# Productivity Commission
# Inquiry into Infrastructure Costs

The Terms of Reference for the inquiry provide scope for the Productivity Commission to analyse and report on the following.

1. The current funding and financing of infrastructure in Australia, by the Commonwealth, the States and the private sector.
2. The rationale, role and objectives of alternative funding and financing mechanisms.
3. The review of the cost structure of major infrastructure projects in Australia; especially, where infrastructure project costs have increased considerably compared to other countries.
4. The ways to improve decision-making and implementation processes to facilitate a reduction in the cost of public infrastructure projects.
5. Any 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.

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The conceptual framework of Lean Construction forms the basis of this submission. This is a perspective in which service providers seek to "provide clients with the value they seek, without waste". This is essentially a focus on the efficient supply of effective services.

In the Lean Construction perspective, improvement in outputs (time, cost, quality etc.) is achieved by focussing the supply chain on the efficient application of resources and technology. This is achieved through a focus on improvement driven by operational performance measurement which exposes error and inefficiency.

In response to the terms of reference, I will primarily address the last three points; particularly, the challenges that this sector faces in delivering value for money by driving productivity improvement through innovation and greater efficiency.

The greatest single challenge facing the construction sector in Australia today is a widespread loss of productivity when compared to other sectors in our economy and to the construction sectors of competing economies. To reverse the slide in efficiency it is essential to focus on a few strategic initiatives and high level measures which will act as performance drivers. Effort should be focused on developing:

- Benchmarking time and cost on all public projects;
- Process performance benchmarks to enable informed buyer decision making;
- Contract forms which encourage early multidisciplinary involvement in planning, encourage innovation and manage risk through a collaborative engagement with the supply chain.

If this framework is suitably devised, it will focus industry on improving its performance and provide buyers with the information they need for informed decision making. It will also encourage better collaboration and risk management.

Firstly, I outline what I consider to be some of the root causes of the productivity challenge in the sector; then, I draw a thumbnail sketch of developments in procurement and their drivers during the

recent past; and, finally, I suggest some remedial measures necessary to redress this loss of competitiveness.

## The root causes of poor productivity

It is my opinion that the root causes of the productivity challenge facing the Australian construction sector are to be found in the following.

1. *Contracts rarely motivate real collaboration.* Collaboration between the parties in the supply chain is weak and this undermines close coordination and inhibits innovation.
2. *Work planning and delivery at the task level is unreliable.* Research has shown that often almost half of all tasks in a project (design and construction) are not undertaken as and when promised.
3. *The costs of errors are not measured.* High levels of error are accepted in all aspects of performance (safety, quality and production) as normal.
4. *Risk is passed down the line regardless of whether that is a sound course of action or not.* Often risk is contractually passed down to a level where it cannot be effectively managed or mitigated.
5. *High levels of error-repetition illustrate a culture of error acceptance rather than learning.* For example, the typical weekly safety walk on a construction project produces a very similar list of hazards each week; these are created by the same parties week after week. "Closing out" does not involve avoiding future reoccurrence; merely, fixing the current instance. The same applies to quality and productivity errors. The high cost of rework is not measured but simply absorbed, and hence there is little drive to reduce rework.

## The procurement challenge

Large constructed projects are among the most complex of human endeavours. Recently these projects have become even larger and more complex. They involve high levels of risk arising from technical complexity, size, the many parties involved, latent conditions, lack of clarity in the client's perception of the project and the long time-span of projects from inception to completion. Inevitably, construction projects are undertaken under intense time and cost pressure.

Such large, complex projects can only be efficiently procured through large scale and close collaboration between the client and the supply chain and within the supply chain. This collaboration is essential for optimal solution generation in design as well as for the effective integration of work and the solution of problems which inevitable arise during project delivery.

## Evolution in procurement practices

### Pre 1990

Three decades ago most projects were designed by professional designers and then put to tender. While that process invested in planning at the front end of projects, the process had a significant weakness: the designers were not sufficiently in touch with changing constructability issues and construction costs and hence impractical designs added to cost.

