks is required through collective involvement of stakeholders.
- The project scope is unclear or difficult to define in the time available and early advice from key stakeholders may be required to assist in defining scope or resolving issues.
- Community concerns are complex and may require special management.
- Project risks are uncertain or unpredictable and project criteria are likely to change.

This system is not suitable for projects where:

- The alliance manager, consultants, contractor and other participant personnel involved are not suited to working as an integrated team.
- Additional alliance implementation costs are not consistent with the project value, or the advantages provided by the system, e.g. where the project is relatively small.
- Participants are not prepared to invest in the resources required in an alliance contract and accept a risk sharing arrangement.

Advantages of the system:

- Greater management efficiencies can be achieved with integrated management for special projects.
- Greater collaboration may improve design and quality outcomes with special projects.
- Early involvement and input of key participants may allow for improved development of responses to the project objectives with special projects.

Disadvantages of the system:

- High demand of personnel resources and input requirements create greater cost margins.
- The client may be forced to take responsibility for the majority of the risks as the scope is generally undefined and therefore lacks certainty.
- In a pure alliance model, there is a perceived lack of open competition and hence it is difficult to demonstrate value-for-money in the early stages of the process.

Implications for achieving quality under this system:

- As for **Managing contractor delivery system**.

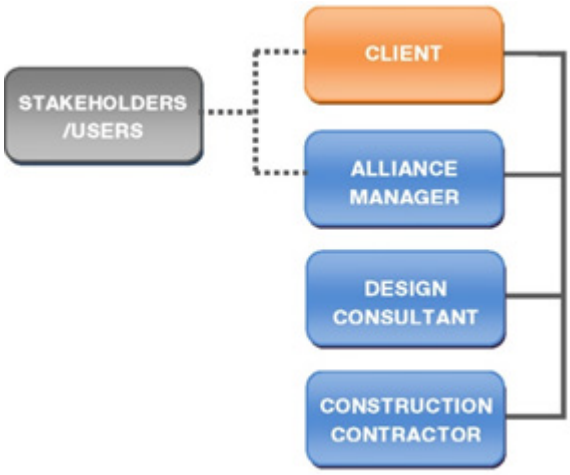


**Figure 4.5: Alliance contract delivery system relationship arrangement**

## 4.5 Public Private Partnership (PPP)

*Also known as Privately Financed Project (PFP), Private Finance Initiative (PFI), Design-Build-Finance-Operate (DBFO).*

This system involves the private sector financing and developing a public asset for a concession period (period where works and services are to be carried out). Government contribution may involve the provision of land or capital works, acceptance of risks, or the commissioning of asset related services, e.g., operation and maintenance.

This system is suitable for:

- Public projects with long service delivery periods.

Advantages of the system:

- It allows capital funding risks to be either partially or totally transferred to the private sector and be spread over a longer period than other delivery systems.
- Depending on project conditions, the asset management risks may be allocated to the private sector developer for the construction period and part or full life of the asset.
- There is an incentive to achieve asset operational efficiency, e.g. lower energy consumption, where the responsibility of operation of the asset is accepted by the developer.

- Lower overall delivery and management costs may offset higher tender process costs incurred by the client.

Disadvantages of the system:

- The client will have to provide time and personnel resources for the tendering and management processes. Specialist advisors or consultants will be required to thoroughly assess the financial and technical proposals, and to document and manage the PPP agreement.
- There is potential for the quality to be compromised and the real benefits and relative costs to be unclear, unless there is complete and appropriate documentation of the asset and service quality requirements.
- There is less client control over the asset quality and the operation of the asset upon its completion.

Implications for achieving quality under this system:

- As for **Managing contractor delivery system**.

