SUBMISSION TO THE PRODUCTIVITY COMMISSION INQUIRY INTO PUBLIC INFRASTRUCTURE PROJECTS

GERARD DE VALENCE

Faculty of Design Architecture and Building

University of Technology Sydney

Contents

Summary and Recommendations

The intention behind this submission is to provide the Commission and the inquiry with a framework for looking at that may not be familiar to the team. This framework is based on research published over the last decade or so into large, complex projects for both public and private sector clients. A great deal is already known about the requirements for successful public infrastructure projects, based on the performance of projects over the last two decades and the many studies and reports that have been done on those projects.

The most effective, and possibly the only way to significantly affect outcome costs of major projects is to change the business model, by revising the procurement strategies and decision-making and implementation processes used.

The important issues in procurement and delivery of major public infrastructure projects now are in the establishment of processes, agencies or offices, and procurement strategies that will greatly increase the likelihood of successful project delivery. Better use of data from previous projects in the evaluation and definition stages of new projects would be a transformative innovation in procurement management.

Many Australian public infrastructure projects are now in the category of megaprojects, large-scale projects typically costing more than $1 billion that attract attention because of their significant economic and/or social impacts. The great majority of megaprojects are completed late and over budget and, once completed, often fail to meet their stated expectations. The larger the project, the more important is the accuracy of early estimates.

However, not all major projects are megaprojects and the typology of these projects ranges from simple to complex. Often the challenge is to identify the right strategy for a project from the extensive range available these days. Generally, what is argued here is that the most effective procurement strategy should be applied to each project, and that developing that strategy is the responsibility of the client.

Recommendation 1: That a segmented approach to major project procurement be applied, with appropriate procurement strategies for projects in the different categories or segments developed. This is based on the proposition that there is a best or most effective and appropriate procurement strategy for each project.

There is a key distinction to be made between controlling public infrastructure project costs once a project gets commenced and avoiding expenditure on unviable projects that are approved as a consequence of poor decision-making. The best way to limit the total expenditure on projects delivered is by avoiding projects that are highly risky and unlikely to meet their time and cost estimates. Project selection is the subject of Recommendation 2, and project delivery of Recommendations 3 to 5.

Recommendation 2: That Reference Class Forecasting or similar process be applied to all proposed projects, and that an Australian database of public infrastructure projects be developed and maintained. All public infrastructure projects' time and cost estimates should be compared and evaluated against previous project outcomes and performance.

The public sector should invest in the development of its capabilities as a client of construction sector, because public client agencies/departments/enterprises are in reality holding the risk of their projects and their performance, and they need to be able to manage that risk.

Recommendation 3: That the Commonwealth Government establish a major construction projects office with responsibility for recruiting the key members of a project client team for each major project at the early stage of project development. The team members are employed for the duration of the project.

Traditional construction procurement is the most effective form of public infrastructure project organization, where consultants are appointed to do the design and a competitive tender is held for one or more contractors to execute the works. This stages project costs and reduces contractor risk. Management of the interaction between designers and contractors is done by the client team, which also takes responsibility for overall project management.

Recommendation 4: That design and construction work be contracted separately to reduce project costs and risks. Design and documentation should be complete before tendering the works to lower contractor risk and project costs.

Sequencing of public infrastructure projects recognises that significant capacity constraints exist in the engineering construction sector. A pipeline of projects in the design stage allows potential suppliers and contractors to build capacity in the knowledge that there will be ongoing opportunities for their staff and equipment.

Recommendation 5: Better sequencing of projects will reduce costs by avoiding capacity constraints. As design work is completed for a project it can be added to a pipeline of projects. Potential suppliers and contractors can use the pipeline of projects to build capacity in the knowledge there will be ongoing opportunities for their staff and equipment.

Recommendations 6 and 7 deal with incentives and market access. Incentives are be the most effective way to improve project performance on public infrastructure projects. Wherever better performance is sought the use of incentives is the best approach, and target cost contracts can provide these. The public client could give up their share of any gains and use that to reward productivity and performance by all contractors and suppliers to the project.