Contracting in this era was primarily on the basis of fixed price, and contractors used broad, cost driven supply chains. Clients sought to define, as best they could, their requirements prior to going to tender. Elaborate contractual documents were designed to shift as much risk as possible to the contractor; and, particularly on complex projects, resolution of contractual issues through legal process often absorbed considerable effort and ultimately added significantly to project costs. Although cost and time overruns were relatively common, the additional costs of client project management and litigation were rarely measured as a project cost.

Government clients did not trust their supply chain; nor did they know them well. Many client representatives were happy to know little about the real risks of design and construction.

**Pre 2000**

In the 1990s government clients pushed their suppliers to operate under international standards in relation to quality, environment and safety. In relation to quality (ISO9000), it is fair to say that much of the construction sector at first saw the challenge as a marketing one, to get on the tender list, rather than an efficiency challenge to eliminate the wasteful expenditures which resulted from avoidable error in construction. While quality systems have matured and improved, high quality failure costs continue to dog the sector (Marosszeky et al 2005, UNSW Report).

Safety legislation also began to have an impact. In an endeavour to drive improvement in safety, government legislation which focused on the culpability of senior management tended to drive bureaucratic, defensive behaviour among contractors, often adding more cost than value to their management systems. In some instances safety documentation on projects became so excessive that it was counterproductive. It added little value other than hoped for legal protection should something go wrong.

The modern profession of project management emerged in this period, wresting management responsibility from architects. However, the new profession did little to drive innovation and efficiency; rather, it saw its charter as improving the quality of project administration.

Increased regulation and the stewardship of project managers saw a very significant increase in bureaucratic management processes but did little for efficiency or innovation--the real drivers of productivity growth. Productivity continued to decline and error levels remained largely unchanged.

**Pre 2014**

A major trend in the early 2000s was the relatively widespread adoption of Alliancing in the delivery of infrastructure projects. This saw a shift to collaboration between public sector clients and their supply chains. It is noteworthy, however, that this had limited application in the building construction sector.

Initially this approach was intended for complex and fast projects such as the North Side Sewerage project for the 2000 Sydney Olympics. Here a significant part of the overall project risk could not be defined upfront and the timeframe was extremely tight. This project was delivered through an Alliance in just over 3 years; whereas, using traditional approaches it would have taken more than 6 years.

Alliancing became more widely adopted as a relatively easy way for under-resourced clients to procure projects. Under this process the project team was motivated by a system of bonuses and penalties within a framework of KRA's and KPIs. In program alliances these motivational frameworks were regularly modified, though generally it was found that this process did not drive continuous improvement; and, in many cases, after a settling period of say the first 6 to 9 months, bonuses became relatively easy to obtain (Marosszeky et al 2010, Evans & Peck Report).

While large and experienced client organisation such as the major state main road, rail and water authorities were able to leverage Alliancing to significant benefit, unfortunately, it became the default procurement option for many less experienced public clients. Since 2009, state treasuries, led by Victoria, have pushed back against Alliancing, regarding it as uncompetitive. However, in doing so, they have wrongly decried collaboration. There is now a significant risk that lessons learned through the era of Alliancing may be lost.

Alliancing has had a number of clear benefits for experienced clients. They got to know their suppliers far better and they got to know the technical and management risks and challenges faced by the supply chain on large complex projects. They also learned to experience and appreciate the benefits of close collaboration with their supply chains and within the supply chain itself creating increased potential for innovation.

**Some underlying drivers of client thinking over the past three decades**

In the intervening decades the procurement practices of clients have been influenced by number of underlying trends.

1. Public sector clients sought to have the private sector finance projects so that the cost would not affect public debt levels.
2. Clients have shown a preference for placing all responsibility and, hence, risk with one party as this simplifies the contractual relationship. Therefore, constructors have increasingly become the single source providers of both design and construction through Design and Construct (D&C) contracts.
3. Clients have subsequently sought to align the interests of the supply chain with their own, hence, the move beyond D&C to Build Own Operate (BOO) and Build Own Operate and Transfer (BOOT) type contracts. Under these and similar schemes the design and construct team is also focused on the operational costs of what is built. With the additional feature of private sector funding, Private Public Partnerships PPPs are consistent with this thinking.