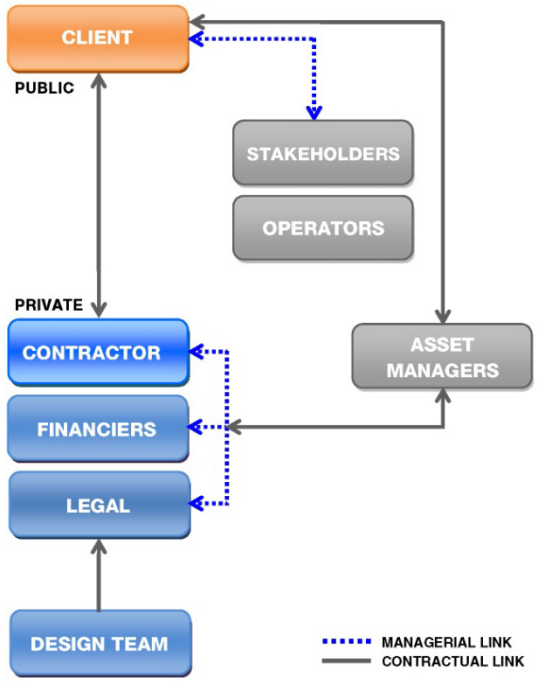


**Figure 4.6: Public Private Partnership relationship arrangement**

## 4.6 Direct labour delivery system

This delivery system involves the client directly procuring services and materials to carry out project works; that is engaging trade contractors for separate trade packages, hiring plant, purchasing equipment and materials. This system requires more detailed expert construction management as it relies on a highly developed and detailed work program for construction.

This system is suitable for projects where:

- There are sufficient in-house management resources, and the project is small.
- The work is an experiment or trial for new processes and technologies.
- Direct control is required to provide increased flexibility, e.g. where work cannot be accurately defined for a contract.

Advantages of the system:

- The client will have more control of design and construction outcomes (through direct involvement).

Disadvantages of the system:

- This system requires intensive construction management; thus, a project/construction manager would normally be engaged to manage the work program.
- The client carries all the risks for work coordination and interface.
- As there is no overall tender price competition, there is less certainty with overall cost and time outcomes and value-for-money.

Implications for achieving quality under this system:

- The likelihood of achieving the client's requirements regarding design and functionality is high, as the client is directly responsible for the procurement of all services and materials.

## 4.7 Early Contract Involvement (ECI, two stage managing contractor)

The ECI delivery system enables the construction contractor and the designer to work together in a contractual relationship with the client, to produce scope and design documents (Stage 1) and construct the project (Stage 2). This arrangement allows for constructability to be built into the design from the start with several risks and uncertainties to be analysed and eliminated before commencement of Stage 2.

Advantages of the system:

- With the early involvement of the construction contractor, a lower level of design completion is required which may potentially reduce both design and construction costs and reduce design time requirement.
- This system allows for a guaranteed maximum sum and avoids likely variations and excessive project contingency fees that are normally associated with other procurement options.
- Through this collaborative process, the contractor benefits by having the ability to secure their profit margin and may be less likely to engage in margin recovery strategies.

Disadvantages of the system:

- The client will have to accept greater risks than that associated with a traditional lump sum contract.
- There is an increased risk of decision making deadlock, where the client may have to arbitrate.

- There is an increased risk of opportunistic behaviour.

Implications for achieving quality under this system:

- As for **Managing contractor delivery system**.

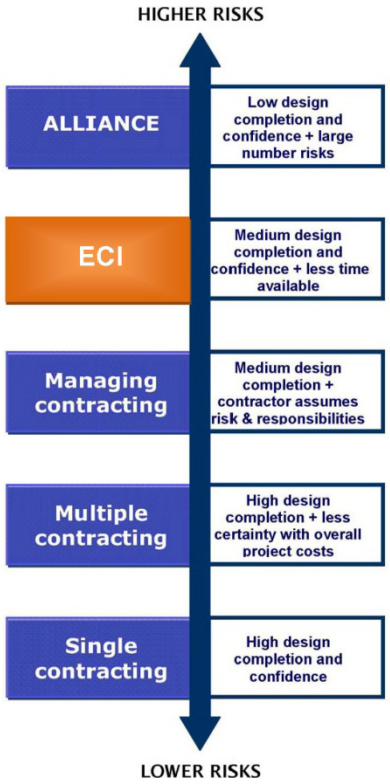


**Figure 4.7: ECI delivery system client risk, when compared to other procurement systems**

### 4.8 Other procurement methods

The procurement methods noted above are the major ones used in Australia. The dynamic nature of the local building industry means that there is ongoing variation to preferred procurement methods and their definitions.[4]

