

Submission to: Department of Employment, Skills, Small and Family Business - Skilled Migration Occupation Lists Consultation

Introducing Roads Australia

Roads Australia (hereafter “RA”) is the peak body for roads within an integrated transport system, representing an industry that contributes \$207 billion annually to the economy and supports 1.3 million jobs. RA brings industry, government and communities together to lead the evolution of Australia’s roads, integrated transport and mobility.

Submission

RA welcomes the opportunity to make a submission to the *Department of Employment, Skills, Small and Family Business (hereafter “the Department”) consultation on updates to the Skilled Migration Occupation Lists*.

Overview

As part of RA’s Strategic Plan¹, we have agreed on five strategic policy priorities, one of which focuses on capacity. In support of this work, in 2019 RA commissioned BIS Oxford Economics to prepare a report quantifying the Australian road network’s economic and social value.² The Report highlights the significant volume of current and future infrastructure projects, with tens of billions of dollars to be spent each year over the next decade and beyond. With this unprecedented spend, it is clear that there is currently a significant gap between demand from government for such infrastructure projects and the Industry’s ability to supply.

Skills Shortages

One of the short- to mid-term manifestations of this issue is a skills shortage, with governments and the university and TAFE sectors struggling to train a sufficient pool of skilled workers to help re-align supply and demand. As such, the transport and infrastructure sector now face skills shortages across the board, with this issue

¹ The RA Strategic Plan is available [here](#).

² The RA BIS Oxford Economics Report is available [here](#), and is also appended to this submission.

highlighted in several RA workshops and roundtable discussions which took place in 2019.³

In several of these workshops, which included government stakeholders and immigration experts from PwC, the participants also highlighted the fact that whilst the Temporary Skills Shortage (TSS) visa system was an improvement on the old system, it still presented RA members with a range of challenges. This included issues such as extensive delays during the visa process e.g. performing reference checks. As such, RA would welcome the opportunity to work with the relevant Government Departments to discuss ways in which the process could be further improved. This includes understanding ways in which RA members could be more proactive in engaging with any available support resources.

Considering the above issues, RA members understand there is no short-term fix to this problem, which will only be solved by the industry, government and education sectors working closely together on sustainable measures to meet demand.

Roads Australia members, in particular our many members involved in engineering design, project management and infrastructure construction, are strongly supportive of the continuation of the Commonwealth's skilled migration programs.

Skilled Migration Occupation Lists

In response to the consultation process on the Department's Skilled Migration Occupation Lists Traffic Light Bulletin, RA has been supporting the efforts of other industry association stakeholders, the *Australian Constructors Association (hereafter "ACA")*⁴ and *Consult Australia (hereafter "CA")*⁵, to gather relevant data on our industry skill requirements.

As there is a substantial overlap between RA's membership base and that of CA and the ACA, RA will not be providing separate data for this particular submission. However, having had confidential access to those submissions, we have included an annex to highlight those areas that are not currently on the Department's lists as well as to provide supporting commentary on the proposed movement on those lists.

³ This included a roundtable discussion in November 2019 between leading industry stakeholders and Corey Hannett, Director-General, Major Transport Infrastructure Authority (MTIA) and Mr Jason Loos, Deputy Secretary Commercial Division, Department of Treasury and Finance Victoria.

⁴ Australian Constructors Association (ACA): <https://www.constructors.com.au/>

⁵ Consult Australia (CA): <https://www.consultaustralia.com.au/>

Looking ahead, RA is planning to do further skills analysis with its members later in 2020, work that will be complementary to that of CA and the ACA, which RA will supply as part of future submissions.

In the meantime, RA commends the work of the *Construction Industry Leadership Forum (CILF)*⁶ which commissioned *BIS Oxford Economics* to develop a policy options paper on the Overseas Recruitment of Skilled Labour. RA has been given confidential access to this paper and notes that the data gathered is a core element of the ACA submission.

The CILF Report highlights that occupational listing has been a major challenge for industry participants, a finding that was highlighted and confirmed in RA's industry roundtables last year. Suggested solutions that will be expanded upon in the ACA submission include:

- Recognising that construction 'mega-projects' are often completed over five to ten years, and that occupations on the STSOL hired specifically for these projects should have pathways to permanent residency.
- Improving industry consultation and communication around the composition of the STSOL, MTSSL and ROL, particularly for the construction industry.
- Reviewing the ANZSCO occupation codes so that they better reflect the evolving roles and occupations in the construction industry.⁷

*Roads Australia supports and commends the information to be provided in the submission by the **Australian Constructors Association** to the Skilled Migration Occupation Lists consultation process.*

The BIS Oxford Economics *NSW Construction Delivery Assessment – Capability and Capacity* Report prepared for Infrastructure NSW gave early focus to the rapidly developing construction skill shortages in that State.⁸ This was a key input to the development of the Infrastructure NSW *Ten Point Commitment to the Construction Sector Action Plan*⁹ and the NSW State Infrastructure Strategy.¹⁰

⁶ Construction Industry Leadership Forum (CILF) information is available [here](#).

⁷ We note that the ACA have highlighted a number of roles not currently on the short- or long-term lists which do not currently have ANZSCO occupation codes (refer to submission annex).

⁸ This BIS Oxford Economics Report is also appended to this submission.

⁹ The Ten Point Commitment to the Construction Sector Action Plan is available [here](#).

¹⁰ The NSW State Infrastructure Strategy is available [here](#).

The Report highlighted emerging shortages of labour in a range of occupations including steel fixers, quantity surveyors, fixed plant operators, designers, environmental engineers, trucking monitors, road designers, tunnellers, site managers, electrical subcontractors, community stakeholder experts, CAT operators, geotech technicians, fabricators, form-workers, scanners and glazers.

As RA's engineering, design and project management members have related skill shortages to deal with, we are also strongly supportive of the survey work being carried out by CA in preparation for their submission. We are confident that this work will address the requirements of RA members in the short- to mid-term.

*Roads Australia supports and commends the information to be provided in the submission by **Consult Australia** to the Skilled Migration Occupation Lists consultation process.*

Next Steps

As outlined in the current RA Strategic Plan, a key imperative is to continue to collaborate with industry and government to promote and build the skills and capabilities required for future infrastructure delivery.

In making this supportive submission, RA commits to continue our work with members, and related parties, to refine our knowledge of skill gaps and needs that can assist in future refinements of the Skilled Migration Occupation Lists by the Department.

In addition to gathering further skills data from our members, RA will be holding a major procurement reform strategy workshop in Melbourne on 5th March 2020, where leading industry and government stakeholders will further develop strategies to address capacity and capability issues, including skills shortages, facing the industry.

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Annex

Consult Australia (CA) Submission

Having had access to CA's draft submission, and taking account of the common membership in relation to those operating in the construction (infrastructure) industry, RA supports CA's commentary and proposals regarding movements between the MLTSSL, STSOL and ROL.

In particular, RA supports CA's comments and analysis regarding Geologists (ANZSCO code 234411) given the increase in demand for geoscience services being driven by significant new investments in road tunnels in Melbourne and Sydney. RA therefore supports CA's position that there is a case to move this profession to the MLTSSL, rather than moving it from STSOL to the ROL.

Australian Constructors Association (ACA) Submission

Having had access to ACA's draft submission, and taking account of the common membership in relation to those operating in the construction (infrastructure) industry, RA supports the ACA's commentary about the composition of the existing short and long term lists, which already accommodate many roles for which a skills shortage exists.

Furthermore, RA supports the ACA's commentary and specific proposals regarding skill shortages not on the Department's short- or long-term lists as follows:

- Design manager/engineer
- Concreter
- Vinyl layer
- Form worker
- Tunnelling Machine Operator
- Supervisor/Foremen
- Steel Fixer

RA understands that this data has been gathered from multiple reputable sources including reports from EY, BIS Oxford Economics, and a CILF internal industry survey utilising input from ACA member organisations (many of which are common to RA).

ATTACHMENTS

The value that roads deliver to the Australian community



\$206.8bn

Added economic value
(GDP) due to roads

1.3m

Jobs
supported

\$22.7bn

of road projects funded
in next 5 years

\$25.4bn

in the following
5 years

We know roads are a vital part of all our lives and a huge enabler of economic activity in Australia.

But how can we measure the positive contribution they make to the community?

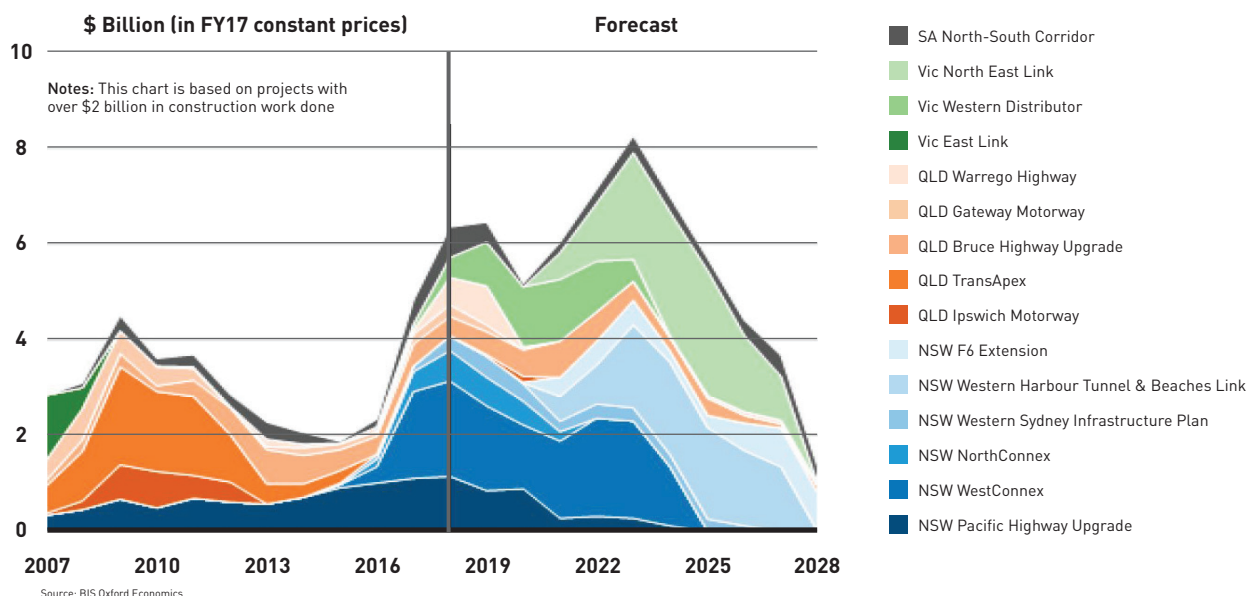
New research, commissioned by Roads Australia, seeks to quantify this massive economic and social value. It finds that activity associated with the roads industry contributes **\$206.8 billion per year** worth of economic value to the economy and supports almost **1.3 million jobs**.

This impact is set to grow over the coming decade, with **\$22.7 billion of roads projects funded** in the next five years, and \$25.4 billion for the five years after that.

Australia's vast road network is a vital social and economic resource that underpins Australia's economic activity and makes our lives better in ways that are as powerful as they are often invisible. Roads are an essential part of an integrated transport system, which includes the safe and efficient movement of people and freight by all modes of transport.

Research undertaken by BIS Oxford Economics for RA quantifies the massive benefits that roads provide and will continue to provide across the economy and community well into the coming decade.

F1. Major Road Projects above A\$2bn

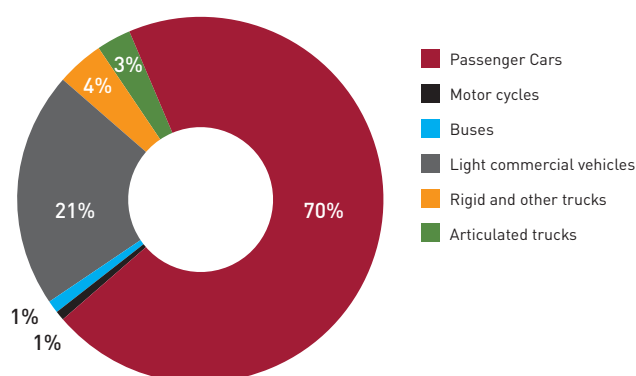


The value that roads deliver to the Australian community

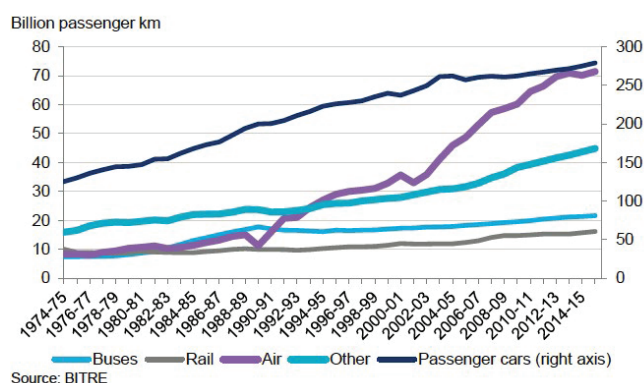
Included in this analysis are positives provided by roads that are not generally well understood in the community.

This includes enabling improved health outcomes and other essential services; facilitating low emission transport options like light rail and bike paths (which often use the road network) and providing people with the option of improving quality of life by living away from major cities.

F2. Mode share of road kilometres, 2017/18



F3. Australian domestic passenger task, by mode of transport



In terms of the broader value, the report uses Economic Impact Analysis to estimate that the roads industry underpins employment to the tune of **1,295,000 full time equivalent positions and contributes \$206.8 billion a year to the economy.**

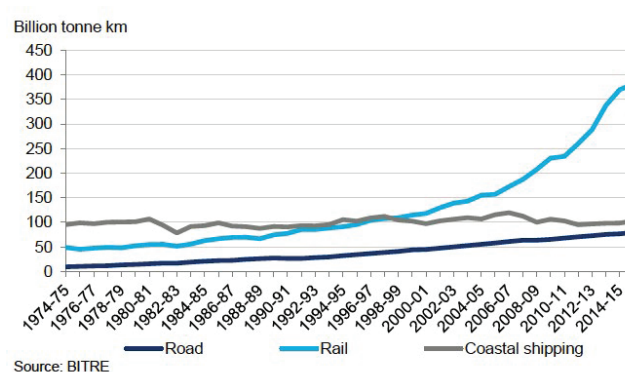
Or to put it another way, **one dollar out of every \$25 generated in the economy spins out of the roads industry.** And when the broader freight logistics industry is factored in, that figure doubles.

The report indicates these benefits will continue to flow over the next decade, with a boom in road projects providing much needed stimulus to an economy that is currently beset by low business investment and sluggish consumer spending.

The transport infrastructure pipeline is worth \$22.7 billion over the years to 2022/23 and \$25.4 billion over the following five years.

This investment in the road network will help accommodate a growing population and increased urban density, and help make our cities more productive and less congested.

F4. Australian domestic freight task, by mode of transport



THE ECONOMIC IMPACT OF AUSTRALIA'S ROADS

SEPTEMBER 2019

BIS Oxford Economics

Effective March 1 2017, UK-headquartered **Oxford Economics**, one of the world's foremost independent global advisory firms acquired a controlling stake in **BIS Shrapnel**. BIS Shrapnel, which had been in continuous operation since July 1, 1964 as a completely independent Australian owned firm with no vested interests of any kind — providing industry research, analysis and forecasting services — merged with the Australian operation of Oxford Economics. The new organisation is now known as BIS Oxford Economics.

Oxford Economics was founded in 1981 as a commercial venture with Oxford University's business college to provide economic forecasting and modelling to UK companies and financial institutions expanding abroad. Since then, we have become one of the world's foremost independent global advisory firms, providing reports, forecasts and analytical tools on 200 countries, 100 industrial sectors and over 3,000 cities. Our best-of-class global economic and industry models and analytical tools give us an unparalleled ability to forecast external market trends and assess their economic, social and business impact.

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Date of publication

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EXECUTIVE SUMMARY

\$133.0 bn

Total economic welfare
value of road availability

*Derived using a community
welfare approach, based on
willingness to pay for roads*

Australian roads ensure the smooth-running of our daily lives while making a valuable contribution to our economy. The roads network is also an integral part of Australia's multi-modal transport network, although the extent of this is not commonly understood. Indeed, the road network's economic and social value is comprised of a wide range of benefits, with examples including:

- Flexibility in facilitating additional (marginal) journeys that would not have otherwise been taken for business or pleasure
- Enabling improved health outcomes and other essential services
- Connecting rail, sea, air and inland port facilities to markets

Other benefits include enabling light rail services and active transport. Light rail services are only able to offer low emission connectivity, place-making and agglomeration benefits due to the road network on which they operate. Similarly, the proliferation of bike networks and the health and environmental benefits they provide are also facilitated by the road network.

Roads also have a so-called "option value", since they provide people with the option to reside away from a major population hub with a rail network and to travel when the rail network is not operating. This option value offers up both gains in productivity, and social welfare ("consumer surplus").

"Roads make a valuable contribution to Australia's economic growth, jobs and social welfare. This ultimately enhances the well-being and livelihoods of all Australians."

\$206.8 bn

Added economic value
(GDP) due to roads

*Based on economic impact
approach using input-output
analysis and satellite data*



In 2017/18 it is estimated there were 529,000 persons directly employed on a full-time equivalent¹ (FTE) basis in the roads industry, of which 313,000 were in the for-hire industry and 215,000 were in-house. This includes both workers involved in the physical transportation of people or goods and workers that directly support these operations.

The roads industry is also a major contributor to economic activity. In 2017/18, the roads industry was directly responsible for around 4 per cent of Australian gross value-added, of which 2.5 per cent was accounted for by the in-house roads industry.

The total economic value added associated with the roads industry was estimated at \$206.8 bn in 2017/18 prices, while total employment is estimated at 1,295,000 FTEs.

The roads industry share of gross value-added is comparable to that of the wholesale trade industry. The broader logistics industry which comprises the activity of the transport, postal and warehousing industry, as well as all in-house transport modes, makes up around 8 per cent of gross value-added.

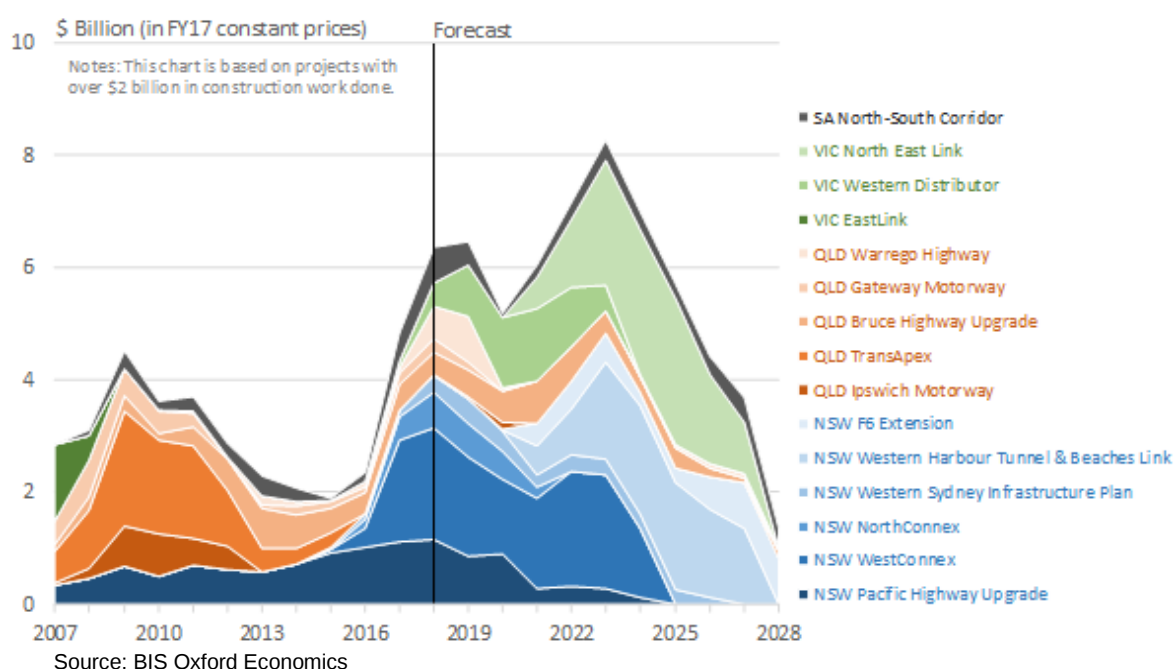
¹ A part-time worker is assumed as 50% of a full-time worker

The total road network coverage in Australia is estimated at 877,651km² of which 73 per cent is classified as local roads controlled by local governments.

Looking ahead, there is a strong pipeline of roads activity underway, with total roads, highways and subdivisions activity expected to average \$22.7bn over the five years to 2022/23 and \$25.4bn over the five years to 2027/28 (in 2016/17 prices).