Recommendation 6: If reduced cost, improved project delivery and increased productivity are sought, target cost contracts will provide the right incentives. As well as contractors it would be possible to include subcontractors and suppliers in the agreement, and their employees, in the gain share agreement. This would be an effective productivity incentive that would work through the entire supply chain and could be incorporated into the project's contracts and industrial relations agreements.

Dividing a large project into a number of smaller contracts reduces the barriers to entry for tenderers and creates opportunities for local contractors to tender for work, particularly in regional areas, and increased competition for work will contain costs. This is an important policy decision.

This can also reduce project costs by removing a layer of management on projects where a large contractor wins the work then subcontracts it out to smaller local contractors, but charges a project management fee. This is not uncommon, but with a client team responsible for project management it is not necessary.

Recommendation 7: Where possible, a project should be broken into sub-projects to reduce barriers to entry for tenderers, create opportunities for local contractors, and increase competition.

Introduction

The brief for the Productivity Commission inquiry on public infrastructure is very wide-ranging. This submission, in its various ways, deals with points five and six in the scope of the inquiry from the *Issues Paper (pp. 41-2)*:

5. Provide advice on ways to improve decision-making and implementation processes to facilitate a reduction in the cost of public infrastructure projects, including in relation to:
   a. measures to improve flexibility and reduce complexity, costs and time for all parties
   b. access to the market for domestic and international constructors, including barriers to entry, and what effect this has on construction costs.
   c. 'greenfield' infrastructure projects.
6. Comment on other relevant policy measures, including any non-legislative approaches, which would help ensure effective delivery of infrastructure services over both the short and long term.

The intention behind this submission is to provide the Commission and the inquiry with a framework for looking at major public infrastructure projects that may not be familiar to the team. This framework is based on research published over the last decade or so into large, complex projects for both public and private sector clients.

The most effective, and possibly the only way to significantly affect the outcome costs of major projects is to change the business model, by revising the procurement strategies and decision-making and implementation processes used. Often the challenge is to identify the right strategy for a project from the extensive range available these days.

Although strategies such as alliance or relational contracts have become widespread in private sector projects, particularly in the resource industry, these require significant commitment by the client to the project team. While not excluded by the recommendations given here, alliances are not a requirement either. The same can be said for other tools and techniques such as lean construction or lean project management, supply chain management and prefabrication or design for construction. Generally, what is argued here is that the most effective procurement strategy should be applied to each project, and that developing that strategy is the responsibility of the client.

If the Government wishes to reduce complexity, costs and time without sacrificing quality and performance there are, in reality, few opportunities to have a major impact on costs. For example, if labour costs are 40 per cent of a project's budget a 10 per cent reduction will reduce project costs by 4 per cent. However, the actual reduction in labour costs cannot be known until the project is largely complete, so the beneficiary of such a reduction under a conventional contract is the contractor, whose profit margin will improve, not the client who has agreed on the price for the project at commencement.

The submission is structured as follows:

- Issues in procurement and delivery of major projects
- Decision-making processes
- Data drives project selection
- Implementation processes
- Unbundling design and construction
- Incentives and target costs
- Market access

Issues in Procurement and Delivery of Major Projects

A great deal is already known about the requirements for successful public infrastructure projects, based on the performance of projects over the last two decades and the many studies and reports that have been done on those projects. Australian State and Commonwealth governments have extensive experience in a wide range of projects, and this experience can be leveraged into improved performance by future projects.

A good summary of the state of knowledge on Australian projects is the PricewaterhouseCoopers (2008: 4-5) *Review of Major Infrastructure Delivery*, which found:

- Project selection must reflect demonstrated need. This means ensuring that projects only proceed if they address clearly identified problems and provide the greatest net benefit to stakeholders.
- Cost effective projects are not the same as least cost proposals. Government should critically evaluate proposals from bidders to independently identify potential risks and assess ability to complete the project to specification and proposed budget.
- The allocation of risks and rewards must be clear and pragmatic. This includes ensuring appropriate risk management strategies are in place for both Government and the private sector that are sufficiently flexible to deal with all of the risk that emerges over the course of the project.
- Need to think more broadly than the project itself. For larger infrastructure projects in particular, all parties should assess how well a project is integrated in the surrounding business and community environment. In some cases, this may mean transport projects should be addressed as part of a 'whole of corridor' solution.
- Unforeseen changes can be commonplace. Contracts and relationships need to be flexible enough to accommodate changes. To achieve this, contracts should be considered as a 'living document' and provide all parties with appropriate degrees of flexibility.
- Effective community consultation is critical. Communicating with the community at all stages of the project is important to ensure there is full information about project specifications and impacts. The evolution of projects including design and outputs should reflect community input wherever possible.
- Collaborative and trust-based relationships between parties are important to project success. Government and private sector partners need to have a cooperative and collaborative approach to project delivery, with transparent communication of expectations and responsibilities.
- Clearly define project scope. This should occur before going to tender and be well communicated during the tender process. Contracts should also be structured so that they are capable of managing and resolving scoping issues.
- Utilisation of new infrastructure assets can be hard to predict. Demand modelling should be as robust (and appropriately conservative) as possible, and funding arrangements should allow for unforeseen outcomes in patronage.

The important issues now are in the establishment of processes, agencies or offices, and procurement strategies that will greatly increase the likelihood of successful project delivery. Better use of data from previous projects in the evaluation and definition stages of new projects would be a transformative innovation in procurement management.

The recommendations below broadly address these issues.

Decision-Making Processes

This submission focuses on major public infrastructure projects, most of which fall into the category of megaprojects. Megaprojects are large-scale projects typically costing more than $1 billion that attract attention because of their significant economic and/or social impacts. Around the world, more and more megaprojects are being proposed and built, and the emerging boom in infrastructure expenditures may have a long way to go yet, a recent McKinsey Global Institute report estimated that USD$57 trillion will be required globally for infrastructure investment between 2013 and 2030 (MGI 2013: 1). The report argues strongly for improved project selection and governance.

The great majority of megaprojects are consistently completed late and over budget and, once completed, megaprojects often fail to meet their stated expectations. The best way to limit the total expenditure on projects delivered is by avoiding projects that are highly risky and unlikely to meet their time and cost estimates.

Many Australian public infrastructure projects are now in this category, major hospital PPP projects the New Royal Adelaide Hospital and the Royal North Shore Hospital are $1 billion plus projects, as were other recently completed toll road, tunnel, desalination plant and railway projects.

Flyvbjerg's characteristics of major projects (2009) are:

- Such projects are inherently risky due to long planning horizons and complex interfaces between the project and its context, and between different parts of the project;
- Decision making, policy, and planning are often multi-actor processes with conflicting interests;
- Often the project's scope or ambition level change significantly;
- Statistical evidence shows that such unplanned events are often unaccounted for, so budget and time contingencies are inadequate;
- As a consequence, misinformation about costs, benefits, and risks is the norm, including the business case;
- The result is cost overruns and/or benefit shortfalls with a majority of projects.

The first study of megaprojects was done by Merrow (1988) in the US on 52 private sector projects – refineries, oil, transport, nuclear. It looked at time and cost performance and the factors that drive the outcomes on these projects. Most met performance and schedule goals, but only four came in on budget with an average cost growth of 88%. He concluded "The larger the project, the more important is the accuracy of early estimates." (1988: 80). This remains the key issue.

Danish researcher Bent Flyvbjerg and his colleagues coined the phrase "Survival of the unfittest" to describe projects that get approved and built despite their appalling economic and financial characteristics and outcomes. They studied the Channel Tunnel, the Great Belt link between Denmark and Europe and the Øresund link between Sweden and Europe in their book *Megaprojects and Risk* (2003). They also developed a database of major projects from around the world that initially focused on transport (roads, rail and bridges), but was extended to include water, power, oil and gas, IT, aerospace.

> From an economic point of view these projects should never have been built, at least not in the form they were. They survived because benefit-cost ratios presented to investors and legislators were hugely inflated, deliberately or not (2009: 348).

Other examples of projects with large cost overruns that seem to meet the criteria used by Flyvberg et. al. are: the Boston Big Dig, Denver Airport, the Millennium Dome, Scottish Parliament building, French TGV, Bangkok Skytrain, Calcutta and Copenhagen metros, and the Sydney Opera House.