## 5 CONTRACTING SYSTEMS SUPPORTING THE PROCUREMENT DELIVERY SYSTEMS

### 5.1 Construct only

This contractual arrangement is generally used within the context of the **Single contracting** procurement system, but it can also be used in a multiple contracting or managing contractor arrangement. It is used when the optimum design can be developed without the involvement of the construction contractor. The documentation (including the construction specification) for this type of contract is fully descriptive, and thus there is less opportunity for innovation. The design decisions are generally made by the design and documentation team.

### 5.2 Design and Construct

These contractual arrangements are generally used within the context of the managing contractor delivery system but may also be used for other delivery systems such as PPP. The three fundamental characteristics of the Design and Construct contract systems are:

- The responsibility of design and construction of the project lies with the one organisation.
- Reimbursement is by means of a fixed lump sum.
- The project is designed and built by the one contractor to meet the needs of the client, as defined in the initial employer's requirements.

There are several variations of this contract, depending on the stage of involvement by the contractor. The varying systems can be distinguished as follows:

- **D&C** (Design and Construct): The contractor is appointed to prepare or complete the client concept design, design development, documentation and construction of the works.
- **DD&C** (Design Development and Construct): The contractor is appointed to develop the client concept design and construct the works after receiving a concept design and perhaps some form of performance based briefing specification from the client. This is only suitable where the design brief can be clearly defined.
- **DN&C** (Design, Novate and Construct)**:** Under this system, the design team is selected by the client and subsequently novated to the construction contractor. The contractual relationship between the design team and client is then transferred to the contractor, once appointed, and with it the responsibility of the design. This system allows the client more control over the initial design whilst also maintaining design continuity throughout the project life cycle.

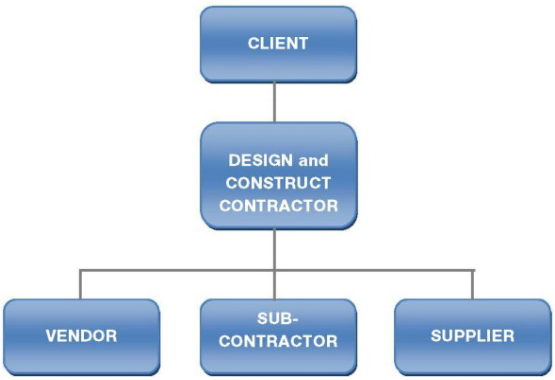


**Figure 5.1: Design and Construct relationship arrangement**

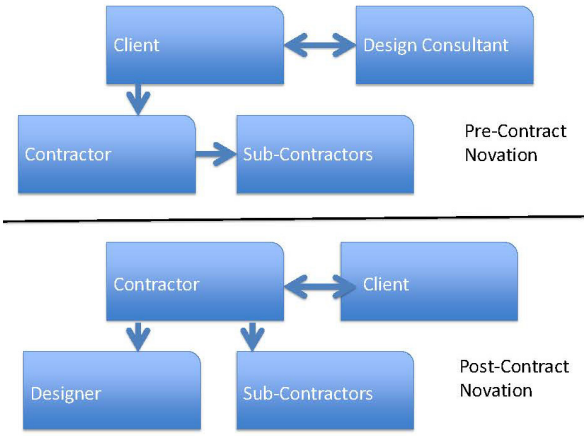


**Figure 5.2: Design, Novate and Construct relationship arrangement**

## 5.3 Design Construct and Operate and/or Maintain

Under this contract the client prepares the design brief, performance or functional briefing specification and perhaps the concept design. The contractor is then responsible for the preparation or completion of the concept design, design development, preparation of construction documentation, construction, and operation and/or maintenance of the completed project.