In the short term, this activity will provide a significant fillip to employment and activity at a time when business investment and consumer spending are sluggish. In the longer run, the increase in the road network will help accommodate a growing population, increased urban density and support the modal-shift required to make our cities more productive.

Major Road Projects above A\$2bn



In terms of the road network's contribution to economic activity, the for-hire industry is counted as part of the transport, postal and warehousing industry division (Division I) in the National Accounts. However, in-house activities by industries (for all transport modes) are not currently separately identified.

Two well-established and robust approaches were used to undertake analysis into the economic value of the road network:

1. **Economic impact (input-output) analysis**, which involves estimating the road network's contribution to *economic activity (growth)* and *employment*. This approach uses the Transport Satellite Account data³ published by ABS as a basis for determining GDP contributions. Indirect effects are also included, relating to employment and activity levels required by suppliers to

² The Bureau of Infrastructure, Transport and Regional Economics (BTIRE) Statistical Yearbook 2018

³ Australian Bureau of Statistics (2018), Cat. No. 5270.0

support the current level of roads activity. Meanwhile, induced effects relate to demand from higher household income due to this related employment.

2. **Economic welfare analysis**, which is focussed on “consumer surplus”: the benefit that the community receives due to proposed road developments. Technically speaking, consumer surplus measures the (net) willingness to pay for goods and services, after allowing for commodity cost. A welfare approach can also allow for the estimation of “externalities” (or third-party effects) which arise even when no goods or services are directly traded.

The results from these distinctive approaches are summarised in Figure 1.

Fig. 1. Value of roads, 2017/18

Economic impact approach	Value
<i>Economic value</i>	<i>\$billion</i>
For-hire roads industry	79.9
In-house roads industry	126.9
Total economic value	206.8
<i>Employment</i>	<i>000 persons</i>
For-hire roads industry	737
In-house roads industry	558
Total employment	1,295
Economic welfare approach	Value
<i>Consumer surplus</i>	<i>\$billion</i>
Passenger car and motorcycle	86.5
Road freight	41.4
Bus	3.2
Sub-total consumer surplus	131.1
Option value (bus only)	1.9
Total economic welfare value	133.0

Source: BIS Oxford Economics

Using alternative approaches gives a fuller picture of value, though it is important to note the distinctions between approaches. The input-output approach, for instance, considers employment and economic activity attributable to the roads industry (for-hire and in-house). It does not therefore cover roads trips made by households for either work or pleasure. The welfare approach on the other hand considers consumer surplus from across all road trip purposes. Thus, it does not consider the cost of journey time and other data limitations suggest that the welfare figure is likely to be conservative.

Crucially, the economic impact results obtained from each approach cannot be added to give a larger impact figure. This arises for several reasons: the bases of each analysis are not directly comparable; the approaches have different methodologies and assumptions; there is an indirect overlap in economic values; and this would result in an inflated figure subject to “double counting”. We therefore report each impact measure individually.

1. INTRODUCTION

1.1 BACKGROUND TO STUDY

BIS Oxford Economics has been engaged by Roads Australia to undertake analysis into the economic value of the road network.

The strategic importance of the road network in facilitating a multi-modal network are not well understood. The economic and social value of the road network includes its:

- 'Last mile' role in connecting rail, sea, air and inland port facilities to markets
- Flexibility in facilitating marginal journeys that would not have otherwise been taken for business
- Flexibility in facilitating marginal journeys that would not have otherwise been taken for pleasure
- Important enabling role for health and other essential services
- Agglomeration benefits and other wider economic benefits from overcoming imperfections in secondary markets
- Enabling of light rail, coach and bus services which are intrinsic to public transport provision
- Enabling of active transport including walking and cycling
- Providing connectivity to areas where rail is not feasible, including regional and remote communities

A road does not produce economic output by itself but is an input to economic activity. The marginal contribution of the road network to economic production varies by industry but is on the whole a comparatively small component.

1.2 AUSTRALIA'S ROAD NETWORK

The total road network coverage in Australia is estimated at 877,651km⁴ of which 73 per cent is classified as local roads controlled by local governments.

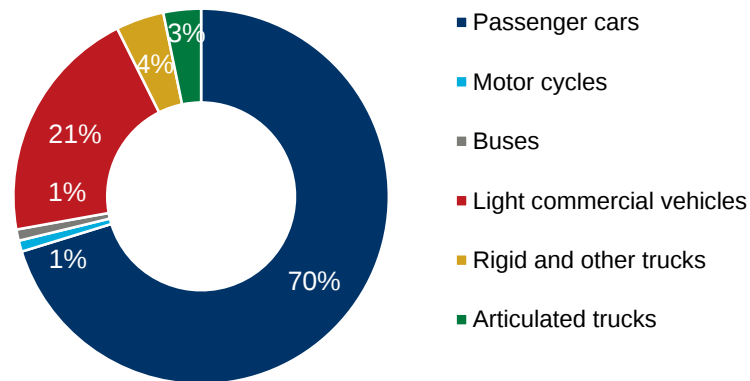
The Australian Bureau of Statistics annual Survey of Motor Vehicle Use, Australia (cat. no. 9208.0) reported 19 million motor vehicles in use for the 12 months ending 2017/18 with an average distance travelled of 13.4 thousand kilometres.

Passenger vehicles accounted for 70.5 per cent of total kilometres travelled and were mostly driven for personal and other use (54 per cent) followed by travel to and from work (25 per cent) and travel for business purposes (21 per cent).

⁴ The Bureau of Infrastructure, Transport and Regional Economics (BTIRE) Statistical Yearbook 2018

On average passenger vehicles were reported to have travelled 12.6 thousand kilometres. In comparison, articulated trucks were reported to have travelled 79.4 thousand kilometres on average.

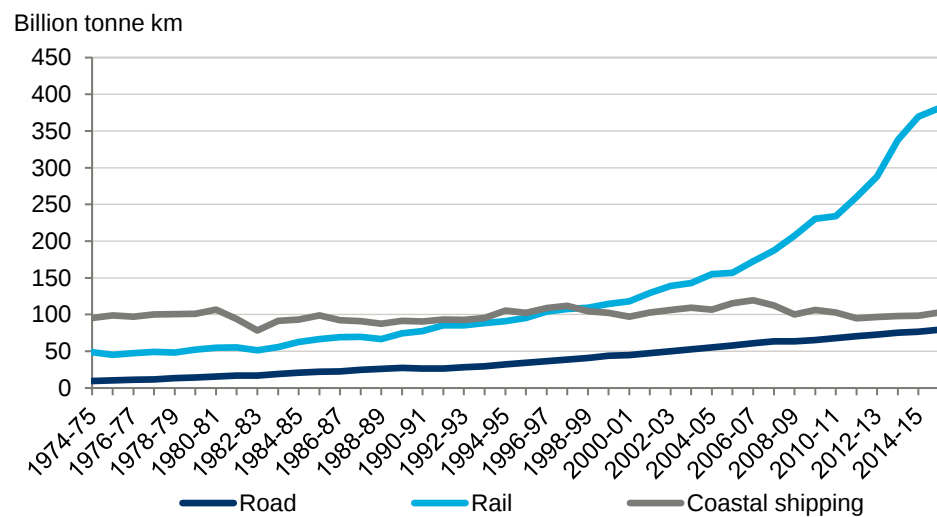
Fig. 2. Mode share of road kilometres, 2017/18



Source: BITRE Statistical Yearbook 2018

The rail network is responsible for moving the bulk of the domestic freight task, with its role have increased significantly over the past two decades. However, the road network plays a crucial role in facilitating this task by providing the 'last mile' role in connecting the freight to its markets.

Fig. 3. Australian domestic freight task, by mode of transport



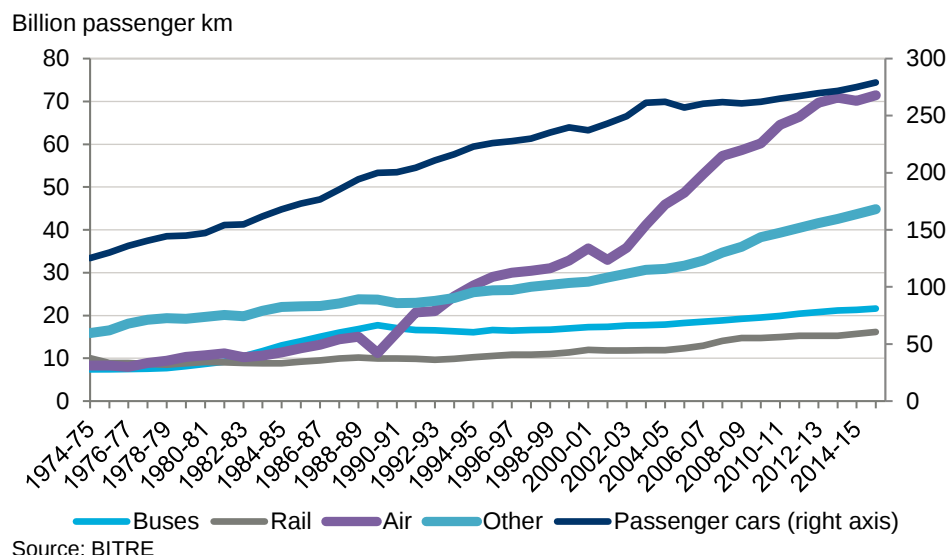
Source: BITRE

In contrast, the road network accounts for the bulk of the domestic passenger task (Fig 3). This includes passenger cars, buses and other non-business use of light commercial vehicles, motorcycles etc.

It should be noted that the transport task figures exclude the increasing use of active transport (e.g. bikes and walking) both for commuting and personal purposes, which are facilitated by the road network. Also, the increasing presence of light rail in major cities and its contribution to the passenger task

are counted under rail, although parts of the route – particularly through the cities – is facilitated by the road network.

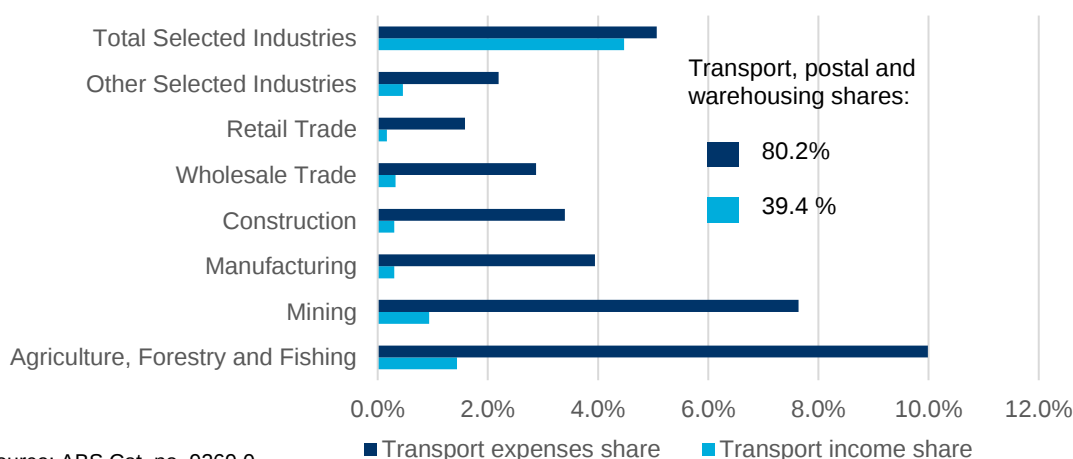
Fig. 4. Australian domestic passenger task, by mode of transport



In terms of the road network's contribution to economic activity, the for-hire industry is counted as part of the transport, postal and warehousing industry division (Division I) in the National Accounts. However, in-house activities by industries (for all transport modes) are not currently separately identified.

The ABS collected economic and financial data for transport activity undertaken by business during 2010-11⁵, which showed that for some non-transport industries transport expenses were a significant part of total expenses. Some non-transport industries also earned a small part of their income from transport activities.

Fig. 5. Business transport shares of activity, 2010-11



⁵ ABS, Business Transport Activity, Australia, 2010-11 (Cat. no. 9269.0). The data excludes entities classified as SISCASector 3 General Government except for Division D and entities classified to Division K

1.3 REPORT COVERAGE

While the focus of this report is on the contribution of the roads sector to economic activity and employment, one of the key benefits of roads is their ‘option value’. For instance, they provide people with the option to reside away from a major population hub with a rail network and they provide the option for people to travel when the rail network is not operating, i.e. at night and off-peak when there are fewer services. This option value offers up both productivity gains and increases in consumer surplus.

Other benefits which can be quantified include the benefits from enabling light rail services and active transport. Whether it is Sydney Light Rail or Brisbane Metro, these projects are only able to offer the low emission connectivity, place-making and agglomeration benefits they do as a result of the road network on which they operate. Similarly, the proliferation of bike networks and the health and environmental benefits they provide are also facilitated by the road network.

Additional research will be required to identify the extent to which the role that roads plays in facilitating the delivery of essential services and potential other social benefits.

We have adopted two approaches to estimating the economic impact of Australia’s road network. In Section 2 we consider an input-output based approach to estimating the road network’s contribution to economic activity and employment using as a basis the Transport Satellite Account published by the Australian Bureau of Statistics (cat. no. 5270.0). In Section 3 we consider an alternative way of measuring the value of the roads using a welfare economics approach.

2. AN INPUT-OUTPUT APPROACH

2.1 THE ABS EXPERIMENTAL TRANSPORT SATELLITE ACCOUNT

In October 2018, the Australian Bureau of Statistics released An Experimental Transport Satellite Account, 2010-11 to 2015-16 (cat. no. 5270.0). The Transport Satellite Account extends the focus of the core National Accounts to provide a more detailed analysis of transport activity. It includes both transport activities conducted on a for-hire basis (primarily undertaken by businesses classified under the transport, postal and warehousing industry division in the National Accounts) as well as activity conducted by businesses for their own use.

The ABS created four new 'in-house' transport industries, one each for road, rail, air and sea transportation. Using data relating to transport activity undertaken in non-transport industries from Business Transport Activity, Australia, 2010-11 (cat. no. 9269.0) and detailed employment information from the Labour Account, the ABS was able to build up a profile for the inputs and use of the four new in-house industries and adjust the supply-use tables incorporated in the National Accounts to explicitly capture the supply and use relating to in-house transport activity. Each of the new industries was assumed to only produce a single output, being in-house transport relating to the specific mode (road, rail, air, sea).

The Transport Satellite Account assumes that the in-house transport industries exhibit the same input structure and production functions as the equivalent for-hire industries. There are three components identified as inputs in the production of in-house road transport: transport related (e.g. fuel, repairs, parts and rental, registration and insurance costs); non-transport related (e.g. other intermediate inputs such as accounting and support services) and value-added components (e.g. taxes, gross operating surplus and compensation of employees).

In-house transport activity is assumed to either be for own use (ancillary production) or for supplying to another institutional unit (secondary production). It is assumed that all activity within the transport, postal and warehousing industry division is for-hire and no products from this industry have been used as input to the in-house industries.

We have used the Transport Satellite Account data as the base for estimating the current size of the roads industry (for-hire and in-house) and establishing an input-output approach to assessing the industry's broader impacts on economic activity and employment. See Appendix A for more details on approach used.

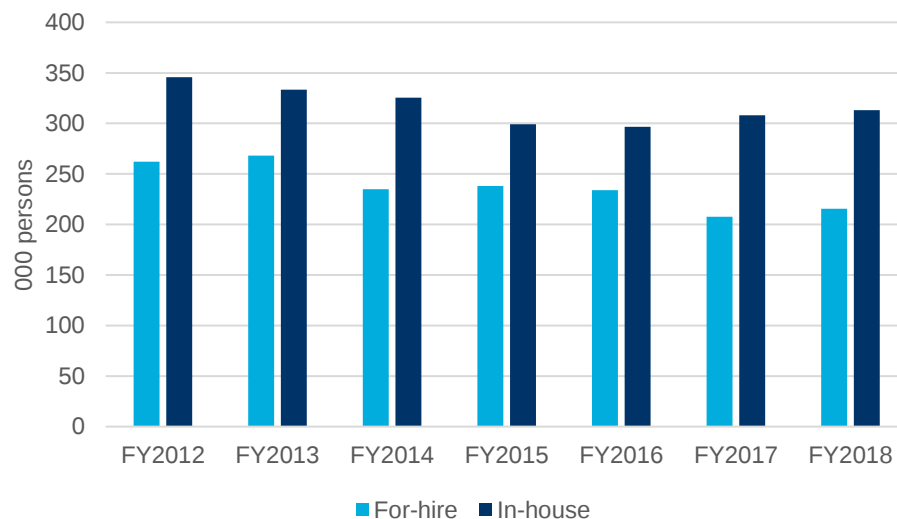
2.2 CURRENT SIZE OF THE ROADS INDUSTRY

In 2017/18 it is estimated there were 529,000 persons directly employed on a full-time equivalent⁶ (FTE) basis in the roads industry, of which 313,000 were in the for-hire industry and 215,000 were in-house. This includes both workers

⁶ A part-time worker is assumed as 50% of a full-time worker

involved in the physical transportation of people or goods and workers that directly support these operations.

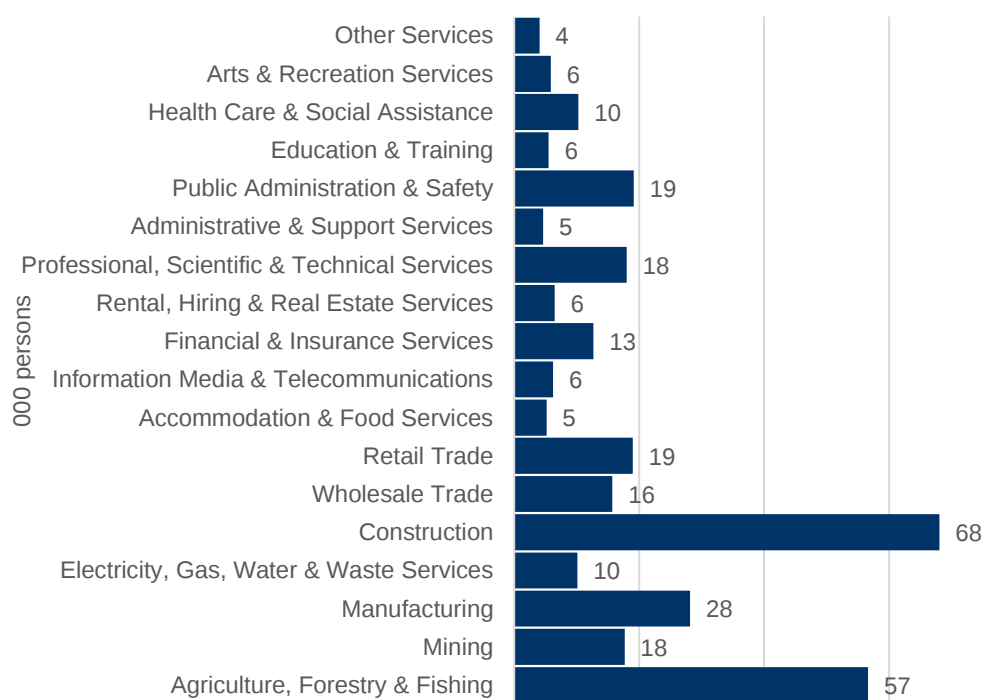
Fig. 6. Roads industry employment by sector (FTEs), 2017/18



Source: BISOE, ABS

For in-house road transportation, the largest employing industry is estimated to be construction with 68,000 full-time equivalent workers in 2017/18, followed by agriculture, forestry and fishing with 57,000 full-time equivalent workers. In total, the road transport industry (for-hire and in-house combined) was estimated to account for 5 per cent of all full-time equivalent employees in 2017/18.

Fig. 7. In-house road industry employment by industry (FTEs), 2017/18



Source: BISOE, ABS

The roads industry is also a major contributor to economic activity. Fig. 7 shows that the roads industry is currently directly responsible for around 4 per cent of Australian gross value-added, of which 2.5 per cent is accounted for by the in-house roads industry. This figure highlights the extent to which the value of the roads industry to gross value-added is underestimated by only considering the for-hire industry.