Throughout the period in review, clients have sought to shift more responsibility downstream onto the supply chain and invest less in upfront planning; whether that planning is done by or for the client. In general terms, clients have sought to shift the front-end cost into the tender process and to shift all risk onto the supply chain. This has had adverse consequences.

The recent introduction of Early Contractor Involvement (ECI) and Early Tender Involvement (ETI) are a welcome and productive reversal of this trend. Under these agreements contractors are engaged at the critical stage of project definition to provide their expertise. Then, the project is tendered in a separate second stage, where price competition becomes a key differentiator.

**The modern construction supply chain**

The supply chain's response to client risk shedding has been to pass risk down the line of the supply chain, often to a level where the parties can do the least to manage it.

Construction work on most projects is delivered through a pyramid subcontract structure. The actual work is generally done by *sub*-subcontractors who provide equipment and small teams of labour. At this level there is a very limited capacity to coordinate or innovate. Both head contractors and the major subcontractors enter into fixed-price agreements with all their suppliers; therefore, investment in the crucial task of innovation and productivity improvement is constrained and confined to the scope of work that falls within a single party's contract.

While these changes have taken place, a few key underlying trends continue to challenge productivity growth.

- *Pushback against Collaboration*. In the last three years, driven by treasury attitudes towards Alliancing, many government budget agencies have turned their back on "collaboration". Among some, collaboration is seen as a dirty word, yet collaboration is critical to innovation and productivity gain. Collaboration and competition are not mutually exclusive.
- *The bureaucratisation of the management of the construction process* has shifted the focus of engineers from the organisation of the work itself to the organisation of management systems. In many construction projects, this has led to an organisational weakness between the engineers, the supervisors and the foremen: one group plans the work while the other builds it.
- *Contracts are awarded largely on the basis of competitive market pricing* and often procured on the basis of inadequate documentation. Yet it is more efficient to operate under a system in which value for money and competitive tension are maintained by effective price benchmarking and cost targeting. Of course, to do this one has to know what projects should cost, and this requires investment in cost and time benchmarking information on the part of the clients.
- *The fragmentation of the supply chain* has increased to a level where the benefits of specialisation are often outweighed by the barriers to process integration, innovation and control across the supply chain.
- *Quality has not improved and remains a major cost impost*. This has continued because the cost is not measured and errors are widely accepted as unavoidable.
- *Cost certainty rather than maximising efficiency and value creation drives procurement.* This has meant that, often, no- one is looking at productivity or innovation across the supply chain, each party is left to its own best endeavours as long as price is guaranteed.
- *Work planning and work delivery is often unreliable.* In both design and construction almost half of all work is not undertaken as and when promised. In making commitments to each other at planning meetings the parties often use language loosely and hide behind ambiguity as a justification for promises not being kept.

These trends have worked against productivity improvement and innovation. Clients and their supply chains have adopted cost certainty as their business driver at the expense of productivity improvement and value creation.

## A lean based critique of construction in Australia

The Japanese approach to manufacturing which was developed in the post war period is called Lean Production[1] and can be most simply defined as "creating customer value without waste". The movement drives continuous improvement through performance measurement. However, for Lean thinking to be of value to our sector, parties must know who their customers are and what their needs are. They must also be aware of waste in the construction process and have a desire to reduce it.

The construction sector faces the following significant challenges in seeking to achieve these common sense goals.