The variations for this contract type include:

- DCO (Design, Construct and Operate) / DDCO (Design Development, Construct and Operate).
- DC&M (Design, Construct and Maintain) / DDC&M (Design Development, Construct and Maintain).

The contract will usually involve a lump sum price for design and construction with operation and/or maintenance costs of the asset based on a schedule of rates. In order for this contract to be effective, the client must be able to define clearly what is required during the operating/ maintenance period. This contract is not suitable for small projects.

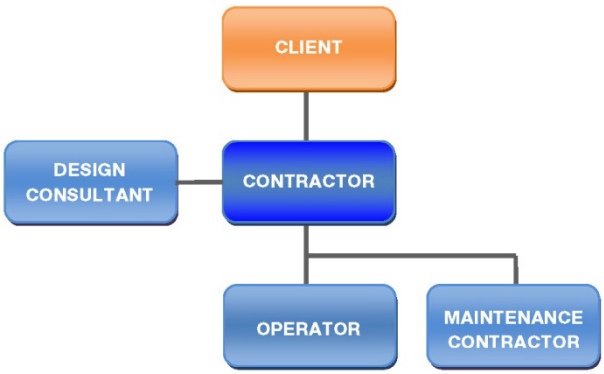


**Figure 5.3: Design, Construct, Operate and/or Maintain**

## 5.4 Guaranteed Maximum Price (GMP)

This contract agreement involves the contractor being compensated for actual costs incurred, plus a fixed fee subject to a ceiling price. Generally, the contractor is responsible for cost overruns and savings (underruns) are returned to the client. This arrangement is also generally applied to Design and Construct type contracts.

This contract is designed to reduce scope for variations to the contract price and completion date by using the following mechanisms:

- Having the contractor take on all the risks associated with ambiguities or discrepancies in the tender/contract documents, by disallowing claims for variations or defects in the documentation.
- Requiring the contractor to take on risks associated with latent conditions with no claims being allowed.
- Minimising allowances for extensions of time, e.g. limiting permitted claims for inclement weather or industrial disputes.
- Requiring all subcontractors be engaged by the contractor and the design team be novated to the contractor so that the contractor can assume full responsibility.
- Disallowing cost adjustment for inflation.
- Possibly allowing a bonus for early completion.

Advantages of this contractual arrangement:

- There is greater potential for on-time completion due to restricted opportunity to claim extensions of time and the optional bonus provisions.
- Less contract management will be required by the client due to a reduction in potential claims and disputes.
- The contract provisions should be less complicated as a result of the restricted right of contractor to process claims.

Disadvantages of this contractual arrangement:

- There is potential for higher tender prices as the tenderers will need to price additional cost/time risks that may not eventuate.
- The high risk requirements of the contract will restrict the field of capable and willing tenderers, which potentially may increase tender prices.
- The client's expectations may not be met where the scope/quality is reduced to meet cost/time target

# 6 PROCUREMENT FOR SUSTAINABLE CONSTRUCTION

*The overall objective of good design is to ensure that buildings, infrastructure, public spaces and places are buildable, fit for purpose, resource efficient, sustainable, resilient, adaptable and attractive. Good design is synonymous with sustainable construction.* [5]

Sustainable procurement can be defined as:

*A process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, while minimising damage to the environment.* [6]

The impact of the Australian construction industry on the environment is substantial, and the need for sustainable procurement has become increasingly critical as illustrated in the following statistics:

*2018-19, 75,800,000 tonnes of waste were generated, 16.8 per cent of which was from the construction stream.* [7]

*Buildings and their users are responsible for almost a quarter of Australia's greenhouse emissions. The energy embodied in existing building stock in Australia is equivalent to ten years of the nation's energy consumption.* [8]

The focus of sustainable procurement is not just on asset delivery but also on the environmental impact of the asset throughout its life cycle, including avoiding unnecessary consumption.