Fig. 8. Roads industry share of total gross value-added

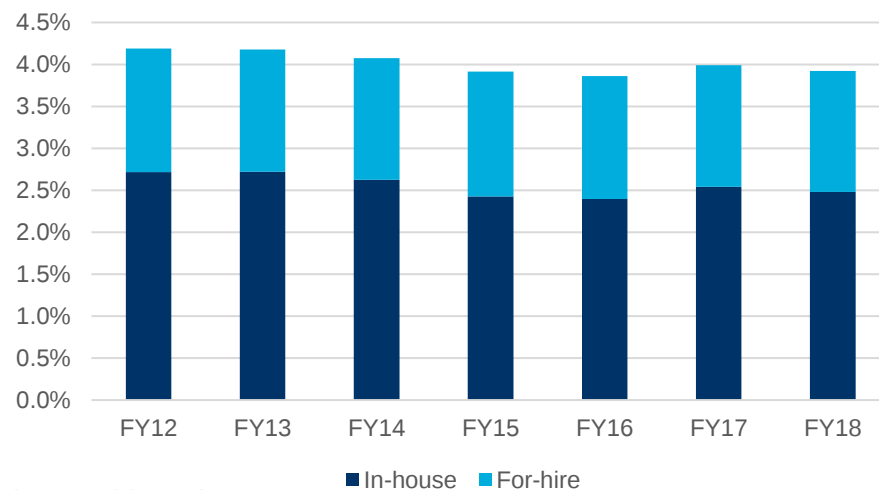
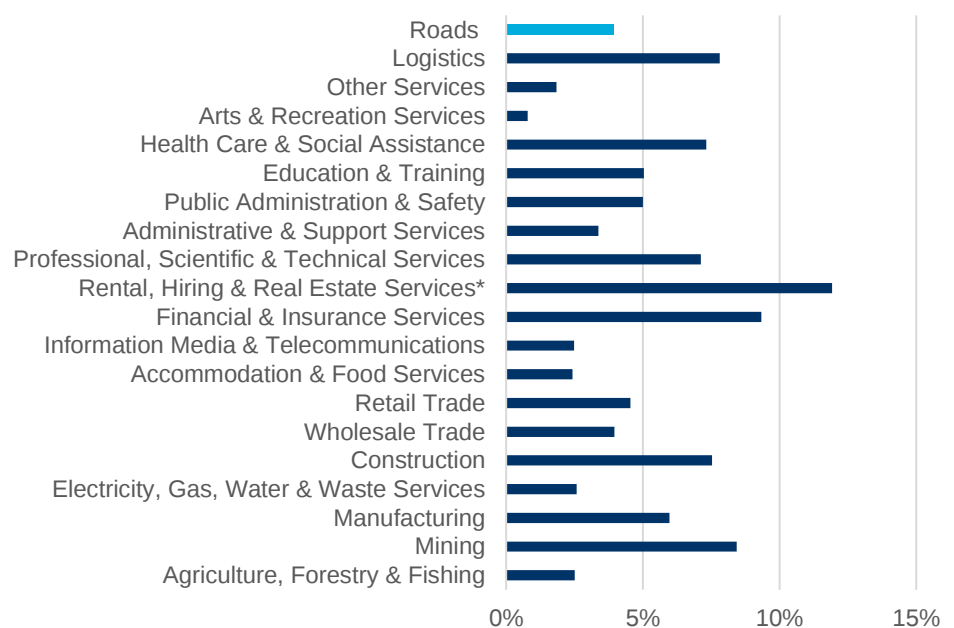


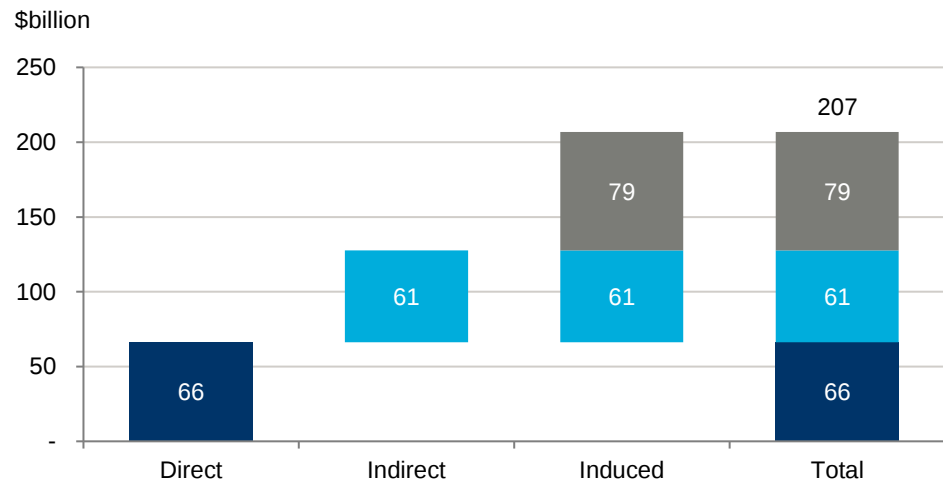
Fig. 8 shows that the roads industry share of gross value-added is comparable to that of the wholesale trade industry. The broader logistics industry which comprises the activity of the transport, postal and warehousing industry, as well as all in-house transport modes, makes up around 8 per cent of gross value added or contributes around the same to value added as both the mining and construction sectors.

Fig. 9. Roads industry share (%) of total gross value-added, 2017/18



In addition to the direct employment and value-added contribution of the roads industry, there are broader benefits to the economy, namely the indirect and induced effects. Indirect effects relate to the employment and activity levels required by suppliers to facilitate the current level of roads activity and induced effects relate to demand from increased household income associated with employment (direct and indirect), a proportion of which will be re-spent on goods and services.

Fig. 10. Total Economic Effects of Roads Industry, 2017/2018

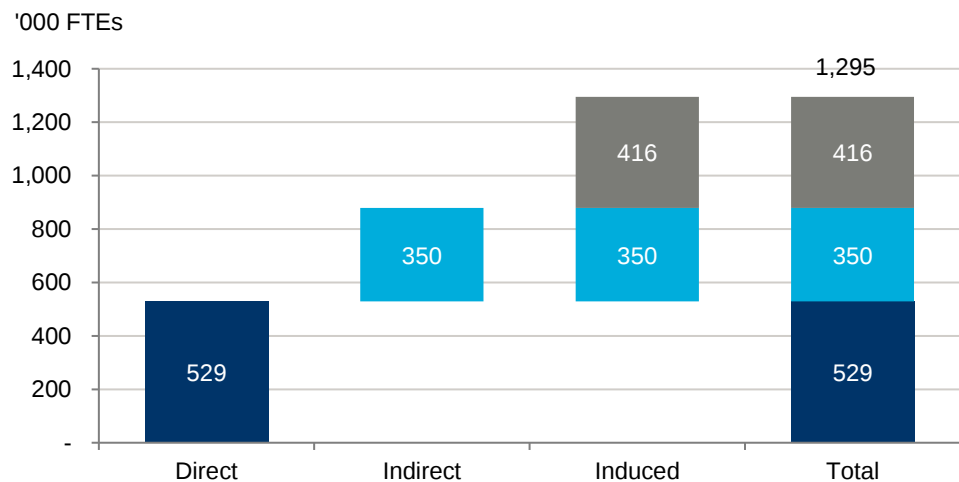


Source: BISOE, ABS

The total economic value of the roads industry in 2017/18 was valued at \$207 billion, comprising \$66billion in direct effects, \$61billion in indirect effects and \$79billion in induced effects.

The broader employment effects are illustrated in Fig. 7. In total it is estimated that the roads industry supports around 1.3 million jobs nationally.

Fig. 11. Total Employment Effects of Roads Industry, 2017/2018



Source: BISOE, ABS

The figures above relate to employment and economic activity attributable to the roads industry (for-hire and in-house). The Transport Satellite Account is linked to the supply-use tables incorporated in the National Accounts. It does not therefore cover roads trips made by households for either work or pleasure. The consumer surplus associated with private car trips is measured in the next section.

3. ECONOMIC WELFARE APPROACH

3.1 BACKGROUND

An alternative to the economic impact (or GDP focused) approach to the valuation of roads is the use of an economic welfare approach. Unlike a GDP focussed approach, an economic welfare approach is focussed on “consumer surplus”, as measured by the (net) willingness to pay for goods and services, after allowing for the cost of those commodities. In addition, a welfare approach can also allow for the estimation of “externalities” (or third-party effects) which arise even when no goods or services are directly traded. We discuss a key externality (option value) in a later section of this chapter.

3.2 CONSUMER SURPLUS

Consumer surplus is a key measure in assessing the value of commodities to society in an economic welfare sense. Consumer surplus refers to the difference between what users pay for a good or service and what they are willing to pay (WTP) for it. For example, a private road user may be WTP \$30 for a trip which only costs her \$10. Her consumer surplus is \$20. Consumer surplus therefore effectively represents a consumer’s “profit” – how much they gain from using a commodity in net terms. The sum of all of the consumer surpluses for individual users adds up to the total consumer surplus for society as a whole for road usage. This allows analysts to measure the net benefit to society from usage.

Consumer surplus (CS) can be estimated using a demand curve relating prices and quantities consumed and data on “price elasticities”⁷. Price elasticities measure the responsiveness of a good or service to a change in price. For example, a price elasticity of 1.0 for road usage means that a 1% increase in the road usage price is associated with a 1% decrease in demand for usage. An elasticity of 0.5 means a 1% increase in price is associated with a 0.5% decrease in demand (known as inelastic demand) while an elasticity of 1.5 means a 1% increase in price is associated with an 1.5% increase in usage.

In essence, a simplified formula for assessing the value of consumer surplus using a linear (straight line) demand curve is:

$$CS = (\text{Total cost} \times 0.5) / (\text{Elasticity})$$

While this is likely to form a lower bound value for consumer surplus, it is nonetheless useful in getting a first order approximation of the consumer surplus associated with a given good or service.⁸

⁷ For a technical discussion of this see Chapter 4 of Boardman, A., Greenberg, D., Vining, A. and Weimer, D., Cost Benefit Analysis: Concepts and Practice, Fifth Edition, 2018

⁸ Technically speaking, models specified in logs (e.g. double log models) can often yield closer approximations to industry demand curves and higher values for CS. However, analysis can “linearise the demand curve” in order to develop a lower bound estimate for consumer surplus values. This is effectively what has been done here.

In the case of valuing Australians' usage of the road network, this approach therefore requires assessing:

1. Total costs of usage
2. The elasticity of demand
3. The values of 1. and 2. for passenger cars and motorcycles, bus and road freight transport.

Note that in assessing item 1, we have limited our valuations to the estimated operating costs of road transport (e.g. fuel, operating costs, fares, fees etc.)⁹.

Estimations of the CS value of Australia road transport are described for private vehicles, bus transport and freight below.

Values have been expressed in 2018 dollars.

3.2.1 Passenger cars and motorcycles

Estimates of the cost of passenger car and motorcycle transport in Australia can be derived from multiplying:

1. the number of kilometers traveled per year; and
2. the average cost per kilometer

Item 1. is readily available from the ABS' *Survey of Motor Vehicle Use, Australia*.¹⁰ This indicates passenger car km travelled (179.8m km) and motorcycle km travelled (2.1m km) in the year up to 30 June 2018. This publication also disaggregates km travelled into urban and rural environments which is of use for the calculation below.

Estimates for the car costs per km were based on medium car operating costs provided in the *NSW Principles and Guidelines for Economic Appraisal 2018*, with an assumed average speed of 40 kph in urban areas and 90 kph in rural ones.¹¹ Separate operating costs for motorcycles were not available, however small car costs for these speeds were used as a proxy. While this may overestimate motorcycle operating costs to some extent, given the relatively small motorcycle km travelled this is unlikely to be material.

This process suggested operating cost of 46.9c/km for urban areas and 29.9/km for rural ones. The equivalent motorcycle costs were 0.34c/km for urban areas and 23.3c/km for rural ones. These estimates produced an average cost of 42.8c/km for passenger vehicles and motorcycles. Given a combined total of some 182million km travelled in the year to 30 June 2018, this implies total expenditure of \$77.9 billion.¹²

⁹ While it might be possible to extend the analysis to include the cost of journey time, this poses additional complications given the lack of data on typical journey times and comprehensive value of time elasticities. This also means that our assessments are likely to be relatively conservative.

¹⁰ ABS (2019) Survey of Motor Vehicle Use, Australia, 12 months ended 30 June 2018, Cat No. 9208.0

¹¹ Transport for NSW, (2018) Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives, June 2018. These are resource costs including fuel, oil, vehicle capital costs, repair and maintenance.

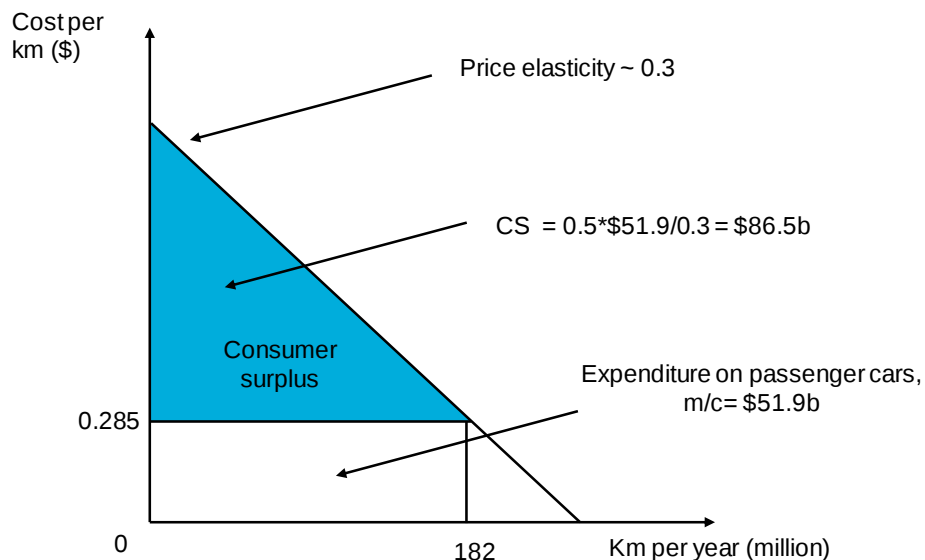
¹² This value is very similar to the figure of \$ 82.7 billion for 2015-16 for Australian household expenditure on owning and operating vehicles estimated in Bureau of Infrastructure, Transport and regional Economics (BITRE)

However, this figure includes vehicle capital costs, whereas our interest is in actual road usage activity. Accordingly, the percentage of vehicle purchase costs within total spending on passenger vehicles and motorcycles was estimated based on BITRE data.¹³ This was then excluded from the calculations.

This produced a revised operating cost figure (excluding capital costs) of \$51.9 billion. A vehicle operating cost elasticity of 0.3 was estimated, based on the extensive international work of Wallis and Schmidt.¹⁴

This produced an estimated consumer surplus of \$86.5 billion for passenger cars and motorcycles, based on the formula given above. The figure below provides a diagrammatic illustration of this figure.

Fig. 12. Passenger car and motorcycle consumer surplus



3.2.2 Road freight

Estimation of a consumer surplus figure for road freight proceeded along broadly similar lines to the estimation for passenger cars and motorcycles above. However, in this case the cost of road freight services can be estimated

(2017) Spending by Australian households on owning and operating vehicles in 2015-16. This alternative estimate provides a cross check to the calculations. Though the figures have some differences (e.g. reference years are slightly different, some passenger cars and motorcycles would be commercially owned) the closeness of the figures is notable.

¹³ BITRE (2017) *ibid*, Table 2

¹⁴ Wallis, I and Schmidt, N.(2003), *Australasian travel demand elasticities: An update of the evidence.*, 6th Australasian Transport Research Forum, Wellington, New Zealand. This figure is also consistent with fuel price elasticities which are more commonly estimated across the literature – see Litman, T 2019 Transit Price Elasticities and Cross Elasticities and de Jong, G. and Gunn, H.F. (2001) “Recent evidence on car cost and time elasticities of travel demand in Europe”. *Journal of Transport Economics and Policy*, 35 (2).

from ABS (2012) *Business Transport Activity, Australia, 2010-11* which disaggregates road freight transport services income.¹⁵ The income from road transport effectively constitutes the road freight costs to the broader community for these services and therefore can be used as a total expenditure estimate. This document was a one-off publication, with subsequent published ABS information omitting a precise road freight transport income estimate. However, the estimated costs can be indexed to the broader growth in road transport Sales and Service Income since 2010-11 using the ABS's *Australian Industry 2017-18* publication.¹⁶

This produces a figure of \$35.7 billion in 2017-18 (up from \$30.1 billion in 2010-11).

A price elasticity of 0.43 was used for road freight based on extensive past modelling work by the Productivity Commission.¹⁷

This yielded a road freight consumer surplus of \$41.4 billion (i.e. $\$35.7 \times 0.5 / 0.43$)

3.2.3 Bus transport

As is the case for road freight, a one-off supplement to an ABS publication, (ABS 2011, *Australian Industry, 2009-10*) provides income for both urban and interurban/rural bus transport income from passenger fares. This income effectively constitutes the user cost of bus transport.

As this data:

1. Included tram fares; and
2. Related to income in 2009-10

it was necessary to make adjustments to derive a “pure” bus fares updated figure.

In order to address the first issue above, tram fare income was excluded based on estimates for 2009-10 for the Melbourne tram network.¹⁸ The second issue was addressed by indexing the 2009-10 figures to RBA estimates of the growth in CPI to 2018.¹⁹ This produced an estimated \$3.1 billion in bus transport costs in 2017-18 (of which \$2.1 billion relates to urban bus transport and \$1 billion to interurban and rural transport).

¹⁵ ABS (2012) *Business Transport Activity, Australia, 2010-11*, Cat. No. 9269.0.

¹⁶ ABS (2019), *Australian Industry 2017-18*, Cat. No. 8155.0

¹⁷ Productivity Commission (2006) *Road and Rail Freight Infrastructure Pricing*

¹⁸ Stone, J. (2015), *Melbourne's public transport: performance and prospects after 15 years of 'privatisation'* Australian Cities Conference 2015. While trams obviously also run on roads, they have been excluded due to the mixed mode nature of light rail (e.g. some routes also run along a dedicated right of way). Only Melbourne tram revenue has been deducted, however this would constitute the great majority of Australian farebox revenue

¹⁹ Reserve Bank of Australia (RBA) “Inflation calculator” <https://www.rba.gov.au/calculator/> accessed 16 August 2019

An elasticity of 0.4 was used for urban bus transport – this figure is consistent with estimates from a variety of sources.²⁰ As there is little Australian evidence for non-urban bus transport, a non-urban bus transport elasticity of 0.9 was based on Dargay and Hanly's major UK study of non-urban buses.²¹

These figures were then used to derive a consumer surplus estimate of \$3.2 billion for buses.

3.3 OPTION VALUE

As indicated above, the externalities associated with road transport may also be considered. One such externality is option value. This is essentially the value associated with the option of having access to a good or service without necessarily using it. In a sense it is akin to a kind of insurance value. Accordingly, having the option of using the road network (or aspects of it) may be of importance to Australians whether or not they make extensive use of large parts of that network and/or network services.

While often discussed, there is little quantification of option value in the Australian or international literature. While there appears to be no generic estimation of the value of accessing the road network *per se*, option values are sometimes estimated for forms of road-using public transport such as bus transport. Even here there appear to be a lack of Australian evidence, though publications such as the ATAP Guidelines recognize the importance of option value in this context.²²

A way forward may be found in the bus transport option value estimates developed by the UK Department for Transport (DfT). These draw on extensive UK research and suggest a bus transport figure of £73 per household, expressed in 2010 terms.²³

Adjusting these figures to 2018 Australian dollars (allowing for both inflation and purchasing power parity (PPP) exchange rates) yields a figure of \$188 per household.²⁴ Allowing for some 9.9 million Australian households, this suggests a total option value figure for bus services of \$1.9 billion in 2017-18.²⁵

²⁰ Transport for NSW op. cit; Wallis and Schmidt, op. cit ; Australian Transport Assessment and Planning (ATAP) Guidelines (2018) M1 Public Transport

²¹ As cited in Litman, op. cit.

²² ATAP op. cit.

²³ UK Department for Transport (2019), TAG Data Book, May 2019. Table A4.1.8 at <https://www.gov.uk/government/publications/tag-data-book> accessed 16 August 2019

²⁴ Allowing for UK inflation calculated using Bank of England, Inflation Calculator <https://www.bankofengland.co.uk/monetary-policy/inflation/inflation-calculator> accessed 16 August 2019 and OECD Purchasing Power Parities at <https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm> accessed 16 August 2019

²⁵ Australian Bureau of Statistics 2016 Census Quickstats https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/036 accessed 16 August 2019

3.4 TOTAL VALUE

The consumer surplus and option value figures estimated above can be combined to derive a total economic welfare estimate for the value of road transport services. This figure represents an alternative to a GDP based approach to the estimation of the value of roads to the Australian community. Using a welfare-based approach the economic value of roads to Australians was estimated as \$133 billion in 2017-18.

As indicated above, data limitations suggest that this figure is likely to be conservative.