However, it should also be noted that some of these projects have turned out well, despite their poor antecedents, including the Sydney Opera House and the Øresund link. Time is an important though unpredictable factor in all this, as the Sydney Opera House shows (no-one remembers the 1,200 per cent cost overrun today).

Flyvbjerg's three types of explanation for proceeding with projects that have little or no prospects of good performance are:

1. Technical: imperfect forecasting techniques, inadequate data, problems in predicting the future, inexperienced forecasters. A popular explanation, but not statistically supported by the distribution of errors in the project database.
2. Psychological: from Kahneman (and Tversky) Nobel Prize winning work on irrationality. His 'planning fallacy' is decisions based on delusional optimism that leads people to overestimate benefits and underestimate costs. There is a large body of experimental evidence for this sort of optimism bias.
3. Political-economic: strategic misrepresentation is an organisational and institutional explanation. Under scarce resources project promoters have an incentive to produce intentionally biased investment appraisals at the approvals stage, (thus underestimated costs + overestimated benefits = funding) and the projects that get funded are ones that look best on paper (i.e. have largest errors) not the best projects. However, these can be the worst, or unfittest projects.

It is well known that the future is uncertain, and an alternative theory of project selection under uncertainty is escalation, or the tendency to throw good money after bad. Uncertainty is an unmeasurable or truly unknown outcome, often unique, and this explanation allows for the original investment appraisal as honest, but overtaken by events. Large infrastructure projects are typically selected under conditions of uncertainty, not risk (which is identifiable and measurable):

- Cost and benefits are many years in future;
- They are large enough to change their economic environment, hence generate unintended consequences;
- Stakeholder action creates a dynamic context with the escalation of commitment driven by post hoc justification of earlier decisions.

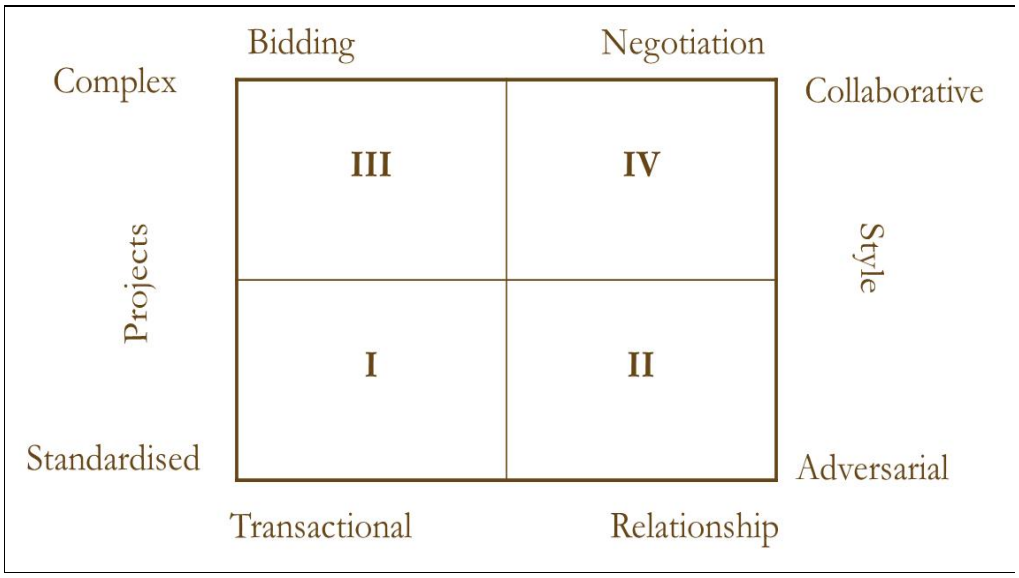
However, not all projects are megaprojects and the typology of major projects ranges from simple to complex. Often the challenge is to identify the right strategy for a project from the extensive range available these days.