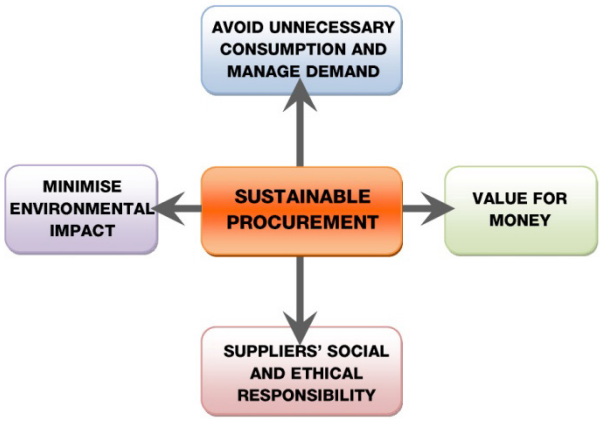


**Figure 6.1: Objectives of sustainable procurement in construction**

## METHODS USED TO MEET SUSTAINABLE PROCUREMENT OBJECTIVES

### 6.1 Facilitating innovation through performance-based specification

A technical brief may be provided, requiring the contractor to complete the design process. When combined with clearly defined, measurable and sustainable objectives (in the design brief), it can theoretically encourage innovation, competition and cost savings, as the means of achieving the brief is left open for the contractor. It is useful in areas where there is fast technological advancement and in areas where a conservative approach may result in resource waste. It is mainly used for specifying fire-resistance level, thermal insulation, emissions and acoustics.

An example of how this method has been used is by setting energy performance targets or operational requirements for lighting rather than specifying the exact product.

Some NATSPEC worksections include optional requirements which provide a standardized approach for specifying construction benchmarks, determined by the Green Building Council of Australia's (GBCA) *Green Star Buildings* rating tool.

### 6.2 Whole Life Cycle Costing (WLC)

This involves using Whole Life Costing or Life Cycle Costing (LCC) for systematic economic consideration. WLC involves taking into consideration planning, design, construction and implementation, operation, and decommissioning costs. The means of achieving this include:

- **Post Occupancy Evaluation (POE):** This requires the inclusion in the construction specification of the performance criteria to be evaluated and the period of evaluation (this is generally 1 to 3 months after handover). Projects where POE was required have reported significant benefits ranging from reduced energy consumption, reduced construction and maintenance costs, and improved occupier productivity.
- **Life cycle impacts**: Construction elements (technology, product or material) such as recycled material content of a product or the energy requirements of the heating and lighting systems, may be used as a criterion of assessment for life cycle impacts. An example of how this method has been employed is the setting of targets for materials purchased for the London Organising Committee of the Olympic and Paralympic Games (LOCOG) venues. They were set as follows:
  - Construction materials (by value) will comprise at least 20% recycled content.
  - 25% of aggregate used will be recycled.
  - 50% of materials (by weight) will be transported to site by sustainable means.
  - Energy-efficient, low emission vehicles will be used on-site. [9]

### 6.3 Open bidding

This is where architects and engineers compile technical construction specifications of required objectives of a project, but the solution is left open to the contractor, it is essentially a performance-based construction specification. The architects and engineers will also be required to check the tender to assess its performance and compliance. The specification may incorporate such requirements as passive solar design performance, energy consumption and water conservation and recycling.

### 6.4 PPP (Public Private Partnership) project assessment indicators

The briefing specification may incorporate project objectives and requirements, which may be used as part of a weighting system for the selection of contractors by requiring the contractors to submit details and concepts demonstrating how the specified criteria can be achieved. Objectives to be addressed may include passive solar design performance, site rehabilitation (if the site is contaminated), use of low energy appliances or use of waterless urinals.

SeeCampus Niederlausitz (County of Oberspreewald-Lausitz, Germany) is an example of a project where the PPP system was used to design, build, and finance a school development. The private partner selected was contracted to operate the technical services, facility management (cleaning, maintenance, caretaker services) and school catering services, including a publicly accessible cafeteria for 30 years. This project also attracted a local corporate sponsor to provide funding for the construction materials (€1 million). Passive solar performance selection criteria used included maximum heating levels, HVAC requirements, minimum air-exchange levels throughout the building and other ventilation requirements.