Fig. 13. Value of roads: economic welfare basis

	\$ billion
Consumer surplus	
Passenger car and motorcycle	86.5
Road freight	41.4
Bus	3.2
<i>Sub-total consumer surplus</i>	<i>131.1</i>
Option value (bus only)	1.9
Total economic welfare value	133.0

Source: BIS Oxford Economics analysis

4. APPENDIX A – METHODOLOGY

Transport Satellite Accounts

- The tables from the Transport Satellite Account were used to expand the supply-use tables associated with the 2015-16 National Accounts to include the in-house transport industries for road, rail, sea and air. Employment and gross value-added for the in-house industries in 2016-17 and 2017-18 were estimated by projecting forward the productivity trends for in-house industries from the Transport Satellite Account using industry employment and value-added movements from the annual National Accounts and Labour Force releases.
- Input-output analysis is conducted using symmetric tables (industry by industry) which are constructed from the supply-use tables (industry by product group). However, converting the supply-use tables to consistent symmetric input-output tables is a nontrivial process and it would not be possible to replicate the approach used by the ABS. A simplifying assumption that outside of the in-house transport industries there is no secondary production was used, so that the supply-use table was considered to represent industry by industry flows.
- An adjustment was made to the 2015-16 supply-use table (with the added in-house industries) to switch the treatment of imports from an indirect to a direct allocation as the area of interest is domestic employment and production.
- The multipliers were then estimated using the expanded 2015-16 supply-use tables and applied to the 2017-18 estimates of employment and gross value-added for the for-hire and in-house roads industries. While the 2016-17 supply-use tables are available, technologies are unlikely to have changed significantly in this time and therefore the 2015-16 multipliers are considered appropriate for use.
- In using an input-output approach no counterfactual is assumed. Obviously, there is some scope with both for-hire and in-house transport movements to be switched to rail, air or sea and therefore alternative uses to be found for resources currently dedicated to roads activity. However, the focus of this analysis is on the currently usage of transport, particularly the road network, and the analytical approach used reflects that.



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NSW CONSTRUCTION DELIVERY ASSESSMENT

CAPABILITY & CAPACITY



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The focus of this Report is identifying gaps in capability and capacity, and the reasons for these gaps.

Abbreviations and Acronyms

ABS	Australian Bureau of Statistics
AEO	Authorised Engineering Organisation
ANZSCO	Australian and New Zealand Standard Classification of Occupations
APIC	Aboriginal Participation in Construction
ASA	Asset Standards Authority
BCA	Building Code of Australia
BER	Building the Education Revolution
BIM	Building Information Modelling
CSELR	Sydney CBD and South East Light Rail project
D&C	Design and Construct contracting
DA	Development Approval
ECI	Early Contractor Involvement
EMS	Environment Management Systems
EPA	Environmental Protection Agency regulations
EPCM	Engineering, Procurement, Construction Management
ETC	Estimated Total Cost
FIFO	Fly In Fly Out workforce
FTTN	Fibre to the Node
FTTP	Fibre to the Premises
GC21	General Conditions of Contract (21)
GFC	Global Financial Crisis
HFC	Hybrid Fibre-Coaxial
IIAF	Infrastructure Investor Assurance Framework
IP	Intellectual Property
IPD	Implicit Price Deflator
ISLP	Infrastructure Skills Legacy Program
JV	Joint Ventures
LNG	Liquefied Natural Gas
NBN	National Broadband Network
NCVER	National Centre for Vocational Education Research
PPI	Producer Price Index
PPP	Public-Private Partnership
R&D	Research and Development
RET	Renewable Energy Target
RAP	Reporting and Assurance Portal
RMS	Roads and Maritime Services
TBM	Tunnel Boring Machine
TfNSW	Transport for NSW
VET	Vocational Education and Training
W2B	Web to Business

OVERVIEW



Objective

Infrastructure NSW has engaged BIS Oxford Economics to produce this report into capability and capacity issues in the New South Wales construction sector that could potentially impact timely and value for money delivery of the NSW Government's infrastructure program.

The key focus of this report is identifying gaps in capability or capacity and the reasons for these gaps. These gaps could be logistical (i.e. access to essential construction inputs such as skills, materials and equipment), technological (i.e. the technical processes of how these inputs are put together) as well as institutional (how effectively industry's resources are engaged). All three aspects are considered in this report.

Methodology and approach

Such an analysis is timely. New South Wales is in 2015/16 a 'construction moment', with a record breaking building boom to be joined by a very strong program of infrastructure investment. However, this report considers more than just the shorter term demand-side pressures exerted by the construction market. Rather, it looks into more fundamental issues that affect the supply chain and industry's capacity and capability to respond to the challenge now, in the near future and over the long term.

Our methodology revolves around industry liaison, via both survey and interview, aimed at gathering views from various commercial players on what they see as the looming limitations to delivering the state's ambitious construction program. In these soundings, industry had both positive and negative feedback regarding the state of the market in New South Wales, the outlook and opportunities for activity, the way the infrastructure program in New South Wales is being procured and delivered, and where the greatest risks to capacity and capability lay.

Along with industry soundings, BIS Oxford Economics has also undertaken interviews with several key NSW Government agencies and departments, as well as conducting further research and analysis to flesh out the issues raised.

Through this approach, key 'pinch points' in the construction industry supply chain in New South Wales have been identified which could come under pressure as the infrastructure program is progressively rolled out.

Challenges

This report shows that while currently cost escalation is under control, the construction industry in New South Wales will face significant capacity and capability challenges over the next five years, as well as the long term. However, a major theme emerging from the research is industry's high confidence in 'getting the job done' – given enough forewarning – provided government is utilising engagement models which encourage industry participation and innovation.

Key findings of this report are:

- ▶ **New South Wales cannot simply rely on competition and excess industry capacity nationally to keep industry margins (and construction cost escalation) at current low levels.** While cost escalation is weak now, it is anticipated to accelerate in coming years as construction activity rises and supply chain risks are exposed.
- ▶ **New risks to skills capability are already emerging, particularly across a class of 'onsite' skills** sets such as site managers, foremen and a range of other onsite professional positions and trades. A large tunnelling program, meanwhile, is adding further challenges.



- ▶ **Risks to construction material supplies are also apparent**, particularly for quarry products and natural sand which are important ingredients in concrete. Meanwhile the loss of domestic manufacturing also threatens local supply of by-products important to the construction industry and increases reliance on overseas supply chains. As quarry supplies move further out from Sydney, trucks will have further to travel, which leads us to the next point.
- ▶ **Transport and logistics risks are of paramount concern**, particularly in metropolitan Sydney. More construction activity means more truck movements, with significant risk of rising costs and delays due to increasingly congested road corridors.

A positive legacy for New South Wales

The pressures which are now being brought to bear on the broader construction industry in New South Wales provide an opportunity to innovate and create a long term value legacy for the state that will assist in responding to future investment demands.

Of these, the most critical innovations may be:

- ▶ **The provision of a clear and coherent 'whole of government' long term project pipeline** to give industry the best possible chance of responding. Ideally, the long term project pipeline will assist with the sequencing and resourcing of key metropolitan and regional projects, and reduce risk on critical infrastructure projects.
- ▶ **Boosting workforce development initiatives to meet demand for key onsite skills** through expanding the coverage of the Infrastructure Skills Legacy Program and removing existing constraints to workforce development initiatives at the procurement phase.

- ▶ **The establishment and regular maintenance of an industry wide construction materials plan**, based on major projects from both the public and private sectors, so that a demand and supply balance for scarce quarry products can be maintained.
- ▶ **The enunciation of a formal construction transport and logistics plan** to avoid bottlenecks, delays and rising costs for the transport of construction materials and disposal of waste.

Perhaps most importantly, there is a need to **review the procurement process** for major projects in New South Wales to ensure it is not only achieving value for money, but is not, by itself, contributing to capacity and capability constraints. Under the right circumstances, the procurement process can become a positive tool for growth and development of the NSW Government's construction program. Proactively partnering with industry may mean expanding the use of innovative procurement models and forms of contracting, and ensuring a philosophy of best value and greatest long run benefit in weighting price and non-price factors to maximise industry participation, investment in capacity and capability, and innovation.

'New South Wales is in a construction moment'

EXECUTIVE SUMMARY

Infrastructure NSW has engaged BIS Oxford Economics to identify capability and capacity issues in the NSW infrastructure sector that could potentially impact the timely and value for money delivery of the NSW Government's infrastructure program in the short and medium term.

In the context of this report, industry capacity refers to the level or quantity of resources available, while capability encompasses the qualities of these resources, how well they match construction industry demands and how effectively they can be combined to produce best value construction outcomes.

This report is the outcome of that engagement. Through an extensive survey and interview program with the broader construction industry and NSW Government procuring agencies – coupled with further research and analysis – this report identifies key gaps in construction industry capacity and capability that could impact on the NSW Government's infrastructure program, as well as solutions that can help keep capacity and capability risks in check.

Data from the Australian Bureau of Statistics (ABS) confirms the importance of the construction industry to the New South Wales state economy. New South Wales recently reclaimed the mantle as Australia's largest state for construction activity, with \$49.7 billion in work done undertaken in the September quarter of 2016. The construction sector in NSW made up around 6 percent of the state economy (as a share of Gross State Product) in 2015/16 but has strong multiplier effects on the broader economy given its links to other industry sectors including manufacturing, trade, transport and professional services. As at June 2016, New South Wales had just under 113,000 businesses in the construction sector, directly employing nearly 338,000 persons, more than any other Australian state or territory.

This report is timely. New South Wales is experiencing historically high levels of building and construction activity now, and has the largest infrastructure investment program of any Australian jurisdiction. New South Wales' construction industry is the fastest growing among the states, with industry output (Gross Value Added) rising 10.8 per cent through 2015/16, compared to just 2.9 nationally. Further growth is anticipated. Transport-related construction is anticipated to rise significantly in New South Wales due to a large pipeline of road and rail projects, but growth is also expected in the construction of utilities, including telecommunications (incorporating the rollout of the National Broadband Network and 5G technologies), as well as electricity and water assets. Over the longer term, higher levels of infrastructure investment and construction will need to be sustained to meet demands from a growing population, trade and transport task.

This report does not, however, focus on the outlook for construction industry demand. Rather, the overarching concern is industry supply – how flexibly industry will be able to respond to demand – and the fundamental issues that are likely to affect industry's ability to meet capacity and capability challenges now, in the near future, and over the long term.

Meeting these challenges will be crucial for the NSW infrastructure program and the broader state economy. Successful negotiation

of these challenges will mean that infrastructure projects will be delivered on time, on budget and to a high quality, providing important economic benefits and value for money for New South Wales. Getting it wrong will likely result in project delays, potential project and business failures (including costly litigation, rectification works as well as social costs) and, overall, higher industry cost escalation.

Construction cost escalation and industry margins are currently weak. Recent industry soundings indicate that this is the result of strong competition for work – particularly given falling construction activity in the mining boom states of Queensland and Western Australia – and the arrival of overseas-based construction contractors into the Australian market.

However, there is a risk that rising levels of construction work in New South Wales (as well as other states and in international markets) – particularly in the large, complex infrastructure space – will expose "pinch-points" in supply. Industry competition and excess national construction industry capacity in the wake of the mining investment downturn cannot be relied upon to constrain growth in construction costs or industry margins in the future.

The Key Challenges

The key capacity and capability challenges identified by this report revolve around securing access to quality skills and construction materials, boosting construction industry productivity, and meeting the transport and logistical challenges associated with a rising construction task.

Ensuring essential skills

The availability of professional and trade construction skills is rated by industry as the most pressing challenge to capacity and capability, with around two-thirds of industry respondents reporting worsening skills availability over the past two years. Ensuring that New South Wales has the necessary construction-related skills to meet growing construction activity and demand is likely to be one of the biggest challenges facing the state's investment program; not just for the next five years, but over coming decades.

Strong increases in New South Wales construction activity projected over the next five years is likely to see construction employment rise from an average of 315,000 persons through 2015/16 to over 350,000 persons over the next few years, according to BIS Oxford Economics forecasts. This will place strains on key occupations and skills at all phases of the investment cycle, from planning and procurement, through to construction activity itself as well as ongoing asset operations and maintenance.

Research undertaken for this report indicates that the most acute risks being felt in the industry today are across a class of 'onsite' skills sets such as site managers, foremen and a range of other onsite professional positions and trades. The latter includes engineers and surveyors, finishing trades for building, concreters, form-workers, mechanical and electrical trades and truck drivers.

Meeting demand for high quality skills in tunnelling and tunnel fit-out is also likely to be particularly challenging given the projected increase in tunnelling work as multiple massive road and rail tunnel projects get underway across New South Wales and interstate. BIS Oxford Economics forecasts indicate that major tunnel-based construction work done across Australia will rise from under \$1 billion in 2014/15 to a sustained peak of over \$6 billion per annum by 2017/18. Here, industry soundings reveal significant capacity and capability risks, with the impact on costs potentially magnified by the sheer number and complexity of these projects, and the sequential nature of the construction process itself.

While New South Wales is currently the beneficiary of a national downturn in investment activity – both in terms of the cost and availability of skills – constraints to the transferability and mobility of skills means that these benefits are not currently being maximised. In particular, research for this report reveals that strict tendering rules have prevented professionals in engineering and project controls on mining projects from working on transport projects in New South Wales. Meanwhile, a lack of affordable housing, coupled with high transaction costs and differences in costs of living are limiting the number of construction workers willing to move to Sydney. Any mobility benefits are likely to erode in coming years in any case as investment activity stabilises in other states and territories, and grows very strongly in New South Wales (and Victoria). In the longer term, a recovery in public and private investment in other states, as well as changing demographics as Australia's skills base ages, will present further capability challenges.

Sourcing construction materials

Construction activity in Australia utilises a mix of locally sourced and imported materials. Research conducted for this report reveals that, while perhaps not as pressing as skills capability, the availability and cost of material inputs to the production process are generally perceived by industry to have a medium to high risk to industry capacity to deliver in New South Wales.

By far the biggest immediate challenges relate to satisfying demand for locally-sourced construction materials – particularly concrete and quarry products in the regions where construction demands are expected to be most focused. By contrast, internationally sourced construction materials, including steel and steel products (both flat and long steel products), oil products (such as diesel fuel and bitumen) and equipment hire is considered to have slightly lower capacity and capability risk.

In many cases, high production costs in Australia is driving the closure of local manufacturing facilities which has implications for the construction industry. One example is the production of clinker for cement, with high energy costs in Australia seeing the number of kilns shrink by two thirds over the past fifteen years, to just five currently. The only remaining kiln in New South Wales is Boral's Berrima facility. While not a capacity or capability issue given the depth of the global clinker market, it remains a cost issue for the New South Wales construction industry.

Overall, the loss of local industry over past decades has led to the drying up of local supply chains, increasing exposure to global supply chain risks, and other "unintended consequences" such as the loss of locally manufacturing by-products important to the construction industry including bitumen (for asphalt), slag (to meet durability specifications in concrete) and fly ash (as a substitute for natural sand). In the case of asphalt, the closure of local refineries has led New South Wales to be reliant on imported bitumen. Trade data suggests a growing gap between published asphalt prices and the import price of bitumen and oil (its core constituent) which may drive higher costs in road construction. Meanwhile, any loss of steel manufacturing in Wollongong would remove the only domestic source of slag for the Sydney market. The closure of coal-fired electricity production units in New South Wales would similarly threaten the production of fly ash.

The development of regional 'hotspots' in demand, such as metropolitan Sydney, is likely to add to the pressure. Access to quarry products in the Sydney region will be crucial, particularly given the closure of two key quarries at Penrith Lakes and Kurnell – the latter a key source of natural sand which is a critical input in the production of cement and concrete. Industry expects that Sydney will exhaust local supplies of natural sand within five years. The loss of access to local natural sand supplies requires solutions such as importing natural sand from other regions, as well as making





greater use of synthetic or manufactured sands through crusher dust and the recycling of spoil. The latter is likely to require greater investment in research and development by materials suppliers to improve the quality of manufactured sands, as well as policies to promote the recycling of spoil.

Research for this report indicates that it takes around a decade for a quarry to progress from conception to operation, and up to fifteen years before a new quarry reaches full capacity. These long lead times for quarry developments means that industry capacity and capability can be adversely impacted by sharp, unanticipated, increases in demand. In the short to medium term, increasing demand tends to be met by transporting materials from more distant quarries, which increases transport costs and impacts supply in source regions.

Boosting productivity

In a world of scarce construction labour and material inputs, coupled with rising demand for construction output, rising construction sector productivity offers an important route to minimising the risk of capacity and capability constraints.

National ABS data shows that construction industry productivity growth – both multifactor and labour – has tended to lag that of the broader “selected industries” measure. Since 1989/90, multifactor productivity in the construction industry has grown at just 0.8 per cent per annum on average, compared to 1.0 per cent for the selected industries measure. Over time, productivity in the construction industry tends to stall for several years before experiencing a step change. Relatively slower growth in productivity means that greater pressure is placed on boosting the quantity of labour and capital inputs to achieve higher levels of construction

output, rather than improving the way they are used together. Where labour and/or capital is scarce, this itself can lead to increased demand pressure on resources, increasing construction costs.

Construction industry productivity could be boosted by:

- ▶ Encouraging the take-up of new productivity enhancing technologies and processes such as prefabrication and modularisation, robotics and automation, use of advanced materials or processes and digital technologies. Robotic advancements are already occurring in the bricklaying industry, with robots being developed that may see bricklaying speeds increased 20-30 fold. Meanwhile, industry soundings and recent data indicate that prefabrication and modularisation is also increasingly used in the construction industry, with prefabricated building imports into New South Wales more than doubling to over \$40 million per annum since 2014.
- ▶ Utilising offshore capacity and capability, which is likely to continue as Australia continues to lose manufacturing capacity.
- ▶ Adopting an innovation-friendly culture – which will be largely driven by the choice of procurement model, and
- ▶ Improving efficiency and literacy in the planning process, given that the cost of obtaining major project planning approvals, and risks of delays, can add substantially to the cost of infrastructure delivery, as well as imparting additional societal costs. Here, the Productivity Commission has estimated the cost of a one-year delay in approvals for an average major project is up to \$59 million, and for a large project up to \$2 billion.

Transport and Logistics

Potentially one of the greatest capacity and capability risks facing the construction industry in New South Wales is the logistical challenge of transporting materials to construction sites, as well as the removal of spoil and waste. While this is true of any region in New South Wales which is contending with a large construction program, it is likely to be amplified in the Sydney metropolitan region given the sheer size of the construction program forecast and the limited transport options available in dense, inner city construction locations.

According to BITRE data, Sydney's urban road network is already under significant strain, with avoidable annual congestion costs estimated at approximately \$6.1 billion in 2015, and likely to rise to between \$9.5 billion and \$12.6 billion by 2030. Increasing construction activity entails increasing truck movements on Sydney's increasingly congested urban road network. According to recent industry interviews for this report, rising road congestion and delays is reducing the maximum number of loads that can be delivered to the metropolitan region each day from around 5-6 loads on the past, to 3-4 loads presently. Meeting existing demand means investing in more trucks and drivers. Rising construction demand amplifies the pressure.

Currently, regulations and approval processes work against the efficient delivery of construction materials to sites. In many cases, approvals processes limit construction times or delivery times for projects in a window between 9am and 3pm to minimise peak hour truck movements for commuters. The downside is the interface to the construction site usually becomes highly congested. This can lead to capacity constraints for on-time delivery of time-sensitive materials such as wet cement, which must be delivered within two hours.

Regulatory constraints also dictate the hours of operation of facilities such as quarries and batch plants that supply construction materials, creating inefficiencies even when the construction projects they service are granted 24-hour operation. Industry sources indicate that of the 18 concrete batch plants which service the Sydney region, three are being resumed in Alexandria for

WestConnex and residential development. This means that more batch plants will be required to meet local construction demand unless restrictions on the hours of operation of batch plants are loosened. Meanwhile, regulatory constraints on the operation hours of the Peats Ridge quarry (which services the 24-hour NorthConnex project), for example, means that a 24-hour operation needs to be simulated by parking a line of metropolitan-bound trucks and ferrying drivers back and forth during the night at large inefficiency and cost.

Meeting the challenge

This report shows that the construction industry in New South Wales faces significant capacity and capability challenges over the next five years – as well as the long term – in meeting projected demands. However, a major theme emerging from the research is industry's high confidence in "getting the job done", particularly if they are:

- ▶ Given long lead times to address these challenges and
- ▶ Provided room in the procurement process to use their knowledge and skills to come up with innovative solutions

For construction industry contractors and suppliers, the main challenge was seen as not an inability to deliver, but rather whether delivery could be achieved in a timely and 'value for money' way. Here, innovations adopted by the NSW Government over the short term and the long term will be crucial in mitigating against capacity and capability risks.