One of the commonly used strategies used to deal with variety such as this is to develop a segmented approach. This would divide construction projects into a number of categories or segments and a specific procurement strategy or strategies would be applied to that category. An example of such an approach is:

- Standardised or commodity projects are low risk, with minimal technical requirements and can be delivered with selective tendering for a guaranteed maximum price, Projects such as conventional buildings, car parks, and straightforward redevelopment or refurbishment would be in this category;
- Buildings are typically suited to a design-build-maintain form of contract because these minimise life cycle costs and effectively allocate risk and responsibility;
- Design and engineering consultants could be on a prequalified shortlist under a framework agreement, or series of agreements based on the size of the projects, with getting onto a tender list dependent on past performance;
- Complex projects often require more collaborative implementation with early involvement by designers, contractors and suppliers. This would include projects with significant technical or software components, such as railway signalling;

- Large long-term infrastructure projects could be done with open-book contracts on a cost plus basis, with incentives, because costs are hard to predict over time.

Figure 1. Project Complexity and Procurement Strategies



Recommendation 1: That a segmented approach to major project procurement be applied, with appropriate procurement strategies for projects in the different categories or segments developed. This is based on the proposition that there is a best or most effective and appropriate procurement strategy for each project.

To reiterate, the most effective, and possibly the only way to significantly affect the outcome costs of major projects is to change the business model, by revising the procurement strategies and decision-making and implementation processes used on the basis of what is known about past projects' performance.

Data Drives Project Selection

The key to better decision-making is better information about the proposed project, and this is done by using the performance of previous projects to inform those decisions. This has become common practice for major capital projects in the private sector. For example, Independent Project Analysis (IPA) was established by Merrow in 1987, and provides a project research capability for the process and extraction industries. Their database in 2012 had 318 megaprojects, of about 11,000 projects from the oil, chemical, pharmaceutical, consumer products, forest products, and minerals industries (Merrow et al. 2012). From this database companies can compare their project with other, similar projects, across a wide range of performance indicators.

Flyvbjerg et al. (2009) proposed a similar solution to optimism bias called Reference Class Forecasting (RFC). This works the same way as the IPA database, but their database is mainly composed of public infrastructure projects, many in the transport sector. RFC involves:

- Identification of a relevant reference class of past, similar projects;
- Establishing a probability distribution for the reference class;
- Comparing the specific project with the reference class distribution.

In decision-making under uncertainty errors of judgment are often systematic and predictable rather than random, manifesting bias rather than confusion, so RFC may limit bias or strategic misrepresentation just by following a procedure and gathering relevant data for a panel of projects to be used in the comparisons. The experience with traffic forecasts for recent tunnel PPPs in NSW and Queensland would argue for an approach like this.

If more realistic, and therefore more accurate, time and cost estimates were given for major projects when they are approved there would be fewer recriminations about project performance and less incentive to find scapegoats on completion, which is typically over budget and schedule. There would be fewer of the common accusations of poor productivity, management failures or poor planning, thus lessening the atmosphere of acrimony that often surrounds major projects in their latter stages. This would also encourage more transparency about the project's performance, in both the delivery and operational stages, particularly by public officials.

Recommendation 2: That Reference Class Forecasting or a similar process be applied to all proposed projects, and that an Australian database of public infrastructure projects be developed and maintained. All public infrastructure projects' time and cost estimates should be compared and evaluated against previous project outcomes and performance.

Infrastructure Australia has started down this path with their benchmarks for major project procurement, and could be responsible for the database. To get sufficient numbers many projects need to be included, and this requires State government cooperation on data for their projects. International comparisons of construction projects are fraught with difficulty, but if included the conversion should be done using purchasing price parity. With a database of suitable projects panels can be set up and Data Envelope Analysis applied to find relative performance levels and benchmarks for a wide variety of projects and project stages.

There is a key distinction that has to be clearly made here, between controlling project costs once a project gets commenced and avoiding expenditure on unviable projects that are approved as a consequence of poor decision-making. Project selection is the subject of Recommendation 2, and project delivery is addressed below.