**Figure 6.2: SeeCampus Nierderlausitz Public Private Partnership for a Passive Solar House School**[10]

### 6.5 Energy Performance Contracting (EPC)

This contractual arrangement stipulates tenderers provide or offer energy carbon savings with a focus on long term savings. This can be achieved through specifying baseline performance criteria, e.g. initial energy saving measures or investment made back through a period of 10 years.

### 6.6 Incentivising innovation within construction contracts

The methods which have been used to achieve this include:

- Allowing for performance payments for key performance indicators, e.g. energy efficiency, use of recycled products, minimising waste and transport movements.
- Including the option of negotiating contract extensions for innovative design options.
- Requiring Best Available Technology (BAT) for lighting, heating, ventilation or other systems.
- Rewarding savings which are generated by an innovation, e.g., the introduction of a LED lighting system.
- Incorporating a gain share clause into the contract, whereby the savings on initial project cost estimates are shared between the client and the contractor.

Other examples of PPP projects include Grafton Correctional Centre, Sydney Light Rail and Sydney Metro Northwest.

## 7 USING BIM (BUILDING INFORMATION MODELLING) IN THE PROCUREMENT PROCESS

BIM is a digital (model) representation of the physical and functional characteristics of a building or facility. The digital model may be passed from the design team to the contractors and eventually to the owner/operator. It can be used in the procurement process for the following requirements/processes:

- **Performance analysis:** BIM can be used to analyse the performance of a facility in such areas as energy / thermal performance, natural and artificial lighting analysis and ventilated facade studies. This tool may be used where POE is required in the contract.
- **Sequencing and cost controlling:** The digital model in conjunction with an associated software can be used to plan and sequence construction and expedite cost analysis. Information stored in the model can assist the tracking of work sequences. This can improve the efficiency and accuracy of cost measurements and the tendering process.
- **Asset management:** BIM can be used to manage the facility assets throughout its life cycle by maintaining up-to-date facility and equipment data, including maintenance schedules, warranties, cost data, upgrades and manufacturer's data. This can be a comprehensive information source for tracking usage, performance and maintenance of an asset that can be passed from the designer and contractor to the owner/operator.
- **Optimising information transfer:** This is achieved by minimising the loss of information (especially where there are team changes) and speeding up processes by reducing redundant work, e.g. inventories can be generated to produce schedule of works for doors/windows, piping and ductwork, conduits, framework components and equipment. Subcontractors can feed further information into the model and use it to generate or produce shop drawings. This improves efficiency and coordination (and consequently minimises risk).