Of these, the most critical innovations may be:

- ▶ **The provision of a clear and coherent "whole of government" long term project pipeline** to give industry the best possible chance of responding, rather than separate pipelines by separate agencies. The pipeline could also include known major projects by the private sector as well as, potentially, major competing projects in other jurisdictions, so that industry is fully aware of the likely call on resources at all stages of construction. The development of a "Critical Projects" list, agreed by all major political parties, may also help avoid sovereign risk issues such as those that affected the East West Link project in Victoria.
- ▶ **Boost workforce development initiatives to meet demand for key onsite skills.** Recent data from the National Centre for Vocational Education Research (NCVER) indicate that enrolments in construction-related programs in New South Wales have been falling since 2013 with the exception of mobile plant operators. While the number of engineering graduates are rising (albeit not for women), not enough tradespersons with onsite capabilities are coming through the education system. Expanding the coverage of the Infrastructure Skills Legacy Program to further projects and skill sets (including onsite professions) is a start, but more needs to be done to remove existing constraints to workforce development initiatives and skills transferability at the procurement phase. Over time, it is expected that these measures will boost education and training, competencies and the number of skilled workers across a range of construction trades. Further incentives and training may also be considered to encourage experienced and capable trades workers to shift into sought after supervisory roles.
- ▶ **The establishment and regular maintenance of an industry wide construction materials plan**, based on major projects from both the public and private sectors, so that the demand and supply balance for scarce quarry products can be quantified, mapped, emerging gaps identified quickly, and strategies put into place to accelerate the development of new supply sources and related logistics. This is particularly important for quarry products given the very long lead times required to develop and approve new quarries, affecting the supply of hard rock, aggregates and sand, and limited sources of supply.

- ▶ **The development and maintenance of a construction transport and logistics plan** to avoid bottlenecks, delays and rising costs for construction materials as a result of congested road transport networks, particularly in the Sydney metropolitan region where construction activity will be most focused. This may include demand management tools for the road network, but also taking greater advantage of non-road transport such as rail and water. Sydney, itself, is amenable to a significant increase in barge use for moving construction materials and spoil, given the ability to load and unload materials at existing city-based ports and the development of distribution facilities upstream. However, it will be crucial that existing transport assets – such as bulk materials loading and unloading facilities in the Bays Precinct – are protected and zoned for construction industry use.

Meeting the capacity and capability challenge also means critically re-assessing the procurement process for major projects in New South Wales to ensure that it is not only achieving value for money in a long term sense, but it is not, by itself, contributing to capacity and capability constraints in the short or long term.

The procurement model chosen – and how it is executed – plays a critical role in risk allocation, on-time delivery and meeting other government outcomes. The contracting model used by agencies can therefore be a positive tool to support a constructive procurement culture, effective delivery and long term sustainability of the NSW infrastructure program.

Procurement, itself, takes up scarce resources. Bid costs can be substantial and lock up skilled resources for long periods of time. On large projects, procurement costs can be measured in the tens of millions of dollars, tying up bid teams of around 100 people.

Industry soundings as part of this research suggest that, while there are many good examples of procurement across most NSW government agencies, there are also areas where the procurement process can be improved, particularly where the procurement approach chosen is:

- ▶ Creating long term risks to industry sustainability and costs (by inadvertently encouraging contractors to take risks on quality)
- ▶ Taking up scarce resources through the tendering process, and not allowing full transferability of skills from the resources sector
- ▶ Not encouraging contractors to invest sufficiently in capability or capacity (that is, firms are not "tooling up", investing in staff, or are simply not bidding for work given a high risk / low margins approach to procurement)
- ▶ Not encouraging innovation and new, "step changes" in productivity (such as the use of new, resource-saving materials, or skills development)

With multiple major tenders being issued by governments across Australia, the capacity of industry to respond meaningfully can diminish in times of high intensity. When there are a high number of major tenders, limited bid budgets and access to skills can dilute the quality of bid teams and tender responses.

Overall, government agency engagement with the construction industry may need to shift from one which is currently competitive and, at times, adversarial, towards a greater partnership approach that maximises the legacy of the infrastructure program. Instead of being highly focused and incentivised to secure the lowest priced work on projects, the procurement model should encourage investment in industry capacity and capability, reward innovation (and hence productivity), and consider "value for money" in a long term sense, which results in a sustainable construction industry delivering quality, long-lived infrastructure for New South Wales.

ABOUT THIS REPORT



Infrastructure NSW engaged BIS Oxford Economics to produce a report into capability and capacity issues facing the state's construction sector, in 2017 and beyond.

Context

New South Wales is in a 'construction moment', with a record breaking building cycle due to peak in 2018 and a very strong program of infrastructure investment that will peak in 2019.

The Report assesses construction against the expected project pipeline across the State, with a view to maximising the legacy for New South Wales.

The Report identifies barriers that could potentially impact timely and value for money delivery of the NSW Government's infrastructure program in the short and medium term. The directions of this Report may result in whole-of-government policy recommendations to address some of the issues identified.

A key focus of this Report is identifying gaps around capability or capacity and the reasons for these gaps. The report considers the supply of labour, materials, and equipment used in infrastructure and building, relative to likely demand.

Scope

Whilst the focus of the analysis reported here is on the next five years (2017-2021), a longer twenty year horizon out to 2036 is also in view.

The Report comments on key risks in regional as well as metropolitan areas of New South Wales, pertaining to regional industry capacity, workforce capability and construction costs.

The emphasis is on New South Wales, yet construction activity in other states and other countries is considered where pertinent.

Objectives

The key objective of the Report is to identify potential supply side constraints, 'pinch points' that could act to obstruct or compromise the delivery of construction in New South Wales over the policy horizon. This includes:

- ▶ barriers, such as lack of transparency, sustainability, flexibility, knowledge retention, risk allocation or industry-government partnership
- ▶ gaps in the supply of skills, construction materials, transport, logistics, equipment, or technology

In achieving this objective, relationships between demand, supply and costs are in view, and we look at evidence from previous construction cycles - including how the present situation may differ from past cycles - and the implications of this for industry wherewithal going forward.

The Report draws upon how inputs (labour, materials, capital) are sourced and utilised in the construction industry, how the mix of inputs may differ by type of work, and the implications of this for input demand.

Industry liaison

A unique contribution of this study is the direct liaison that has been carried out with construction industry leaders. Through a quantitative survey and by taking soundings in the form of face to face interviews, BIS Oxford Economics has garnered the views of industry players across a range of issues. The resulting data and observations reported here will help inform government decision making.

A number of government agencies were also interviewed, and their views are also incorporated in this Report.

The Report:

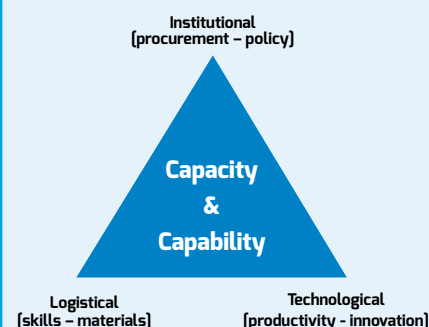
- ▶ puts context around the state's construction program by providing historical data and forecasts of construction activity in New South Wales
- ▶ tabulates the results from an industry survey
- ▶ documents the insights gleaned from the industry and agency soundings
- ▶ provides supplementary market data to flesh out key issues
- ▶ filters the analysis down to five Critical Issues
- ▶ provides pointers for the way forward

The Report identifies options and actions which can assist to minimise potential pitfalls from the construction program, and to maximise the positive legacy from the construction program.

What is meant by capacity and capability?

Capacity refers to the resources available. Capability means the ability of those resources to achieve maximum project benefits

Capacity and capability can be affected by several factors:



- 1 **Logistical** – reliable access to essential inputs (skills and materials) by producers
- 2 **Technological** – optimal combination (of inputs to produce outputs) by producers
- 3 **Institutional** – full participation (in tenders and legacy programs) by producers

All three perspectives are treated in this Report.



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CONSTRUCTION OUTLOOK

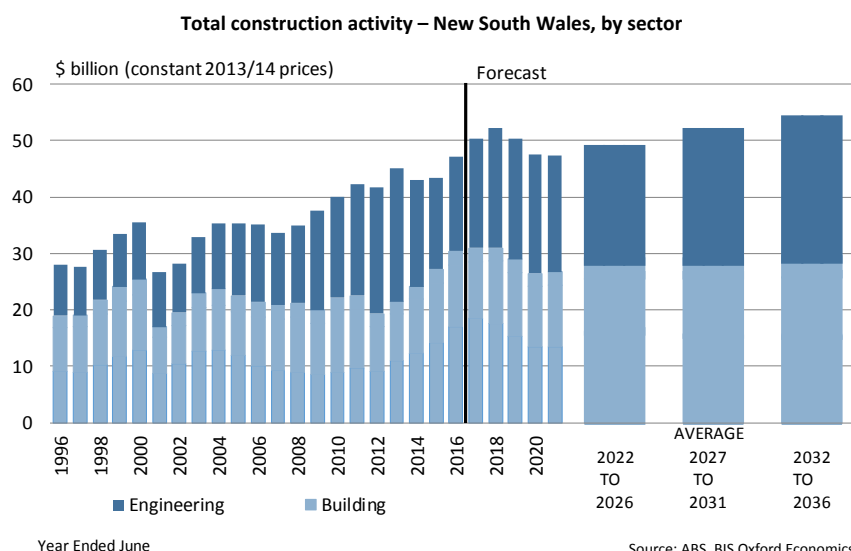
Construction Outlook



Capability and capacity issues in the construction industry will be of great importance over the coming years as New South Wales enters a challenging construction program. Total construction activity is forecast to increase towards a peak in 2017/18, driven by strong growth in engineering construction activity.

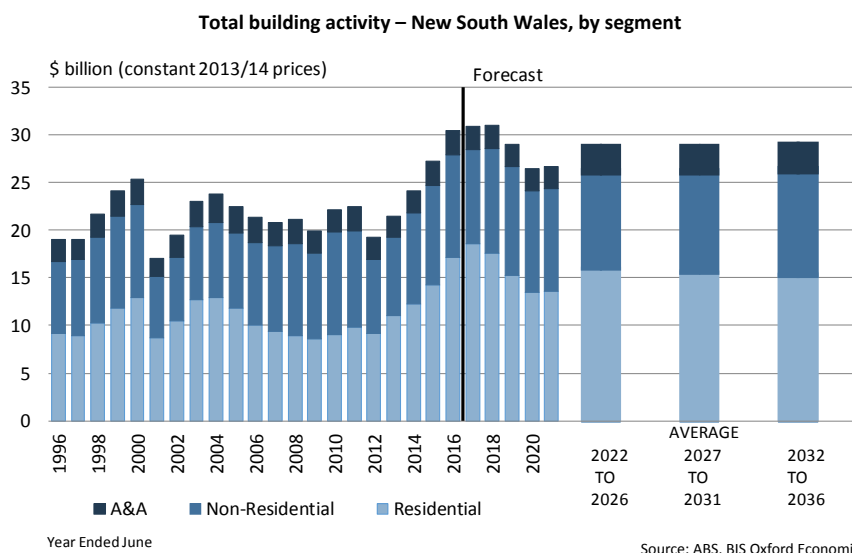
NSW Construction Outlook: By Segment

Below is a summary of state construction activity by segment, measured in real work done terms.



Building by segment – NSW

Since 2012/13 there has been a sustained upturn in total residential work done. Much of the growth was led by the strength of the high density sector. Activity will subside from this peak over the next four years. Activity will still remain relatively high historically speaking. Non-residential building work done will see a brief uptrend. Despite some fluctuations from year-to-year, however, non-residential building is anticipated to continue its relatively flat trend post GFC over the coming years. Overall, total building construction is expected to rise in 2017/18 on the back of major projects, before declining to 2019/20.



Residential building

Total residential building work done in New South Wales remained relatively weak over the decade to 2011/12, averaging an annual result of approximately \$10.27 billion (in constant 2013/14 prices). On the back of government stimulus measures, work done posted modest growth in 2009/10 (+5%) and 2010/11 (+9%), but then subsequently weakened in 2011/12 (-7%).

Since 2012/13 there has been a sustained upturn in total residential work done, lifting a cumulative 87% to \$17.11 billion over the four years to 2015/16. Underpinning the growth is a significant dwelling undersupply (that has built up after years of very weak construction volumes), low interest rates and an improvement in economic conditions in the state. While both detached and attached dwellings participated positively in this boom, it was the strength in the high density sector that has led much of the growth. Both domestic and foreign investors play a crucial role, especially in the inner city apartment market of Sydney.

Given the sizable pipeline of major apartment developments, it is forecast that total work done will continue to expand in 2016/17 (+9%). From this likely peak, we expect substantial contractions to eventuate over 2017/18 (-5%), 2018/19 (-13%) and 2019/20 (-11%). Poor affordability, an easing back in foreign investment, and softer underlying demand are anticipated to drag on activity going forward despite the persistence of a dwelling undersupply in Sydney and the low interest rate environment.

Long-term forecasts: As falling building activity sees some pressure re-emerge in the New South Wales residential market, green shoots in new residential construction are anticipated to appear again from 2020/21. Over the medium term, for the five years to 2026, growth in activity is forecast to be positive but lackluster. Migration flows, a solid economic outlook and a monetary policy stance that is still conducive to housing demand will support activity.

Over the third five-year period 2027-2031 we expect to see a softening of activity as the market absorbs the dwellings created in the 2022-2026 upturn and the population ages. Activity will still be relatively high, historically speaking. Further out to 2036, total residential work done is projected to stay rather flat. Slowing population growth will not provide the demand required to warrant further residential construction.

Non-residential building

Total work done in New South Wales fell 6% in 2010/11 and 23% in 2011/12 to a trough of \$7.83 billion, with weakness predominately reflecting the BER scheme completing. From this low, activity steadily improved, with strong growth setting in over 2013/14 (+17%) and 2014/15 (+8%), lifting total work done back above the \$10 billion mark. Commercial & industrial building continued its impressive performance with growth of 15%, whilst social & institutional building held relatively flat. Work on the \$900 million Sydney Convention & Entertainment Centre Redevelopment and Barangaroo Precinct provided considerable support.

Total work done continued its uptrend, expanding 3% to \$10.76 billion in 2015/16. Commercial & industrial lifted 2% and social & institutional building rose 6%. Entertainment & recreation was the main bright spot with growth of 64%. The \$225 million St George Hospital Expansion and \$200 million Stockland Green Hills Expansion were the largest projects starting construction.

Off the current high base, it is forecast that NSW non-residential building will ease back 8% in 2016/17. This decline largely reflects the smaller backlog of major projects accumulated over the previous two years and the completion of major projects at Barangaroo and Darling Harbour. Commencement of the \$600 million Castle Towers Expansion and \$450 million North West Rail Link Stations in the Hills region should help soften the overall fall.

It is forecast for 2017/18 that total non-residential work done will rebound 10%. The strong state economy will help underpin investment in new projects and thereby support the work done figures. Commercial & industrial is set to ramp up by 9% with offices (+13%) and transport (+68%) propelling much of this expansion. Social & institutional building is scheduled to grow 11%. There are a lot a large projects looming, with nine projects valued over \$200 million scheduled to start construction. The largest of these are the \$600 million New Grafton Prison and \$600 million Commonwealth Bank Campus.

Major NSW construction projects: next 5 years

Major Building projects include:

- › Castle Towers - Expansion - Stage 3
- › Allianz Stadium Redevelopment
- › Barangaroo - Crown Hotel Accommodation
- › Barangaroo - Crown Hotel Casino
- › Westmead Hospital Redevelopment - Acute Services Building
- › New Grafton Prison
- › Commonwealth Bank Campus
- › New Maitland Hospital
- › Prince of Wales Hospital Upgrade
- › ANZ Stadium Reconfiguration
- › New Rouse Hill Hospital
- › North West Rail Link - Eight Stations
- › Western Sydney Stadium

Major Engineering projects include:

- › Pacific Highway upgrades (since 1996)
- › National Broadband Network
- › Sydney Metro Northwest
- › WestConnex - Stage 2
- › WestConnex - Stage 1 - M4 (Parramatta to Haberfield)
- › Western Sydney Infrastructure Plan
- › Northconnex - M1 to M2 Motorway Link
- › CBD and South East Light Rail project
- › Sydney Metro City & Southwest
- › WestConnex - Stage 3 - M4-M5 Link
- › Parramatta Light Rail
- › Narromine to Narroabri Inland Rail Project (307km new track)
- › Mount Pleasant Open Cut Mine
- › Newcastle Light Rail
- › Dubbo Zirconia Project
- › Narroabri to North Star Inland Rail Project
- › Maules Creek Black Coal Mine

Building activity includes all construction across new residential (detached houses, medium density, high density units), home renovations, and non-residential (such as offices, retail, hotels education, health aged care, transport, warehouses, factories, etc – both new and refurbishment).

Generally building incorporates any structure that has a roof, whereas engineering construction does not involve roofing.

A further marginal improvement is expected for 2018/19 as a series of major hospital developments drives health work done higher (+27%). A few major stadium and casino developments should hold entertainment & recreation building at a high level. As economic conditions deteriorate modestly in the state, a weaker result is forecast for 2019/20 (-7%). However, activity is anticipated to remain at an elevated base over the \$10 billion mark. An increasingly undersupplied office sector and the commencement of Badgerys Creek Airport in Sydney's west should drive an improvement towards the tail end of the forecast horizon in 2020/21 (+2%).

Long-term forecasts: Total non-residential commencements over the 2022–2026 period are forecast to decline by 7% (on the 2017–2021 period) to \$9.9 billion per annum. Population growth is slowing, and in effect is pulling down on the incremental building requirement. As such, the forecast profile is continuing a relatively flat trend in non-residential building post GFC.

Over the 2027–2031 period, the average level of activity is expected to rise a further 5% to \$10.43 billion. Strong growth in New South Wales' older population will drive growth in health and aged care. A rise in student numbers will also support higher education building over the decade to 2030/31. Total non-residential activity in the 2031–2036 period is projected to further build on from the previous period, expanding by 4%.

Engineering construction by segment – NSW

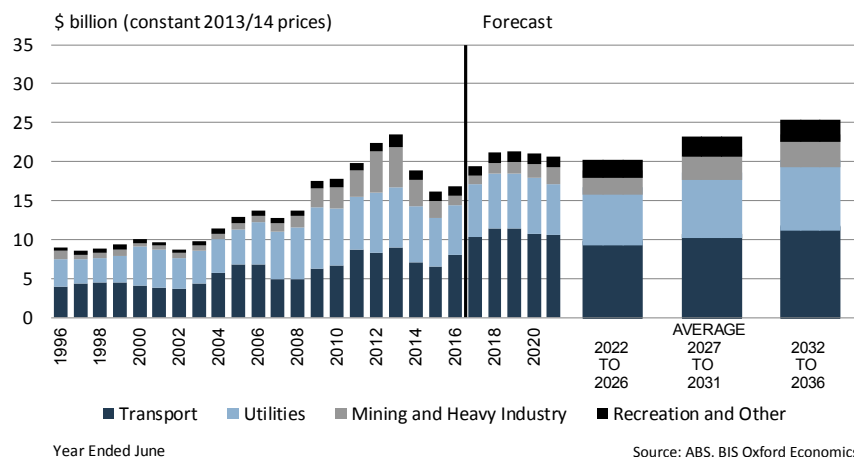
Engineering construction activity in New South Wales fell to \$16.7 billion in 2015/16. The market has continued to develop consistent with expectations. Transport investment is expected to rise due to a large pipeline of road and rail projects. Utilities investment has dropped steadily since 2012/13 – although investment in the NBN is propping up the sector. Overall, the engineering construction market is expected to increase to 2018/19 before declining marginally to 2020/21 as major projects shift gears. A sustained infrastructure pipeline and increasing long term infrastructure requirement is expected to drive higher levels of engineering construction long term.

New South Wales also experienced a boom in mining-related engineering construction during the 2000s and early 2010s, focused particularly in the Hunter and Southern region coalfields, but also including gold and base metals projects in the west. This included the construction of mines as well as expanded coal port and rail capacity (the latter assisted by a substantial Commonwealth Government boost to Australian Rail Track Corporation – ARTC – funding of improvements to the Hunter Valley Coal Chain rail network). Meanwhile, transport and utilities construction also rose substantially during this time, particularly in roads, railways and electricity. Much of this boost to non-mining engineering construction was sponsored by the public sector (mostly Commonwealth and State Governments), with important private sector contributions in toll roads as well as electricity generation.

Between 2012/13 and 2014/15, engineering construction activity in New South Wales fell 31%. Sharp collapses in coal prices from 2012 was a key driver, with mining and heavy industry construction falling from a peak of \$5.2 billion in 2011/12 to \$2.2 billion in 2014/15 (and just \$1.2 billion in 2015/16). But there have also been significant declines in public sector funded work (falling from a peak of \$12.2 billion in 2011/12 to just \$8.5 billion in 2014/15), with railways, electricity and roads the key segments to fall.

In 2015/16, the engineering construction market has shown signs of a recovery, with total work done rising 3.6% to \$16.7 billion driven predominantly by a 20% increase in publicly funded work (rising to \$10.2 billion). And the outlook is very strong, with total engineering construction projected by BIS Oxford Economics to rise to over \$21 billion by 2017/18 and, given the strength of the project pipeline, remain above \$20 billion per annum for the foreseeable future.