Implementation Processes

Since the Latham (1992) and Egan (1998) reports in the UK, the construction industry reform movement in the UK, Australia and elsewhere has been largely based on the proposition that the cause of most problems in the industry is the commercial relationship between the client and contractors on the one hand, and contractors' organization of their supply chain on the other. This approach made contractual relationships the focus of much of the reform agenda to improve industry performance, and over the last two decades has produced sophisticated procurement strategies such as framework agreements and alliance contracting.

Following the argument made above about getting the project decision right, Merrow (2011) argues that the owner's job is to specify the right project and the contractor's job is to deliver a project as specified, on time and on budget. In his view contractual relationships are more tactics than strategy, and cannot address any fundamental weaknesses in the client's management of the project. This crucial point is now widely recognised by private sector clients/owners of large engineering projects. For example, Shell and BP have recently established project academies because they have come to understand that significant risk transfer from clients to contractors is structurally impossible.

This approach to the client's responsibility for project initiation and definition requires larger and more capable client teams, and cannot be achieved through employing consultants or interim employees. The BAA procurement strategy for Heathrow Terminal 5 is often used as an example of a client taking on project management and accepting the responsibility for risk (Gil 2009). This was a megaproject that did complete on time and on budget.

The reason the public sector should invest in the development of its capabilities as a client of construction sector is because the public client agencies/departments/enterprises are in reality holding the risk of their projects and the performance of those projects, and they need to be able to manage that risk. While risk can be managed by contracts, it cannot magically be made to disappear with contracts.

However, it would not be cost effective for all these public clients to individually develop such capabilities, so a coordinating office or agency is necessary. Also, it is difficult for public clients to maintain their project teams over time as staff rotate and move on, yet this continuity is an essential component of good project performance. These client teams are responsible for the process of project shaping and front-end definition, the prerequisite for creating value for the client.

Recommendation 3: That the Commonwealth Government establish a major construction projects office with responsibility for recruiting the key members of a project client team for each major project at the early stage of project development. The team members are employed for the duration of the project.

The client team could also investigate procurement strategies and systems that move away from the transactional win-lose paradigm typically found in the construction industry toward more relational approaches. While not always applicable, there are opportunities for partial win-win outcomes in construction that reflect the ongoing nature of tendering and procurement as the same participants repeatedly encounter each other (Cox 2004a and b).

Strategies such as alliance or relational contracts are not excluded by the recommendations given here. Neither are other tools and techniques such as lean construction or lean project management, supply chain management and prefabrication or design for construction. The most effective procurement strategy should be applied to each project, and that developing that strategy is the responsibility of the client.

The cost of the client project management team is not an added extra to the project. This can be carried by the contractor and included in the project budget, where it is not explicit and may or may not be a reasonable amount, or it can be paid directly by the client. The task is essential and has to be funded regardless of the mechanism.

Further, by taking responsibility for recruitment of the project team the client can control the quality of the team and the work they do. Successful projects are the result of good project management

but there is a limit to the number and availability of good project managers. A program of public infrastructure projects also offers the opportunity for training of project managers.

Unbundling Design and Construction

While there is some support for design and construct procurement of buildings and social infrastructure from Australian school and hospital PPPs, there is less for physical infrastructure. This is probably due to the buildability issues found in complex buildings with many services, like hospitals, or the emphasis on maintenance costs with schools. Infrastructure projects, however, require extensive engineering and design work to be done.

Using trends in the private sector again as an example, Merrow (2011) argues the best form of project delivery is what he calls 'mixed': hiring engineering design contractors on a reimbursable contract and construction contractors on a separate fixed price contract. The evidence from the IPA database is that this is the most effective form of project organization for the process and extractive industries that he database mainly cover. It is essentially traditional construction procurement, where consultants are appointed to do the design and a competitive tender is held for one or more contractors to execute the works on site against a complete design.

There are a number of advantages with this strategy of unbundling design and construction for public infrastructure projects. Firstly, breaking a project into smaller, sequential contracts spreads the cost out over time, and does not incur and accrue interest costs on finance for design work (as in a PPP).

Secondly, it makes quality control easier and more effective, by being focused on each stage, an important risk management tool. Separating the design stage will also improve opportunities for consultation with the community and stakeholders.