- *Many supply chain members have poor recognition of who their key customers are*. For example, construction subcontractors do not view the following trade contractor that builds on their work as a 'customer', nor do designers view the fabricators and erectors as their 'customers'. Because of these dysfunctional relationships, innovation and collaboration suffer.
- *High levels of waste are accepted as business as usual.* For example, defect costs which are significant (>5% of project value during the construction period) are not measured but simply carried forward as a business cost. The high cost of defect liability insurance claims and subsequent rework is unidentified. Post contract rework and the associated legal costs are not merely noteworthy but have, in the past decade, contributed to the demise of a number of significant mid-tier construction companies.
- *Process performance measurement is barely used in the sector;* yet, performance measurement is the key driver of process improvement. For example, rework costs will only be reduced once they are measured. Similarly, productivity will only improve in real terms once productivity is measured.
- Efficiency is most challenged at the interfaces between parties in the supply chain. Yet, because today we contract on the basis of a highly fragmented, fixed-price supply chain, we have been unable to focus on a broad range of fundamental performance measures which could give insight into areas of inefficiency. These measures include issues such as equipment productivity; cost of damage to materials and finishes during construction; rework costs; project productivity; project duration; enterprise productivity; task productivity; the benefits of standardisation of details and components; planning reliability and the reliability of task execution, to name just a few. These are the types of process performance measures through which an organisation and an industry can focus on driving continuous improvement and innovation.

### The cost impact of unreliable behaviour

Recent thinking in the Lean Construction community has reconceptualised the delivery of projects through multiparty arrangements in terms of work being completed through a network of

[1] Womack and Jones; The Machine that Changed the World, LEI, 1990

commitments rather than the traditional view of projects as a schedule of tasks. This shifts the focus to collaboration and reliable behaviour.

The reliability of commitments (weekly plan reliability) both in design and construction was identified in the mid-1990s in the US as a key indicator of process efficiency in construction. Measurements of Plan Percent Complete (PPC) around the world, including in Australia, indicate that as a broad average, about 40% of commitments made at the weekly planning level are not fulfilled. Chronic unreliability is costly.

For example, on a recent research study in the US on the Whiting Oil Refinery in Indiana a study of the relationship between plan reliability (% of planned tasks completed within the planning week) and labour productivity showed that an increase in weekly plan reliability from 50% to 80% correlated with a 29% improvement in labour productivity. It was also found that work packages with a 50% plan reliability were completed on budget, indicating that labour productivity rates at the budget stage tacitly assume that about half of what is planned at the weekly level will not be undertaken as planned.

As every project is costed on the historic 'business as usual' (BAU) productivity rate, which is based on a BAU plan reliability of 50-60% at the weekly plan level, we cost our inefficiency (plan unreliability) into our budgets for future projects. Under this system, as long as we meet our budgets there is no motivation for improvement.

**How performance based policy approaches were adopted in Singapore**

Fundamentally, Lean thinking based processes are those which use performance measurement to drive an improvement in process outcomes. This can be at the project, enterprise or national level.

The following examples from the construction policy settings of the Singapore Building & Construction Authority (BCA) have been selected to provide some insight into the way in which a performance measurement based approach can drive industry reform[2].

a) BCA raised construction quality in the residential housing sector through the development and implementation of a quality performance measurement framework (CONQAS). Organisations with a track record of high quality construction were given preference over those that did not. Information about CONQAS is available through iTunes, and private sector clients today use the framework to rate their constructors and drive up quality in their developments. The system has been in use since 1989 and Singaporean quality is now being benchmarked internationally.
b) BCA decided to improve the constructability of buildings in 2001 and to encourage industry change it developed the Constructability Appraisal System (CAS) as a part of a policy framework designed to drive the increased use of prefabrication in buildings; and, thereby, increase onsite labour productivity. An organisation's constructability score forms a part of the Singaporean tender evaluation process when it awards tenders for new projects.
c) More recently the BCA has developed training and recognition in the area of productivity improvement through a training program. It also introduced its Construction Productivity Awards program in 2010, designed to recognise achievements in productivity improvement across the construction supply chain.

[2] http://www.bca.gov.sg/index.html

d) Since mid-2013, all building applications for buildings with a floor area greater than 20,000 square metres are in a mandated Building Information Modelling (BIM) format. This strategy was introduced over a number of years in order to drive industry towards the early adoption of BIM, because of the broader benefits the technology offers in terms of improved communication, improved solution development, error avoidance and construction prototyping. These are all benefits that Lean Construction endorses and seeks to engender.
e) Construction labour productivity figures are published by the Singapore Department of Statistics (DOS) as well as the productivity indicator adopted by the Economic Strategies Committee (ESC) as a benchmark. These are measured in terms of Value-Added per Employee ( VAP). VAP can be defined as the wealth created by a firm or an industry per employee.