Engineering construction activity – New South Wales, by segment



By broad segment:

Transport: This segment is expected to be the strongest growth market for New South Wales engineering construction over the next few years, with a substantial contribution from roads initially, but then segueing into a very large program of rail construction. Apart from a raft of NSW Government funded roads projects, roads activity will be strongly supported by the roads-heavy \$50 billion Commonwealth Government's Infrastructure Investment Program (2015/16 to 2018/19), the completion of the Pacific Highway Upgrade Program (and particularly, the \$4.5 billion Woolgoolga to Ballina section) as well as the Western Sydney Infrastructure Program to support the development of Sydney's second airport at Badgerys Creek. Rail will also be a large component of transport construction, with the New South Wales Government undertaking major multi-billion dollar investments in metros (North West, Sydney and South West, and West) and light rail (Sydney, Parramatta and Newcastle). Later, these projects could be supplemented by the Commonwealth Government's \$10 billion Inland Rail initiative, involving significant construction activity in the south, north and west of New South Wales.

Utilities: unlike transport, this segment is experiencing declines from the boom years during the 2000s, with the exception of telecommunications which is set to increase rapidly over the next few years as the NBN rollout reaches a more intensive phase involving a mix of fibre to the premises (FTTP), fibre to the node (FTTN), hybrid fibre-coaxial (HFC), wireless and satellite technologies. Electricity construction is expected to rise from current lows, given the need to meet the national 2020 Renewable Energy Target (RET) and as the National Electricity Market moves back towards supply/demand balance with the retirement of 'dirtier' coal fired generation in Victoria. Water construction has fallen from drought-driven peaks (including the construction of Sydney's desalination plant), but is now expected to pick up as the capital works program focuses on securing and improving regional water resources to support communities, agriculture and mining, as well as the capital replacement program of ageing infrastructure in the capital cities.

Mining and heavy industry: construction in this segment is expected to reach a trough in 2016/17, before rising through each of the next five years. Higher coal prices are driving a mild pickup in coal construction activity now, and this is expected to accelerate later this decade given high quality thermal coal reserves available in the Hunter region. While coal's share of the global energy market is expected to fall, high quality Newcastle coals should continue to find a market with traditional buyers (Japan, Korea and Taiwan) as well as with a potentially fast-growing market developing in South East Asia. Alongside coal, rising commodity prices over the next five years are also expected to trigger investment in other minerals and metals projects in New South Wales, including gold, silver, copper, zirconia and minerals sands.

NSW Construction Outlook: By Region

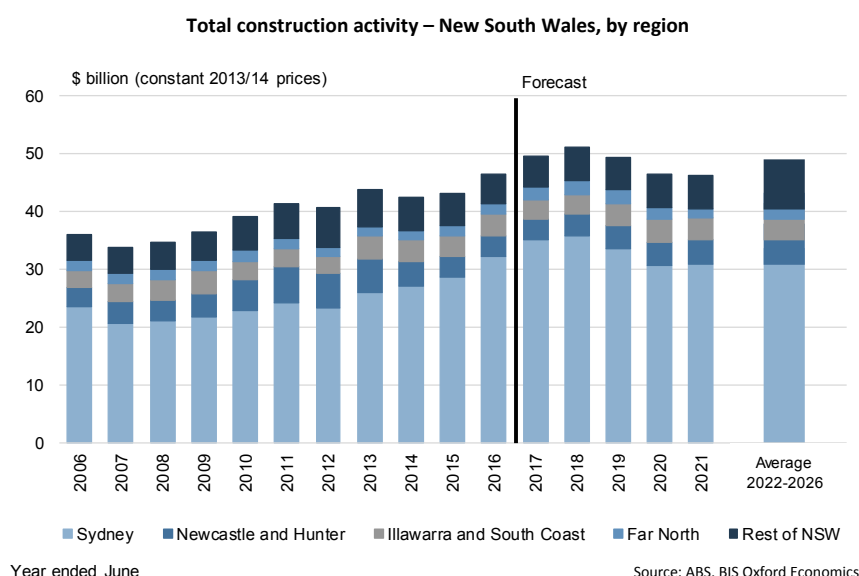
During the resources boom, the challenge was meeting capacity and capability in regional areas (particularly the Hunter). However, as the economy moves away from mining driven growth to broad-based growth, the capacity and capability challenge will be focused in the metropolitan areas. This will, however, present challenges for undertaking work in regional areas as skills and materials are directed towards Sydney especially.

Building by region – NSW

As the capital, Sydney is by far the dominant economic and population centre in New South Wales. Naturally, the Sydney region dominates building activity. Sydney's rapid house price growth has attracted strong demand from the investor segment of the market, which has been a particular boon to the high density inner and middle ring apartment market, with Parramatta also benefitting. This largely Sydney driven residential boom has also found help from regional New South Wales, especially those regions with links to the capital such as Illawarra and Newcastle & Lake Macquarie. The Hunter, however, is an example where activity has declined due to its close ties to the mining sector.

With the eventual slowdown in state-wide residential activity, most regional areas will fall in line. When there is a downturn, such as the one we expect to eventuate after 2016/17, activity in these areas will tend to follow a less dramatic fall.

Meanwhile, non-residential activity will continue to strengthen in 2017/18 to pre GFC levels with Coffs Harbour–Grafton receiving a significant boost from the New Grafton Prison and several major projects in Greater Sydney.



Engineering construction by region – NSW

The Sydney metropolitan region dominates engineering construction activity, and is expected to continue its dominance over the next decade. Sydney's status as a world city will continue to drive demand for new and improved infrastructure, particularly in the vital transport segment. Road construction will remain the largest sector of engineering construction, supported by the WestConnex project, and the NorthConnex toll road project. The Western Sydney Airport at Badgerys Creek will also be a significant driver of public construction for the region, well beyond the expected open date in 2026. While the runways will constitute road construction, the vast majority of the impact will be in related infrastructure, including rail links, road upgrades and additional water, sewerage and electricity investment. Rail work will also commence on the Parramatta Light Rail, Sydney Metro West and Sydney Metro City and Southwest.

Engineering construction in non-Sydney regions pales in comparison to Sydney construction. The Newcastle Light rail will contribute to engineering activity in the Newcastle and Hunter while the 155 kilometre upgrade of the Pacific Highway between Woolgoolga to Ballina is providing substantial construction work in the far north of the state.

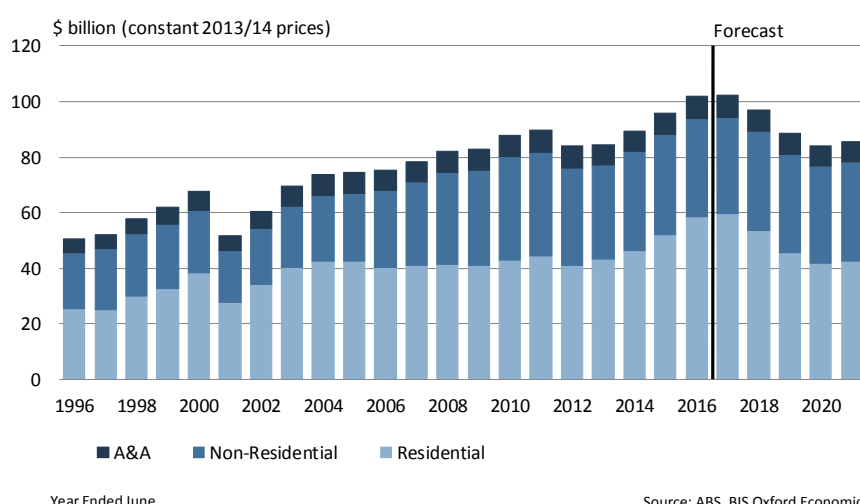
National Construction Outlook

Nationally, residential **building** construction is heavily influenced by the performance of the two largest states, New South Wales and Victoria. Common factors such as historically very low interest rates, relatively stable economic conditions and a sizable dwelling stock deficiency nationwide helped drive the recent upturn and build the right environment for national work done to reach its own record of \$58.54 billion in 2015/16. It is forecast that activity will only marginally build on from its current record level in 2016/17 (+2%). Further out, contractions are to be expected.

All major states will participate in the downturn. Victoria will lead the decline among the eastern states from its unsustainably high base as looseness in key markets (especially in the Melbourne inner city apartment market) increasingly hinders the prospects for price growth and limits housing demand. Western Australia will continue to fall sharply thanks to the weakening economic outlook there in response to the declining resources sector.

Nationally, a modest rise in total non-residential building came through in 2013/14 (+5%), backed by a significant pipeline of large projects and gradually improving economic conditions. Activity flattened out over 2014/15 and 2015/16 around the \$35.7 billion mark as weaker results in health and other social & institutional building were countered by gains in accommodation and aged care.

Total building activity – Australia, by segment

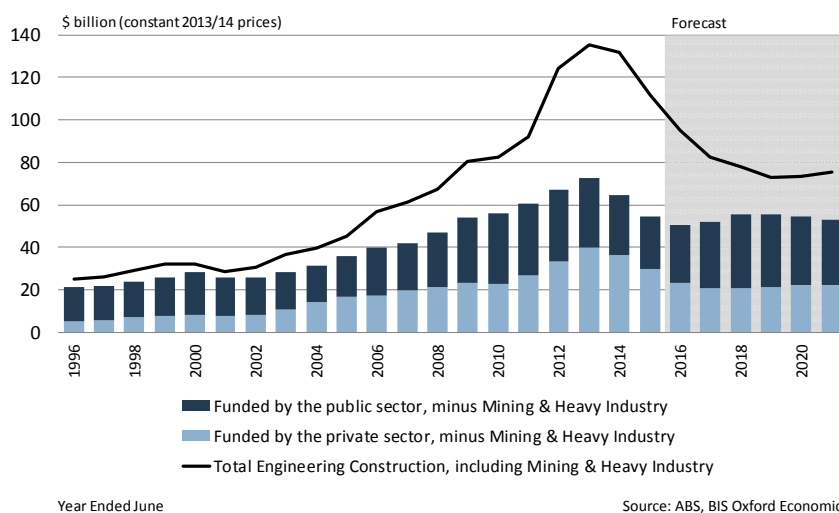


Engineering construction includes all non-building construction activity across transport (roads, bridges, railways, harbours), utilities (water, sewerage, electricity, gas pipelines and telecommunications), recreation, mining and heavy industry construction and other engineering. As such, this category of construction covers economic infrastructure, whereas building tends to cover social infrastructure (including health and education building).

Total non-residential activity is forecast to decline by 2% in 2016/17, with lower office and health construction driving the fall. Other social and institutional building should help prevent a larger decline, with a number of major defense and prison projects scheduled to start over the coming years. Over the subsequent years to 2020/21, a relatively flat profile around the \$35 billion mark is forecast. Weaker economic conditions are expected to take hold from 2018 as business investment remains tepid.

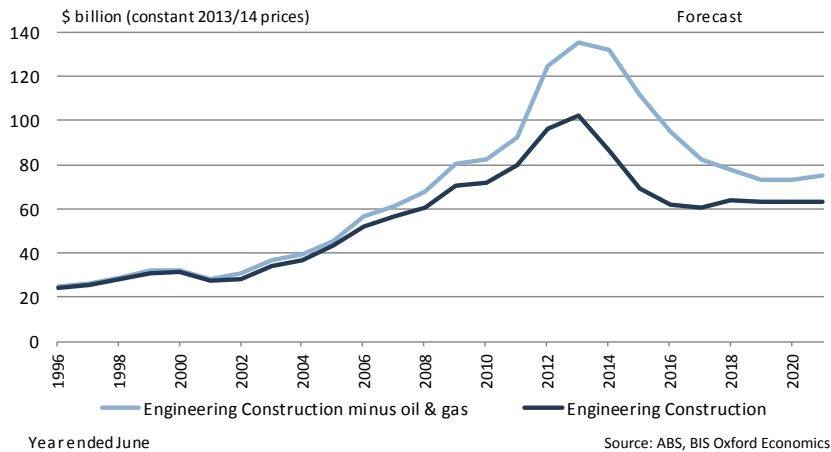
At the national level, total **engineering** construction work done increased strongly during the 2000s and early 2010s, rising from around \$30 billion in work done in 2001/02 and peaking at \$135 billion in work done during 2012/13. This was driven by both booming resources investment (involving the construction of mines and heavy industry facilities, railways and ports) as well as a near doubling in publicly funded infrastructure construction (across roads, railways, water, sewerage and electricity). Between 2012/13 and 2015/16, the value of national engineering construction work done has fallen a cumulative 30% to \$95 billion. This is primarily due to sharp falls in mining-related construction activities (railways, harbours and mining and heavy industry construction) but also falls in publicly funded engineering construction, despite a sharp upswing in publicly funded telecommunications activity (the rollout of the National Broadband Network).

Engineering construction activity, including and excluding Mining & Heavy Industry Construction, Public and Private Sector funding splits - Australia



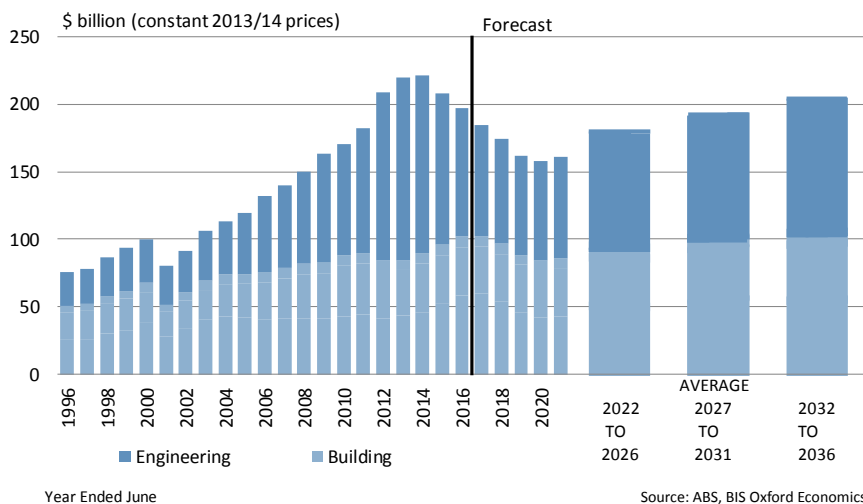
Looking ahead, the downturn in national engineering construction activity still has 2-3 years to run. However, this outlook is heavily impacted by the ongoing collapse in oil and gas-related construction, as a series of large multi-billion dollar projects are completed in Queensland, Western Australia and the Northern Territory. The sheer scale of the downturn in the \$200 billion+ LNG investment cycle means that its decline will ultimately shape the path of total engineering construction work as measured by the Australian Bureau of Statistics (ABS), despite much of this work being effectively offshored and not contestable to Australian-based contractors.

Engineering construction activity less Oil & Gas Construction – Australia



Consequently, perhaps a more relevant indicator of the path of engineering construction activity contestable to local contractors is the total engineering constructions series excluding oil and gas construction (a sub-segment of mining and heavy industry construction). This series indicates that engineering construction activity will trough in 2016/17 and move to a higher level thereafter. Transport, utilities and recreation construction (that is total engineering construction less mining and heavy industry) is expected to rise over the next two years – led particularly by large road and rail projects – and stay above 2015/16 levels through the next five years. Nearly all of the increase here is being funded by the public sector (as shown in the chart above), with privately funded non-mining and heavy industry construction expected to remain relatively flat. In other words, growth in the engineering construction market is overwhelmingly being driven by public sector procurement.

Total construction activity - Australia, by sector





2 CONSTRUCTION CHALLENGES

Construction Challenges



Challenges facing New South Wales

Analysis of capability and capacity issues in the New South Wales infrastructure sector is timely.

New South Wales – with eastern seaboard Australia – is entering an ‘infrastructure moment’. The sheer volume of work proposed came through as a concern during the interviews with industry conducted for this Report (see chapter 3). The funding from asset sales and the public investment in infrastructure is welcome, say contractors, yet at the same time many practical questions are emerging around the task itself. Participants wonder ‘how will NSW build all the new schools and hospitals with the money now available in the wake of the Ausgrid sale?’. Industry participants noted their capacity utilisation is already rising and that at some point they would hit capacity constraints.

The worry is that with such a big pipeline, things will slip: participants reported some projects were already slipping, say from the first quarter to the third quarter. This increases cost and risk. Partly this is because of delays on the government side, prompting observers to ask, do the state’s agencies have the resources to deliver the pipeline?

Interview participants also recognised there are challenges on the industry side. In the past, a number of participants admitted, industry may not have been so good at responding. This time, they felt it would be better, because *‘we’ve got through the mining boom and are better for it’*. In addition, overseas resources are on call: several big international firms are coming to Australia, especially for specialist roles such as tunnelling (for soft ground tunnel boring ‘we need international experience, we are not doing it very often in Australia’). Big projects tend to attract the best people from around the world – but that puts Sydney in competition with Singapore, London and other major markets.

There was much discussion during the practitioner interviews around the meaning of ‘capacity’ and ‘capability’. If capacity is about the volume of resources available, and capability is about the ability of those resources to do the work well, then industry seems more concerned about the second. Participants expressed optimism that industry will ultimately cope with the volume of construction. If there is a huge call on construction materials, for instance, then ‘industry will find a way’ to source the materials, as it has demonstrated in the past – albeit with pockets of price escalation.

The capability side – the mix and timing of the current NSW construction wave – are perhaps more troubling for industry participants:

- the pipeline of projects underway in NSW includes a mix of activities that are somewhat different than normal, such as a number of tunnels
- this is compounded by work also scheduled in the wider market, involving specialised projects in Victoria, Queensland and elsewhere¹
- as NSW construction activity swings from building to civil, the specific demands on skills and materials will shift²
- this program attracts a higher degree of public scrutiny and pressure to achieve challenging program milestones due to the profile of the projects³
- potential threats from union threshold behaviour close to deadlines could result in increased cost to industry to get the work finished

These concerns need to be set against the masterplan in New South Wales. In this Report we discuss the importance of the construction program being fully integrated and transparent to all stakeholders, in order to optimise the response by industry and ensure it remains nimble.

Can the industry get a better picture of the future workload, especially as government’s share of the work is high and rising? Beyond 2019, there is already a need for industry to plan, including making critical decisions about staffing and investment in capacity.

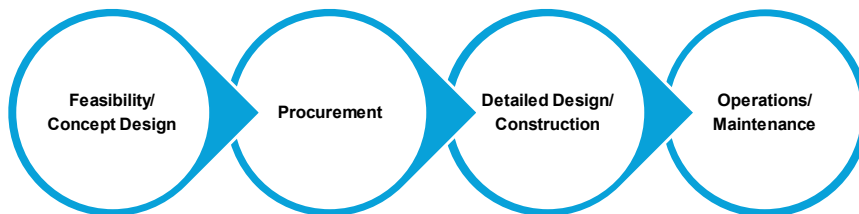
‘The worry is that with such a big pipeline things will slip’

¹New South Wales is competing for specialised resources against Victoria (VIC has done an asset lease deal that will generate dollars to spend on infrastructure and will add further pressure on resources) and Brisbane, as well as New Zealand which has two big tunnel projects in Auckland plus road projects, as well as Singapore and China which are also booming thereby creating heightened demand.

²For example, high rise apartments use precast concrete that is typically moulded off-site, while engineering projects typically do their own precast on site and the mix of skills will differ.

³For instance, tunnels have a history of leak problems, making it desirable to seal them properly, but there can be a tendency for a contractor to say ‘we’ve got to finish the tunnel on time’ and to cut corners in the second half fitout stage, which often trips things up due to logistics (limited entry/exit points to the tunnel can delay fitout works which must follow along behind the borer).

Risks to capacity and capability exist at each stage of the project lifecycle



Central to the success of the program will be the infrastructure planning, procurement and governance arrangements in NSW. These matters have been addressed in the national context in the 2014 Productivity Commission report on Public Infrastructure.⁴ Yet our industry soundings indicate that these are still particular matters of concern in New South Wales.

Industry representatives noted that *'the construction landscape in NSW is littered with carcasses from past booms'* and suggested this reflects the traditional situation in the state, described as a 'race to the bottom' involving too many operators earning thin margins 'leaving no wriggle room' with contractors 'bearing the risk for everything', on top of the expensive cost of putting a bid together. It was predicted by industry that some contractors will fail because they are taking on huge risks, and that the resulting litigation battles could push project costs higher than anticipated.

Government agencies are also concerned about this. They are aware that some projects are being underbid and that some contractors haven't allowed for enough resources. Agencies further noted that the resources of many contractors are increasingly stretched. The current apartment boom is like a magnet for subcontractors versus more complex projects such as hospitals (eg. operating theatres) and schools (eg science labs), because it is 'sometimes easier to just build a unit block', raising the possibility that some builders are pulling out of tendering for the more challenging non-residential/civil projects that are critical to the wave.