Thirdly, completion of design and documentation before tendering reduces contractor risk and therefore the total project cost. In particular, having the site investigation complete removes one of the biggest risk factors in a project and this alone can substantially reduce costs. Management of the interaction between designers and contractors is done by the client team, which also takes responsibility for overall project management.

Recommendation 4: That design and construction work be contracted separately to spread the cost over time and reduce project costs and risks. Design and documentation should be complete before tendering the works to lower contractor risk and project costs.

Fourth, this approach will allow more intelligent sequencing of public infrastructure projects. There are significant capacity constraints in the engineering construction sector, as the recent experience of cost blowouts and schedule slippage with major resource projects has shown. As the design work is completed for a project it can be added to a pipeline of projects and released for tender when conditions are appropriate, or when other projects are approaching completion. As projects of different scale are prepared they can be put to tender or held back as Further, potential suppliers and contractors can use the pipeline of projects to build capacity in the knowledge that there will be ongoing opportunities for their staff and equipment.

Recommendation 5: Better sequencing of projects will reduce costs by avoiding capacity constraints. As design work is completed for a project it can be added to a pipeline of projects. Potential suppliers and contractors can use the pipeline of projects to build capacity in the knowledge there will be ongoing opportunities for their staff and equipment.

Incentives and Target Costing

Target cost contracts have been widely used in manufacturing for many years, and are not a new idea in engineering construction either. A common version is a 'cost plus incentive fee' agreement that has incentives for the contractor to reduce construction cost. They are well known in the UK, where the National Economic Development Office (NEDO) defined them as:

> target cost contracts specify a best estimate of the cost of the work to be carried out. During the course of the work, the initial target cost will be adjusted by agreement between the client or his nominated representative and the contractor to allow for any changes to the original specification. Difference between target cost and actual cost at completion are shared between the parties to the contract (NEDO, 1982).

The distinguishing feature of these contracts is the pain share/gain share mechanism. With a cost overrun it is assumed that it is to some extent due to contractor inefficiency, and the client should not bear all the extra expense. However, when a contractor completes a job below target cost there should be a reward for efficient management, the sharing ratio is agreed in advance and varies from 50:50 to complex systems of benefit and risk sharing.

A target cost contract is made between the client and the contractor after the tender, with the financial incentives intended to build a trusting relationship. The agreement and the pain share/ gain share mechanism is between the client and the contractor and does not include designers, subcontractors and suppliers. This is the weakness in these contracts, as under a fixed-price or maximum price contract the contractor can attempt to shift risks further down the supply chain to maximise their profit. However, with separated design and construction this is less of an issue.

Incentives would be the most effective way to reduce cost, improve project delivery and increase productivity on public infrastructure projects. Wherever better performance is sought the use of incentives is the best approach, and target cost contracts will provide the right incentives.

With target cost contracts it would be a possible to include subcontractors and suppliers in the agreement, and contractor and subcontractor employees in the gain share agreement. This would be an effective productivity incentive that would work through the entire supply chain and could be incorporated into the projects contracts and industrial relations agreements.

The incentives for improved project delivery and increased productivity possible with target cost contracts should be incorporated into project contracts and industrial relations agreements. Contractors can increase their profit by delivering projects at a cost less than the estimate, or contractors profit can reduce if the estimate was optimistic. The pain or gain is traditionally shared with the client. Gil (2009) details the evolution through three stages of the Commercial Agreement used on Heathrow Terminal 5 and the effectiveness, despite it's complexity, of the incentive scheme used on that project.

Rather than the public sector client sharing in the gain from improved performance, this share could be used to provide an incentive for increased productivity through the supply chain, and thus allow

subcontractors and employees to benefit. It seems obvious that if subcontractors and suppliers, and their employees, were included in the gain share agreement they would have an incentive to increase their productivity. It would also change the dynamics around negotiation of project agreements.

Recommendation 6: If reduced cost, improved project delivery and increased productivity are sought, target cost contracts will provide the right incentives. As well as contractors, it would be possible to include subcontractors and suppliers and their employees in the gain share agreement. This would be an effective productivity incentive that would work through the entire supply chain and could be incorporated into the project's contracts and industrial relations agreements.