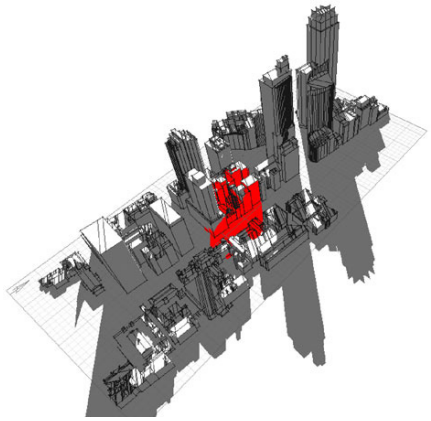

**Figure 7.1: Overshadowing studies on neighbouring developments using BIM.**

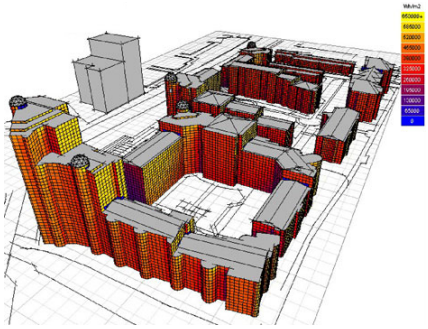

**Figure 7.2: Surface mapping and solar radiation analysis using BIM.**

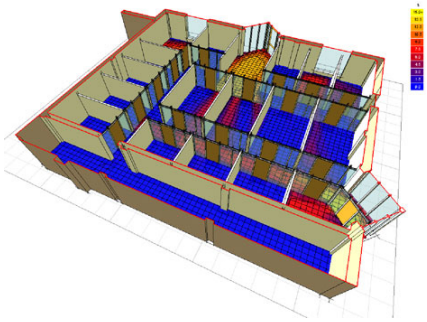

**Figure 7.3: Visibility analysis, determining quality and amount of views for individual offices using BIM**

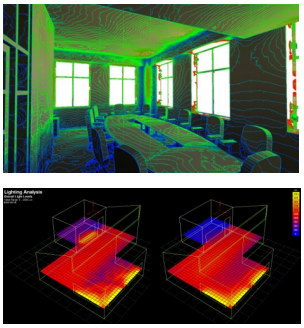

**Figure 7.4: Overall lighting levels and daylight analysis using BIM**

## 8 E-PROCUREMENT SYSTEMS

E-procurement has been defined as the use of information and communication technology, such as an internet-based system, by mainly government agencies to procure goods and services.
E-procurement systems for construction services, facilitates the following:

- Notification of tenders open.
- Posting of tender details and submission requirements.
- Allowing tenderers to prequalify and register.
- Facilitating tender submissions.
- Assessing bids/tenders.
- Monitoring/auditing efficiency and effectiveness of procurement.
- Electronic payment processing.

Advantages of the system:

- **Accelerated procurement:** This system allows for accessing real-time bidding information, as well as providing faster and more secure document exchange.
- **Improved efficiency:** This is achieved through:
  - Providing an integrated information system where information is shared and can be accessed by all government departments.
  - Reducing transaction cost by reducing paper documentation and eliminating redundant and repetitive procedures, e.g., company registration (which can be loaded once into a database).
  - Eliminating the need for personal visits.
  - Standardisation of documentation and procedures as all tenders would be conducted through the one channel.
  - Archiving work packages for future reference.
- **Improved transparency to minimise corruption:** This is achieved through:
  - Providing single point accountability.
  - Minimising human interaction in the bidding process.
  - Centralising data to enhance inventory.
  - Information management and improved tracking capabilities.
  - Providing equal access terms and conditions for all appropriate parties.

Disadvantages or barriers to the implementation of E-procurement systems:

- Lack of flexibility.
- Significant resources required to set up a system.
- The tenderer is required to financially invest in and learn a new system.
- If more than one system is used simultaneously, it can be confusing.

Refer NATSPEC BIM www.bim.natspec.org

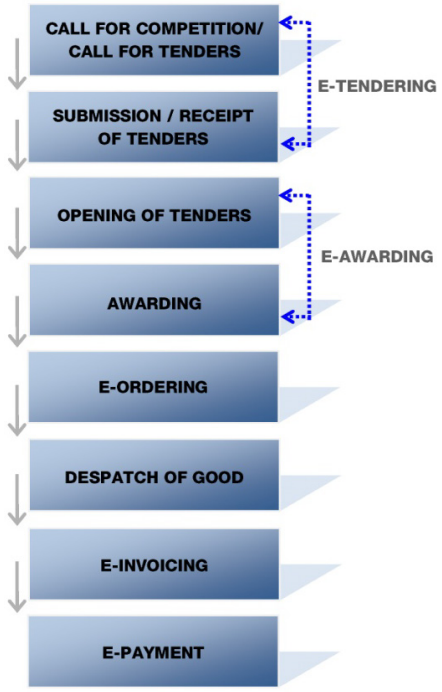


**Figure 8.1: E-procurement processes**

E-procurement systems currently in use:

- illion TenderLink in Australasia: Online tendering system used by both the public and private sector.
  illion.tenderlink.com
- Individual states in Australia have government tendering websites for public works procurement, e.g. Tenders WA.
  www.tenders.wa.gov.au

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