According to industry sources this in turn is pushing up prices for projects that involve complexity/risk, skewing into the potential threat of cost escalation against major New South Wales projects. With such a substantial pipeline, price escalation is a worry. Industry observers tell us that for some resources, escalation is now starting to accelerate in Sydney.⁵

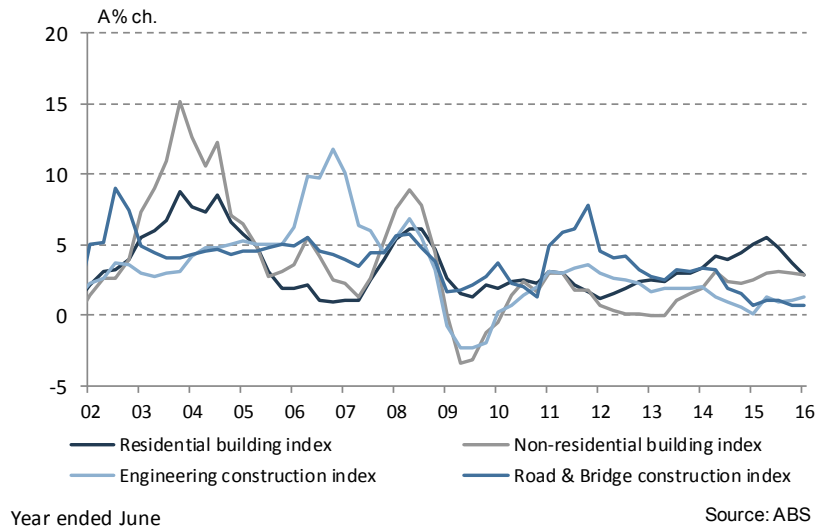
Despite surging construction, cost growth has, surprisingly remained contained. There are a number of factors at play that could provide a possible explanation for this, including:

- **Intense competition** – from recent industry interviews, participants stressed the growing level of competition across the construction sector, and tight margins.
- **Shift in the type of activity** – the current period is seeing the mix of residential activity change from detached houses to apartments, and engineering from mining to civil. The mix of materials is evolving accordingly.
- **The end of the boom elsewhere** – with the mining boom waning in other states this has potentially freed up capability and capacity in the market to deliver in NSW.
- **Low inflation environment** – the Australian economy has been in a low demand / low inflationary environment for several years, including record low wage growth.

'Sydney is now the new Perth as the construction epicentre'

⁴Productivity Commission 2014, Public Infrastructure, Inquiry Report No.71, Canberra <http://www.pc.gov.au/inquiries/completed/infrastructure/report>
⁵There is not the same problem in regional areas (yet), especially near the Queensland and Victorian borders where there are available people and materials from across the state line.

Construction price indices - annual percent change, New South Wales



Additionally, the onset of the GFC drove a sharp correction in Australian dollar prices for steel and oil products (such as bitumen and diesel fuel) and, even accounting for the depreciation in the Australian dollar, this was a key factor driving the sharp deceleration in growth in the engineering construction IPD through 2009/10. While engineering construction activity picked up again nationally and in New South Wales between 2009 and 2013, the combination of stagnating steel prices and higher competition for work amongst contractors (impacting on margins) has helped keep cost growth in check. Over the past two years, growth in the NSW engineering construction IPD has tracked around 1% per annum, driven by falling levels of construction activity (nationally and in New South Wales) as the mining investment boom has unwound alongside public infrastructure investment, another downward correction in oil prices, and a highly competitive contractor market.

Yet the risks are now growing. At the moment, according to industry soundings, labour inputs are a greater issue than materials in terms of potential cost escalation. For example, bricklayers used to charge \$1.20 a brick, now it's \$2. Estimators right now 'are as rare as hens teeth'. And the list of skills in short supply is growing.

'We have not seen excessive price escalation to date but now the mood is just starting to turn'

BIS Oxford Economics' liaison with industry for this report suggests that construction skill shortages are presently developing in a range of occupations, participants specifically mentioned steel fixers, quantity surveyors, fixed plant operators, designers, environmental engineers, trucking monitors, road designers, tunnellers, site managers, electrical sub-contractors, community stakeholder experts, CAT operators, geotech technicians, selected trades, fabricators with the right skill mix, trained formworkers, scanners, and glaziers. Generally, professional services salaries are tightening.

Meanwhile, the capacity to source key construction materials and inputs is becoming an issue as the project pipeline heats up. With almost simultaneous upswings in both apartments and infrastructure, some industry participants 'are seeing escalation in key materials such as cement and concrete'.⁶ Industry players report that the cost of dwelling construction inputs is 'creeping up', when an item is in short supply, and in some cases now **'you need to give six months notice to source your requirements'**.

One NSW government agency reported that it has not seen price escalation to date but now 'the mood is just starting to turn'. It is starting to cost more to get project managers, for instance. As the volume of work ramps up, large busy contractors (and established sub-contractors) are becoming more choosy, less accepting of risk, more demanding of how the packages are presented to them and offering less timely service. During the tender process agencies 'used to be able to pile on conditions, but now contractors are less accepting'. It seems inevitable that tenderers will ask government to share some of this risk, going forward.⁷

If skills and materials capacity hits a major pinch point in 2018-19, prices could escalate beyond those currently budgeted. This will have the effect of reducing the *real* funding available to each agency: with higher cost inflation, a given number of project dollars will buy less. Industry points out that D&C (design & construct) contracting, currently popular in NSW, is particularly vulnerable to cost escalation. We address the issue of choice of contract in this Report.

Given the large infrastructure construction program, a scenario may emerge where contractors will start jobs, only to find a year later that costs are blowing out. Quality may also suffer. There exists a tradeoff between quantity and quality: if you require increased quantities, then you may see quality decline. As demand increases, imports will be on the rise and industry says this also tends to erode quality.

⁶There is no shortage of concrete as such but the lead time required for ordering is lengthening and price is rising. Moreover, the issue is nuanced by sub-category: the rise in precast demand on the back of the apartment boom and other building in NSW is pushing up the price of precast because of limitations on available plant capacity as well as skills to make the moulds.

⁷Industry participants suggested government shares escalation risk with industry. For example, based on a reference index, the contractor puts in a claim and is reimbursed for increases over the index.

One factor that may particularly exacerbate escalation is transport and logistics capacity. Construction solutions have to be *delivered* solutions, and that raises a host of questions about freightage networks. Industry participants interviewed were often more concerned about moving construction materials around than sourcing the materials themselves.

Steel, concrete, and other materials generally need to be shipped to the site.⁸ Industry says that 'on time distribution is getting harder'. The truck fleet is not being used to the maximum: a lot of trucks are on the road in peak hour, but the trucks are also underutilised outside 9-5 business hours.⁹ Major suppliers report rising difficulty to deliver concrete on time: wet concrete has an expiry limit (approximately 2 hours). Brick producers say moving 100,000 tonnes of bricks a year around Sydney is getting harder (transport = about 1/3 of the delivered cost of a brick). Suppliers who track delivery times say their analysis shows it is taking longer than it used to in metropolitan areas (regions show no significant change yet), due to rising congestion.

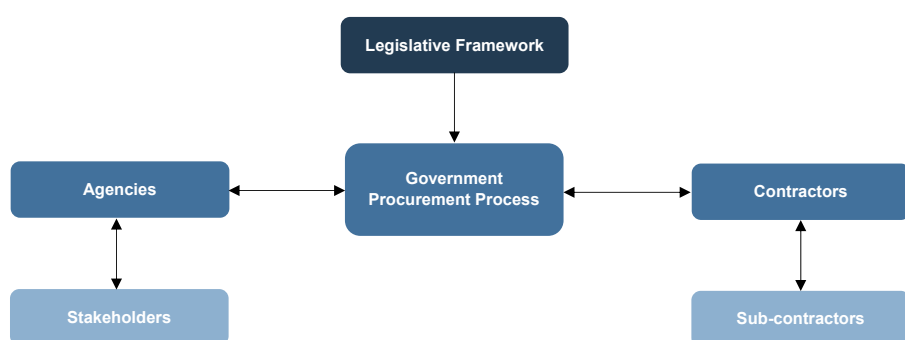
Greater flexibility may be needed from the government, because of the increasing challenge across Sydney to get trucks there and back on time. There is an ever-pressing need to develop and unclog Sydney's transport system. For instance, it was suggested that the traffic authorities should streamline where cars can park, including on weekends, to keep key arteries clear seven days. Where passenger rail is at capacity limits, expanded train capacity may mean cars can be taken off the road. And more could be made of alternative transport modes (such as waterways).

Suppliers may also need permits to be allowed to produce more from existing factories. Regulations are understandable if the (say, concrete) foundry sits in the middle of suburbia. Equally, during construction peaks government may need to consider special approval for extra production, expanded truck movements, temporary relaxing of EPA regulations, and the like.

In summary, the New South Wales construction program is ambitious, as much in procurement as in delivery. The Government has rarely run a mega-program this size all at once (20+ mega projects concurrently - see page 11). Based on our recent industry and agency soundings, key themes that emerge are:

- The overall sequencing/approval process may benefit from better synchronisation across NSW agencies and possibly interstate. NSW Government is arguably over-clustering projects, and under-sequencing them. This is stretching scarce bid resources now. This has been identified by the Productivity Commission as a 'weak' spot for governments nationally, with governments found to exhibit deficiencies in using coherent decision-making frameworks to assess the portfolio of potential projects.
- As construction activity rises, the risk of cost blowouts, including increased loadings on labour and materials, will increase as NSW strives to get projects finished on time in the face of public pressure.
- Transport and logistics – currently, the price of materials (quarry, steel, concrete) is manageable, but there are price pressures in haulage (especially delivering pre-cast, modular units and other bulky items).
- Forward transparency of the pipeline and industry engagement has improved in some agencies but needs to be government wide (given the lead time to order specialised equipment and skills). The Brisbane/Melbourne/New Zealand project pipelines matter too, as these are all competing for resources.
- Government moves to streamline the planning/procurement process and enhance literacy (see box) are welcome.

Ultimately, concerns around the construction program feed into the broader issue of risk, including pricing project risks fully (latent risks) and efficiently allocating risks between public and private partners.



Source: BIS Oxford Economics

Department of Planning and Environment

The Department of Planning and Environment is responsible for effective and sustainable major development planning to support growing NSW. The primary legislation that governs most of the Department's core business functions is the **Environmental Planning and Assessment Act 1979**. The Department administers legislation on behalf of the Minister for Planning. The Department is constrained by legislation to follow a given process for approvals and related decisions. Our recommendation is to set up a literacy program to help industry users get the most out of the process.

Source: Department of Planning and Environment Annual Report 2014/15

'Construction solutions have to be delivered solutions, which raises a host of questions about logistics'

⁸An alternative is to use on site batching (concrete) or fixing (steel), say, but these can increase the price. And there may be local noise and other (eg. EPA) restrictions.

⁹Barriers are often encountered (eg road closures - yes government does alert industry in advance but the detours are often long and convoluted). Rail is not used much, because the route from quarry to project is convoluted and requires road transportation.



3

METHODOLOGY

BIS Oxford Economics was engaged by Infrastructure NSW to assess capacity and capability of the construction industry in New South Wales, and particularly to garner a 'grass roots' perspective from the industry itself.

Accordingly, our methodology revolved around industry liaison, via both survey and interviews, aimed at gathering views from commercial players on what they see as the looming limitations on delivering the NSW's ambitious construction program.

We also talked with half a dozen key state agencies.

The liaison has then been supplemented by BIS Oxford Economics' own data analysis.

Industry liaison

BIS Oxford Economics has drawn upon its extensive network of industry contacts to conduct 'soundings' of industry leaders. This has been used to gauge concerns about their capacity and capability to deliver as well as glean positive ideas for improvement, around a range of potential issues such as:

- ▶ access to exhaustible raw materials
- ▶ supply of essential labour skills
- ▶ the potential role of technological advances
- ▶ alternative procurement models
- ▶ finance constraints
- ▶ economies of scale
- ▶ import competition
- ▶ role of international contractors
- ▶ environmental and recycling strategies
- ▶ forms of partnership between industry and government
- ▶ regional issues
- ▶ transport and logistics
- ▶ public sector construction programs 'crowding out' private activity
- ▶ NSW's position relative to other states

As BIS Oxford Economics took the 'pulse' of industry we have generated a unique information database and gained invaluable insight into industry concerns, as well as uncovering opportunities for better ways of delivery.

Survey

BIS Oxford Economics designed an industry survey to obtain quantitative feedback on various issues concerning construction industry capacity and capability in New South Wales.

The survey generates quantitative ratings of industry opinion and complements the qualitative feedback from industry interviews.

Questions surveyed include:

- ▶ what is the outlook for construction activity in NSW and outside of NSW compared to current conditions?
- ▶ where are input cost pressures or supply constraints likely to emerge going forward, their likely level of impact on the construction industry and whether they are a short term or long term risk?
- ▶ what operational or delivery constraints affecting industry capacity and capability are likely to emerge going forward, their likely level of impact on the construction industry and whether they are a short term or long term risk?
- ▶ what short term and long term external factors are likely to impact on the construction industry?
- ▶ how important are government actions to mitigating downside risks (or maximising positive benefits) associated with the forward construction pipeline in NSW?
- ▶ how important are technologies and strategies for improving construction industry productivity?
- ▶ what hurdles are evident to improving construction industry productivity?

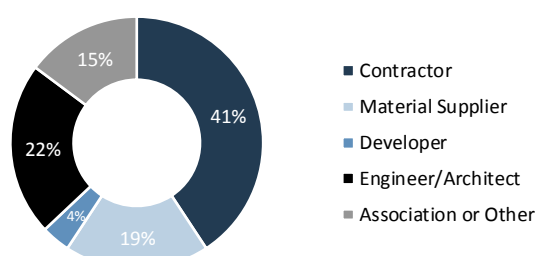
The survey questions and collected responses are presented in Chapter 4. In addition to set questions, space for free form comment was also provided to respondents.

BIS Oxford Economics received 25 valid responses to the **2016 Construction Delivery Assessment Survey** ('the survey').

Respondents were broadly representative across the construction sector.

- In question 2A of the survey, respondents were asked to choose their sector.

2A. Type of Business: % of respondents



Eleven (41%) respondents identified as 'Contractors', 6 (22%) respondents identified as an 'Engineer or Architect', 5 (19%) of respondents identified as a 'Material Supplier', 4 (15%) respondents identified as an 'Association or Other', and 1 (4%) respondent identified as a 'Developer'.

- In question 2B of the survey, respondents were asked to identify the size of their business (in approximate annual Australian turnover in A\$). The results are as follows:

The majority of respondents identified the size of their annual business turnover as over \$1 billion, accounting for 54% of total respondents. 18% of respondents identified their annual business turnover as between \$500 million and \$1 billion. 15% of respondents identified the size of their business between \$50 million and \$500 million. 13% of respondents identified their annual business turnover as less than \$50 million.

- In question 2C of the survey, respondents were asked to identify the approximate share of their Australian turnover by segment. We averaged results across all respondents, which are as follows:

Engineering construction was the largest segment contributing to turnover, accounting for 41% share. Residential building construction contributed to 25% of turnover, with non-residential building contributing to 23% of turnover. Other (non-construction) contributed to 11% of turnover.

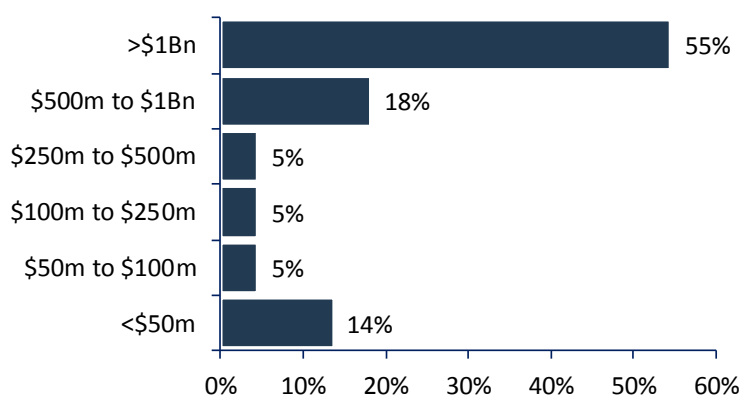
- In question 2D of the survey, respondents were asked to identify the share of approximate annual New South Wales turnover in A\$. The results are as follows:

The majority of respondents identified the size of their annual NSW business turnover as between \$500m and \$1 billion, accounting for 29% of total respondents. 19% respondents identified their annual NSW business turnover as less than \$50m. 14% of respondents identified their annual NSW business turnover as over \$1 billion.

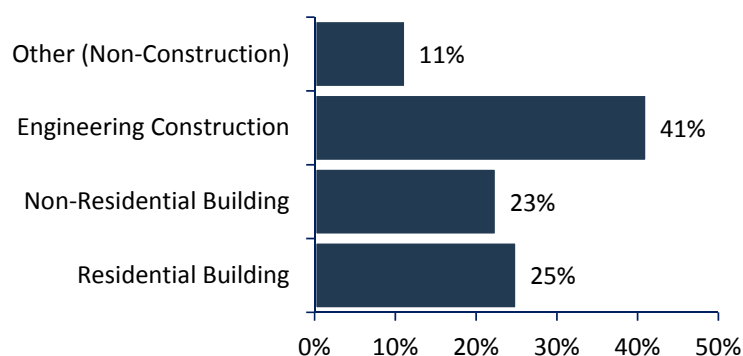
- In question 2E of the survey, respondents were asked to identify the approximate share of their NSW turnover by segment. We averaged results across all respondents, which are as follows:

At the NSW level, engineering construction was the largest segment contributing to turnover, accounting for a 44% share. Residential building construction contributed to 29% of turnover, with non-residential building contributing to 23% of turnover. Other (non-construction) contributed to 4% of turnover.

2B. Size of Business (\$A): % of respondents



2C. Share of Australian turnover by construction segment: % of respondents



Interviews

BIS Oxford Economics conducted structured interviews with various participants in the construction industry and government agencies.

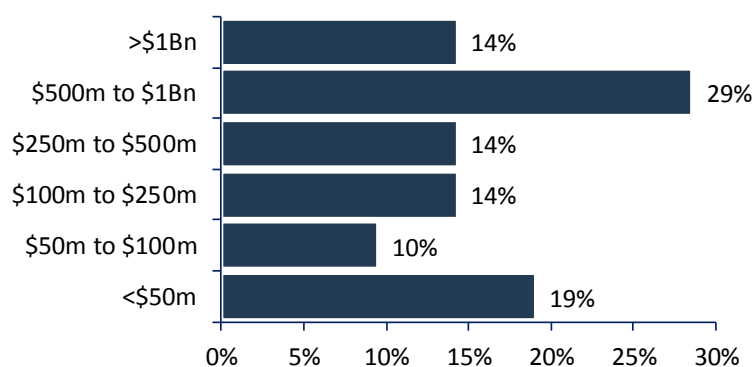
We interviewed senior personnel from over 40 key organisations across the construction industry, seeking their input and perspectives in identifying potential risks to capacity and capability. Input supply constraints such as skills and materials, the approach to project procurement, as well as other factors – technology, transport, external risks – emerged as critical issues. Participants offered their thoughts on developing industry policies that will help mitigate against downside risks, while preserving the benefits of the state's construction program.

While many of the concerns of the construction industry speak to the next 5 years, participants also were asked to consider the next 20 years.

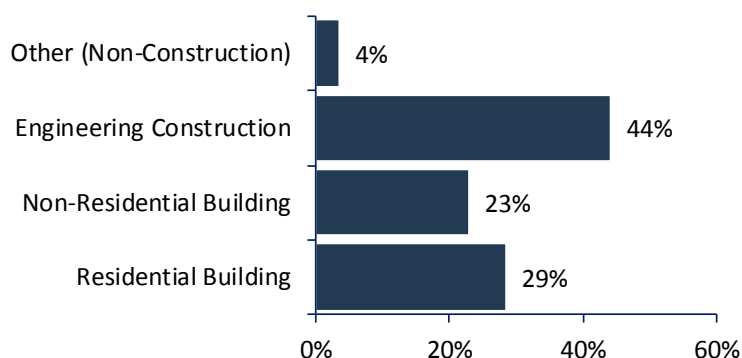
In this Report we do not identify or attribute any comments or views expressed in these interviews back to individuals or companies. We have simply documented the issues raised and the thoughtful contribution participants have generally made toward planning and delivering the construction program in New South Wales.

Note: Figures in charts may not sum to 100% due to rounding.

2D. NSW turnover by construction segment (A\$): % of respondents



2E. Share of NSW turnover by construction segment: % of respondents



The forecasting methodology

Supplementing the survey and interviews, BIS Oxford Economics also includes in this Report considerable data analysis, forecast and desktop research.

We provide construction activity data for NSW, in work done terms (Chapter 1). Historical numbers are sourced from the Australian Bureau of Statistics (ABS), covering the value of engineering and building construction work done, classified by state, and filtered by sub-sector.

We then provide 20-year forecasts of NSW construction activity, with a focus on the next five years. Our forecasts derive from the combination of 'bottom-up' and 'top-down' approaches.

The bottom-up method involves analysing the capital programs of government departments and public authorities and private sector investment plans project-by-project, sector-by-sector.