Market Access

Competition is typically limited in procurement for major public infrastructure projects. There are several reasons for this: tendering and procurement costs can be excessive; high technical complexity is sometimes an important factor; senior staff time, experience and availability can be an issue; and for contractors outside the first tier access to finance for large projects can be difficult (KPMG 2010). While outside the scope of this submission, it is worth noting that it is taking much longer than anticipated for the pre-financial crisis project finance market to re-emerge as a market for project bonds.

Design of the tender process is significant, because there is a trade-off between the degree of competition in competitive bidding and the size of contracts. Larger projects can benefit from economies of scale and scope, which are generally expected to be found in large-scale public infrastructure projects. On the other hand, large contracts will restrict competition if potential bidders are constrained by technical skills and access to other resources (de Valence 2010).

Therefore, dividing a large project into a number of contracts or sub-projects is an important policy decision. Having the design complete before tendering facilitates the division of a large project into a number of sub-projects, for example a road or highway project can be done as a number of individual stages that link up on completion. This then reduces the barriers to entry for tenderers and creates opportunities for local contractors to tender for work, particularly in regional areas. Increased competition for work should contain costs as well.

Recommendation 7: Where possible, a project should be broken into sub-projects to reduce barriers to entry for tenderers, create opportunities for local contractors, and increase competition.

This can also reduce project costs by removing a layer of management on projects where a large contractor wins the work then subcontracts it out to smaller local contractors, but charges a project management fee. This is not uncommon, but with a client team responsible for project management it is not necessary.

References

Cox, A .2004a. Business relationship alignment: On the commensurability of value capture and mutuality in buyer and supplier exchange. *Supply Chain Management: An International Journal*, 9 (5), 410-20.

Cox, A. 2004b. The art of the possible: Relationship management in power regimes and supply chains. *Supply Chain Management: An International Journal*, 9 (5),346-56.

de Valence, G. 2010. Innovation, Procurement and Construction Industry Development, *Australian Journal of Construction Economics and Building*, 10:4, pp. 50-59.

Egan, J. 1998. *Rethinking Construction*. Department of the Environment, Transport and the Regions: London. Available from DETR web site.

Flyvbjerg, B., Bruzelius, N. and Rothengatter, W. 2003. *Megaprojects and Risk: An Anatomy of Ambition*, Cambridge, Cambridge University Press.

Flyvbjerg, B., Garbuto, M. and Lovallo, D. 2009. Delusion and deception in large infrastructure projects: Two models for explaining and preventing executive disaster, *California Management Review*, Vol. 51, No. 2. 170-95.

Gil, N. 2009. Developing Cooperative project client-supplier relationships: How much to expect from relational contracts, *California Management Review*, Winter. 144-169.

KPMG 2010. *PPP Procurement: Review of Barriers to Competition and Efficiency in the Procurement of PPP Project*s, KPMG Corporate Finance (Aust.), Infrastructure Australia.

Latham, M. 1994. *Constructing The Team*. Final Report of the Government/Industry, Review of Procurement and Contractual Arrangements in the UK Construction Industry. HMSO: London.

McKinsey Global Institute 2013. *Infrastructure Productivity: How to save $1trillion a year*. http://www.mckinsey.com/insights/engineering_construction/infrastructure_productivity

Merrow, E., Sonnhalter, K., Somanchi**,** R. and Griffith, A. 2009. *Productivity in the UK Engineering Construction Industry*, United Kingdom Department for Business, Innovation and Skills. http://ipaglobal.com/News-Room/Publications

Merrow, E.W. 1988. *Understanding the Outcomes of Megaprojects,* RAND Corporation, Santa Monica.

Merrow. E.W. 2011. *Industrial Megaprojects: Concepts, Strategies and Practices for Success*, Wiley, Hoboken, NJ.

NEDO (National Economic Development Office) 1982. *Target Cost Contracts: A Worthwhile Alternative*, Civil Engineering Economic Development Committee, London, National Economic Development Office.

PricewaterhouseCoopers 2008. *Review of Major Infrastructure Delivery*, Infrastructure Australia.