While there is evidence that most mandated measures are gamed by some members of any group (e.g. LTIs are under-reported by having injured staff doing 'training' while they recover), there is also evidence of significant improvement in the areas being measured. Just as safety has improved in the Australian industry, quality and productivity have improved in the Singaporean industry as a result of the measurement based strategies adopted there.

**Lean Construction at UK Highways Agency (UKHA)**

Since 2009, when the Global Financial Crisis created the need for greater efficiency, the UKHA has been strategically moving its supply chain towards adopting Lean Construction (production) techniques. Its support for this initiative can be seen on its website[3] where a Deployment Handbook, Deployment Guides, a Lean Maturity Assessment Toolkit (HALMAT) and standard forms and templates describe the processes developed for use by the Highways Agency supply chain.

In his 2013 New Year Message, Derek Drysdale, the UKHA Divisional Director Lean Improvement, reported[4] on the achievements of the first three years in some detail, including £90 million in recognised savings to date. He also announced that the agency itself was planning to deploy Lean practices within its own operations in 2013. The agency also reported a return on investment of 20:1 through its Lean initiative.

An overview of the UKHA Lean journey can be seen in the presentation that Sue Housley, a HA Lean Technical Manager gave at the 2012 Lean in Public Infrastructure Conference[5] in Tampere, Finland. The five pillars of the UKHA Lean supply chain initiative used to drive continuous improvement in project delivery are:

i. collaborative planning;
ii. visual management;
iii. problem solving;
iv. benefits realisation; and
v. knowledge transfer.

[3] http://www.highways.gov.uk/specialist-information/lean-improvement/
[4] http://assets.highways.gov.uk/specialist-information/lean-announcements/New%20year%20message%202013%20Derek%20Drysdale.pdf
[5] http://assets.highways.gov.uk/specialist-information/lean-announcements/Integrated%20Teams%20in%20the%20Highways%20Agency%20Sue%20Housley.pdf

In addition to providing a framework, tools, processes and guides for process improvement, the UKHA—HALMAT framework is used as a basis for assessing organisational maturity and providing direction for ongoing productivity improvement to the supply chain at the enterprise level.

**UK Cabinet office**

Recently the UK government recognised the declining performance and competitiveness of its national construction industry. In February 2012, the UK Cabinet Office established for the first time a joint Data and Benchmarking Task Group [6] to:

> *Help deliver the objectives of the Government's Construction Strategy and Infrastructure UK Cost Review Implementation Plan. The plan supports new procurement models being trialled as part of the delivery of the Government Construction Strategy. The strategy is to be effected without impacting either whole of life value or the long-term health of the construction industry. The strategy will establish common approaches for measuring costs and value across the Government estate and embed a benchmarking methodology going forward.*
>
> *Key features to be included are to:*
> - *establish the approach in the form of common minimum requirements;*
> - *adopt common cost summary formats and mandate this for clients and industry;*
> - *identify against common cost summary where differences occur between different sectors;*
> - *establish additional cost data collection requirements, e.g. pre-contract and whole of life costs;*
> - *identify standard project descriptions or categories that can be common to any data set to assist in identifying comparable project types used across sectors, including the private sector for benchmarking purposes;*
> - *identify elements which need further detailed cost analysis;*
> - *identify approaches to data collection which allow benchmarking of procurement approaches, e.g. Design& Build, Frameworks and Cost Led Procurement;*
> - *establish a method for assessing the effect of legislative, Technical changes or government polices (e.g. BIM) that could be expected to flow through to construction costs;*
> - *identify possible private sector comparators of building types worthy of future consideration to identify cost differences; and*
> - *meet government departments on a regular basis and discuss current trends in costs, contractor intelligence and new work practices.*

The UK cabinet office has set Departmental Cost Reduction Trajectories. Each department is to report the progress being made in delivering the Government's Construction Industry Strategy target of achieving 15 – 20% reduction in cost by the end of the current parliament. The trajectory profiles will be subject to each department's individual capital programs. The UK government set the following headline objectives for the construction industry:

- *lower costs by 33%;*
- *achieve faster project delivery by 50%;*
- *lower emissions in the built environment by 50%; and*
- *achieve a 50% reduction in the trade gap between total exports and imports for construction products and materials.*

[6] https://www.gov.uk/government/publications/government-construction-strategy

These quantifiable goals set by the UK Government are distinctive. They are understandable, measurable and capable of progressive accountable implementation. The UK's approaches for measuring costs and value across the government estate, and embedding a common benchmarking methodology would also be appropriate for Australia as a longer-term goal, say by 2023.

**The UK cost benefit targets are achievable.** There is evidence across projects completed in Australia that 15 - 20% of project capital cost can be avoided. Improved productivity in the form proposed in this submission involves much more than cost of labour inputs. The duration of projects adds to the cost of expensive site overheads and financing costs. Many of the current procurement methods employed in Australia create dysfunctional relationships across the supply chain, avoidable risk transfers, duplications and waste. Improved utilization of construction resources and time can deliver enormous recurrent savings to the economy. If a 15% cost reduction could be achieved across the industry in Australia by 2023, the recurrent cost of projects nationally could be reduced by at least $25.0 billion.

## Policy Proposals for improving productivity in the Australian Construction Sector

1. A first step towards driving productivity improvement would be the development of a high level performance assessment framework to compare key aspects of project delivery on all public sector projects and programs. This would provide a basis for driving continuous improvement and for sharing best practices in key delivery aspects of construction. High level measures of time, cost and labour productivity should be included to give visibility to overall outcomes. Performance improvement targets such as those adopted in the UK strategy (and discussed in the previous section) should be adopted for the next decade.

2. Process reliability issues such as time from Practical Completion to 100% defect free completion, project development and approval timeframes, cost of rework, reliability of suppliers and cost of safety accidents would provide stimuli for performance improvement among contractors and regulators.

3. Government client organisations should be encouraged to adopt procurement strategies that encourage Lean processes improvement within their supply chains along similar lines to those developed by the UK Highways Agency, and more broadly across the UK Government sector.

4. The development of a construction productivity improvement specialisation should be encouraged and Construction Productivity Improvement awards should be established to recognise outstanding efficiency in project delivery.

5. From the client down, procurement reform is required to encourage collaboration, innovation and continuous improvement at every level of the supply chain. The current standard forms of contract in widespread use are designed to shed risk and, thereby, stifle collaboration.

6. Repeat clients, particularly in the public sector, need to develop skills in the effective use of data and management information so that they can define the realistic cost and duration of projects. Possessing such information will assist them to function as 'intelligent clients' and drive out waste and drive up efficiency in their projects.

Finally, it is worthwhile to look at the entire UK Government's construction strategy since 2011[7]. This strategy shows the genuine commitment of the government and all it agencies to industry productivity improvement and all that that requires. The UK Government has recognised the need for and potential of the Lean production based approach to industry reform.

The Australian construction sector needs the leadership of clear government policy executed through its public clients to drive benefits for the national economy and the industry.

**Submission by Marton Marosszeky**

Marton Marosszeky is the co-founder and National Chair of the Lean Construction Institute of Australia. He is also the principal of Marosszeky Associates and consults in Lean Construction implementation. For a number of years he led the Lean Construction consulting service line within Evans and Peck. Marton was the Multiplex Professor of Construction Innovation in the School of Civil and Environmental Engineering at UNSW (2002-06) and co-author of the management text, *Total Quality in the Construction Supply Chain* (Elsevier, 2006).

He has 40 years' experience in the construction sector, initially, in road construction and maintenance, then in structural design and building construction and, finally, concurrently as an academic and a consultant. His research and consulting while at UNSW centred on the areas of construction process improvement and infrastructure durability performance. In recent years he has consulted in business process improvement in design and construction to the infrastructure, building and energy, both in Canada and Australia.

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[7] https://www.gov.uk/government/publications/government-construction-strategy