As a check and balance, we then temper our forecasts with a 'top-down' approach, so that they are consistent both with historical levels of investment and with our assumptions of the economic environment, public capital expenditure cycle and private investment cycle.





4

INDUSTRY VIEWS: SURVEY RESULTS

Construction program

New South Wales is currently delivering a large program of construction; a pipeline which is on a scale with major development programs elsewhere in the world.

This may challenge the capacity and capability of both industry and government, and raises a number of program issues, around the volume of work, the mix of work, potential price escalation, and risk

Each of these has the potential to make or break the program.

As part of this study, BIS Oxford Economics conducted a survey of industry participants to gauge views on capacity and capability going forward. We asked about the construction program, particularly overall capacity and capability.

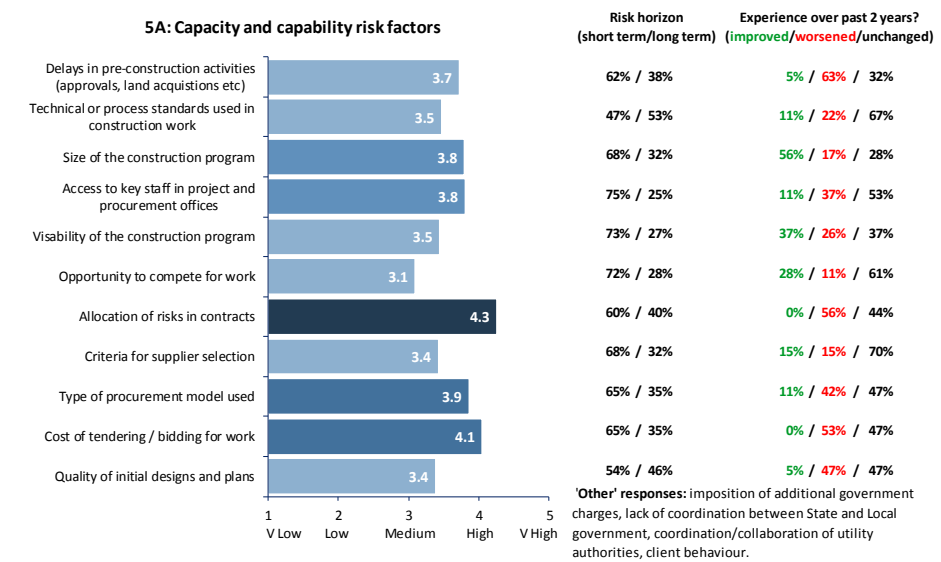
In question 5 of the survey, respondents were asked the following question:

"In your view, what aspects of the construction delivery program affecting industry capacity and capability are emerging or likely to emerge going forward, their likely level of impact on the construction industry and whether they are a short term or long term risk (or both)? Note that short term refers to within the next 5 years, whilst long term refers to the next 5-20 years."

Respondents were to rate the level of impact of construction delivery program factors on capacity and capability between 1-5, with 5 indicating 'very high impact', 4 indicating 'high level of impact', 3 indicating 'medium level of impact', 2 indicating 'low level of impact', and 1 indicating 'very low level of impact'.

Respondents were also asked to rate their experience of the construction delivery program over the past two years, either as 'improved', 'worsened' or 'unchanged', and whether it is a short term risk, long term risk, or both.

Respondent results were averaged, with results as follows:



Respondents indicated that 'allocation of risks in contracts' is the highest construction delivery program factor affecting industry capacity and capability, because of its effect on industry's willingness to tender, to invest, to innovate and to think long term. 60% of respondents identified this as primarily a short term risk, with 56% of respondents identifying their experience of risk allocation in contracts as having 'worsened' over the past 2 years. No respondent indicated that this factor had improved in the past two years.

'Too much of the design cost is in managing the approval process'

Other responses listed include:

- › cost of tendering/bidding for work: 65% of respondents identified this as a short term risk, with 53% of respondents identifying their experience of tender/bid costs as having 'worsened' over the past 2 years. No respondent indicated that this factor had improved in the past two years
- › type of procurement model used: 65% of respondents identified this as a short term risk. 42% of respondents identified their experience of this as having 'worsened' over the past 2 years, while 47% of respondents said it has 'unchanged'

Survey Respondents elaborated as follows:

In terms of 'contract risk':

- › "Risk transfer and poor profitability have been a key feature of the industry since the GFC. The poor outcomes for contractors in this environment have seen industry consolidation and a reluctance for investment in the building industry. Until there is some reward for the risk and effort taken by the industry there will continue to be a lack of investment in new capacity."
- › "As a general rule, the risk allocation within a standard construction project is acceptable; the issue is that the associated profit does not always compensate for the risk profile."
- › "Key risks are around risk allocation in contract work, in particular lead contractors or builders desire to pass on risk to suppliers without compensating for the cost."

In terms of 'tendering/bidding':

- › "The approvals process has become more onerous and the requirements are increasing for each project. There seems to be more authorities/bodies that need to be consulted. A streamlined simpler and transparent system needs to be initiated."
- › "Cost of tendering can be prohibitive, PPP's for instance is substantially more than a similar non PPP project due to the required design cost being incurred by each tenderer."

In terms of 'procurement':

- › "Overall, whilst procurement process and funding lies primarily through state, and the load remains high, government procurement and program management risk will remain a high risk."
- › "Too much of the design cost is in managing approvals. 40% of the costs are doing design/60% of the costs are managing the approval process."
- › "The State is exploring alternative procurement approaches for major construction projects based on new entrants and the wash out from the Engineer, Procure, Construct, Manage (EPCM) / Managing Contractor models in the mining industry. The outcome is the shoe horning of new models into otherwise simple projects and significantly extending the procurement cycle, while not improving efficiency, risk allocation or cost compared to the traditional models."

- “Government work is crowding the construction sector - driven by the need to sustain the economy post mining boom. The complexity of the procurement process, combined with probity and planning approvals processes are adding significant time delays to multiple projects - whether government initiated or not.”

In terms of “access to key staff”:

- “Uncertainty of the timing and scale of projects planned means the industry does not plan ahead for resources. It is very difficult for entities to employ staff and secure the required supply chain effectively if there are several other entities bidding for the same pipeline of work.”

Respondents were asked what initiatives should be undertaken to mitigate against capacity and capability risks identified in Question 5A. Respondant elaborated as follows:

- “Early engagement of the supply chain on design & procurement considerations so that resources to support project requirements can be aligned.”
- “In relation to the cost of tendering – a review of the existing tender process. Perhaps may include a reimbursable amount to the tenderers and/or a review of the expectation/ requirement of the tender documents. Perhaps more information to be included in the tender documents, this may alleviate the duplication of effort.”
- “Communication between States on the overall programme and consideration of implications verses individual State focus. Procure projects on a ‘best for project’ basis rather than trying to force a model on projects. Reduce bid costs for proponents and provide reimbursement, reduce the number of shortlisted candidates and improve the selection criteria to more accurately reflect the demands and values of the client.”
- “High quality concept design and risk allocation models. Government must work collaboratively with contractors to share risk and not pass all risk to the contractor.”
- “There is a high level of competition in the construction and engineering sectors, despite the large workloads being experienced in NSW. There are still contractors willing to bid with low margins on the assumption they will secure additional profits via variations. This is significant risk as was seen with the demise of several contractors a few years ago who had a similar commercial approach.”



‘Government would do well to work more collaboratively with contractors’

Inputs and costs

At a fundamental level, capacity and capability risks in the New South Wales construction sector inevitably relate to the degree in which industry has access to key construction inputs, including construction materials, equipment and workforce skills, both professional and trades-based. Of importance is not necessarily the growth in – or level of – industry demand, but rather how flexibly supply can respond to demand, either by being able to scale up locally or to draw on external supply chains. Constraints to input supply often have implications for input costs, and may threaten the timely delivery of construction projects.

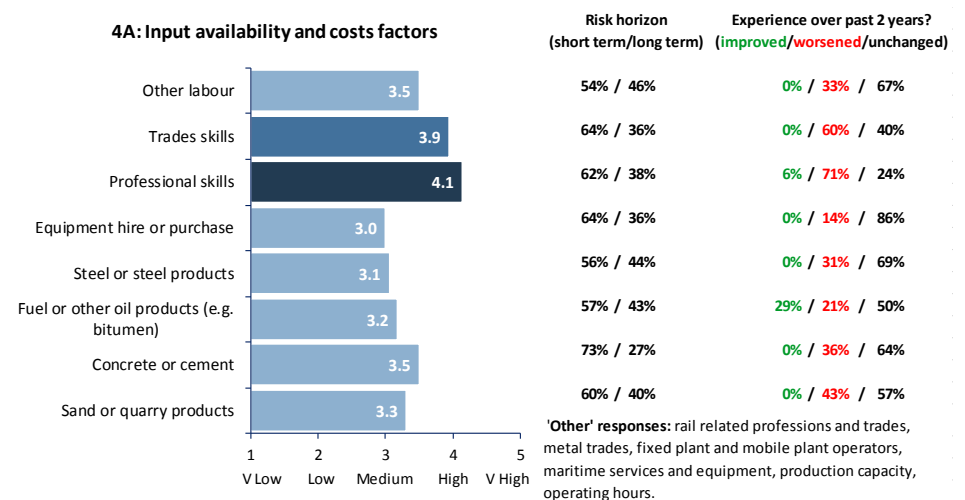
In question 4 of the survey, respondents were asked the following question:

“In your view, what construction input availability or cost pressures affecting industry capacity and capability are emerging, or likely to emerge going forward? What is their likely level of impact on construction industry capacity and capability? Please identify whether they represent a short term or long term risk (or both)? Note that short term refers to within the next 5 years, whilst long term refers to the next 5-20 years. Please note also if there has been improvement or deterioration in the availability or cost of input supply over the last two years.”

Respondents were to rate the level of impact of construction input availability or cost pressures on construction capacity and capability between 1-5, with 5 indicating ‘very high impact’, 4 indicating ‘high level of impact’, 3 indicating ‘medium level of impact’, 2 indicating ‘low level of impact’, and 1 indicating ‘very low level of impact’.

Respondents were also asked to rate their experience of the availability of cost of input supply over the past two years, either as ‘improved’, ‘worsened’ or ‘unchanged’.

Respondent results were averaged, with results as follows:



Respondents indicated that ‘professional skills’ was the highest construction input availability affecting industry capacity and capability. 62% of respondents identified this as primarily a short term risk, with 71% of respondents identifying their experience of professional skills as having ‘worsened’ over the past 2 years.

Additional responses listed include:

- Trade skills: 64% of respondents identified this as a short term risk, with 60% of respondents identifying their experience of trade skills as having ‘worsened’ over the past 2 years.
- Other labour: respondents identified this equally as a short term and long term risk. 33% of respondents identified their experience of this as having ‘worsened’ over the past 2 years, while 67% of respondents said it has ‘unchanged’.
- Concrete or cement: 73% of respondents identified this as a short term risk. 36% of respondents identified their experience of this has having ‘worsened’ over the past 2 years, while 64% of respondents said it has ‘unchanged’.

With the majority of factors listed in the survey (except fuel or other oil products e.g. bitumen), almost no respondents listed their experience over the past 2 years as having 'improved'.

Respondents elaborated as follows:

In terms of 'resources':

- *"In NSW we anticipate significant upward price pressure on sand, other quarry products and concrete due to relocation of major supply sources to areas well outside the Sydney metropolitan area."*
- *"Quarry products are at risk of being locked up for single major projects, leading to considerable short falls of availability in the Sydney region."*
- *"Regulatory constraints of operating new quarries/mines and the lengthy time factor taken from conception to become a fully operational site."*
- *"In the past 3-6 months we have seen an increase in concrete pricing and an increase in lead times for deliveries on concrete."*
- *"Large pipeline of work over the next few years for steel is more about locking in prices now and being exposed to commodity price movements in the next two-three years."*

In terms of 'professional and technical skills':

- *"WA-based resources are not at this stage interested in moving East without considerable inducements."*
- *"It is very difficult to recruit qualified staff in surveying and the demographics indicate it will not improve even in 10 years if current work continues."*
- *"Professional skills, particularly quality foreman, site supervisors, site engineers are more difficult to secure and premiums required to attract and retain high quality staff".*

In terms of 'trades skills':

- *"Contractors needing trade skills will generally identify the need at the time they need skilled tradespeople - to ensure skills are available at the time they are needed, a pipeline of apprentices and trainees need to be in training 3 and 4 years beforehand."*
- *"Two main issues with construction trades – they are unavailable and/or lack efficiency. Unavailability is driven by low number of tradesman or high volume of works, or both. Observations and commentary regarding efficiencies is effected by competency (or lack of) and or poor site supervision. This may also be affected by the high number of workers from overseas (predominately Asia and Europe) – the poor understanding of the local rules/laws coupled with poor education/ qualifications results in poor efficiencies."*
- *"The lack of depth in the supply of new trade skills through the apprentice system, and the tendency for business taking on apprentices to be motivated more by sourcing cheap labour, is contributing to this lack of depth."*

In terms of 'other labour' issues:

- *"Skills and labour issues are as a result of underinvestment in training and disincentive to progress for workers, given excessively generous award / union rates and conditions."*
- *"Salary costs are starting to rise greater than inflation and the hourly rates we charge are still tight due to market pressures."*

Respondents were asked what initiatives should be undertaken to mitigate against capacity and capability risks identified in Question 4A. Responses included:

- *"Improved co-ordination of project pipelines across government."*

- *"Better visibility and early engagement in projects."*
- *"Sequencing major projects over the next 10 years so we don't have a 'feast or famine' situation."*
- *"A workforce planning process that maps future workforce needs to anticipate future workforce supply for the industry or for each project should be adopted. This process can identify potential gaps and strategies to close the gaps, including recruitment and skilling strategies. It can also be used to highlight other strategies such as using interstate workforces and to plan for the impact that this approach may have. In Queensland a state government Training Policy exists to ensure that publicly funded projects include employment of apprentices and trainees and involve the skilling of the existing workforce. This can help with major projects leaving a positive and sustainable legacy of skilled workers behind for the next tranche of project work."*
- *"There needs to be government recognition of skill shortages and TAFE and university need to be encouraged to provide graduates in areas of skills shortage."*
- *"In relation to construction trades - Increase and incentivise the participation rate in trade education and apprenticeships – perhaps by reduced education fees and greater collaboration between Private Industry and Government. Police the participation of overseas workers by the provision of transition / bridging courses between overseas certificates and local requirements."*
- *"Better transport links to allow distant commute."*
- *"Reduce and remove red tape in building approval processes."*
- *"More balanced procurement models and risk allocation that recognise these risk factors."*
- *"New sources of sand, quarry and concrete products must be developed within close proximity to major infrastructure projects or smart, efficient logistics approaches to ensure continuity of supply and reduced traffic congestion."*
- *"Ensure master plans for major cities are completed to allow for major changes in the industry."*
- *"Stimulate investment in R&D in the building material sector to accelerate the shift towards less labour dependent buildings systems & materials."*

Supply chain

Underlining access to key construction inputs – whether it be for materials and equipment, or construction skills – is the reliance on a host of external supply chain factors including the quality of transport and logistics, education and training, industry profitability and productivity, and access to global markets amongst other factors. Each of these may have an important role to play in providing capacity and capability to the New South Wales construction industry.

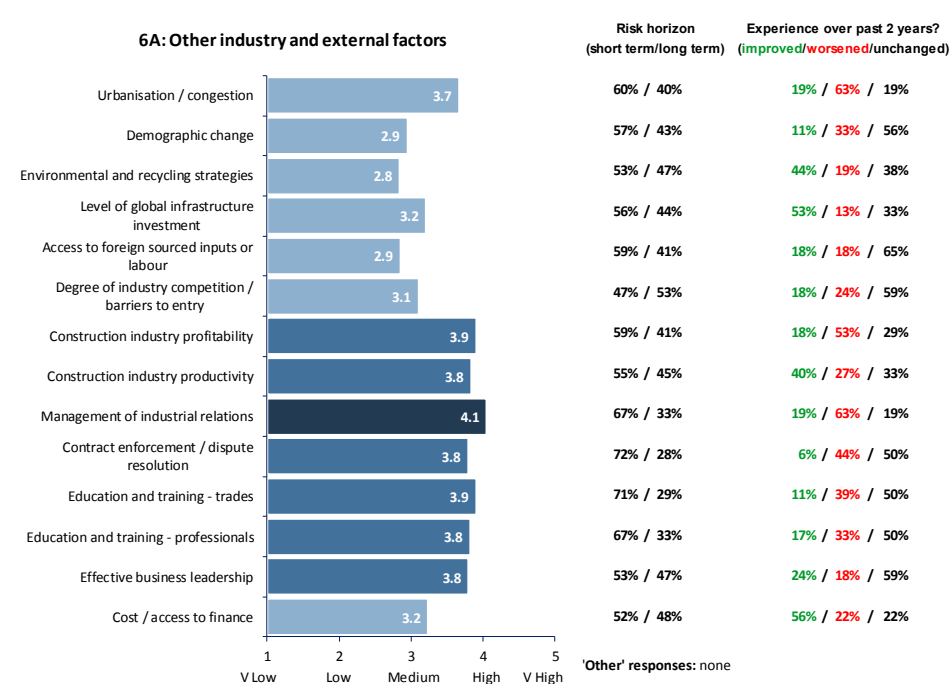
In question 6 of the survey, respondents were asked the following question:

“In your view, what other industry or external factors are likely to impact on construction industry capacity and capability? Note that short term refers to within the next 5 years, whilst long term refers to the next 5-20 years. Please also indicate whether that factor has had an improving or worsening impact on capacity and capability over the last two years.”

Respondents were to rate the level of impact of industry or external factors on capacity and capability between 1-5, with 5 indicating ‘very high impact’, 4 indicating ‘high level of impact’, 3 indicating ‘medium level of impact’, 2 indicating ‘low level of impact’, and 1 indicating ‘very low level of impact’.

Respondents were also asked to rate their experience of factors over the past two years, either as ‘improved’, ‘worsened’ or ‘unchanged’, and whether it is a short term risk, long term risk, or both.

Respondent results were averaged, with results as follows:



Respondents indicated that ‘management of industrial relations’ is the highest industry/ external factor affecting industry capacity and capability. 67% of respondents identified this as primarily a short term risk, with 63% of respondents identifying their experience industrial relations management as having ‘worsened’ over the past 2 years.

Additional responses listed include:

- Construction industry profitability: 59% of respondents identified this as a short term risk, with 53% of respondents identifying their experience of tender/bid costs as having 'worsened' over the past 2 years.
- Education and training – trades: 71% of respondents identified this as a short term risk. 39% of respondents identified their experience of this as having 'worsened' over the past 2 years, while 50% of respondents said it has 'unchanged'.
- Additional responses include: 'construction industry productivity', 'contract enforcement/dispute resolution', 'education and training – professionals', 'effective business leadership'.

Interestingly, 'environmental and recycling strategies', 'demographic strategies' and 'access to foreign sourced inputs or labour' were generally considered as not as important issues by respondents.

Survey Respondents elaborated as follows:

In terms of 'education and training':

- *"Education and training for trades and professionals across the construction industry is poor and perception is that it will worsen. University courses and industry expectation is poorly aligned – perception is that there is a heavy reliance on "learning-on-the-job" and this is not achieved due to poor mentoring / training programs within industry."*

In terms of 'profitability':

- *"Margins have been expanding in the construction sector but the growth in the scale of work being undertaken by companies that have never undertaken larger workloads brings with it a significant risk of business failure which has collateral impacts across the industry. We are at a point in the cycle where business failures are to be expected."*

In terms of 'productivity':

- *"In relation to construction industry productivity – observations and commentary is that this is influenced by union activity, poorly (or un-) trained tradesman and/or poor supervision."*

Respondents were asked what initiatives should be undertaken to mitigate against capacity and capability risks identified in Question 6A. Survey responses included:

- *"In relation to construction trades - Increase and incentivise the participation rate in trade education and apprenticeships – perhaps by reduced education fees and greater collaboration between Private Industry and Government. Police the participation of overseas workers by the provision of transition / bridging courses between overseas certificates and local requirements. In relation to university courses – collaboration between education facilities and industry to align the undergrad programs with industry expectation."*
- *"In relation to Construction productivity - the mandate and involvement of unions in the construction industry needs to be reviewed – this would increase union membership as well as encourage joint efforts in improving productivity in the industry – this may include more involvement of unions in encouraging and promoting trades and in the training and apprenticeships."*
- *"An industrial relations regime that allows greater workplace engagement directly between employees and employers and provides greater workplace flexibility for the benefit of all."*

Technology

An important strategy in reducing the risks of capacity and capability constraints in the New South Wales construction industry involves maximising industry productivity. This can mean that calls on scarce construction inputs are optimised. Here, taking advantage of new technologies and innovations in strategy, procurement processes and delivery may well be crucial. Apart from specifically surveying the industry on the importance of these factors, hurdles to improving capacity and capability were also canvassed.

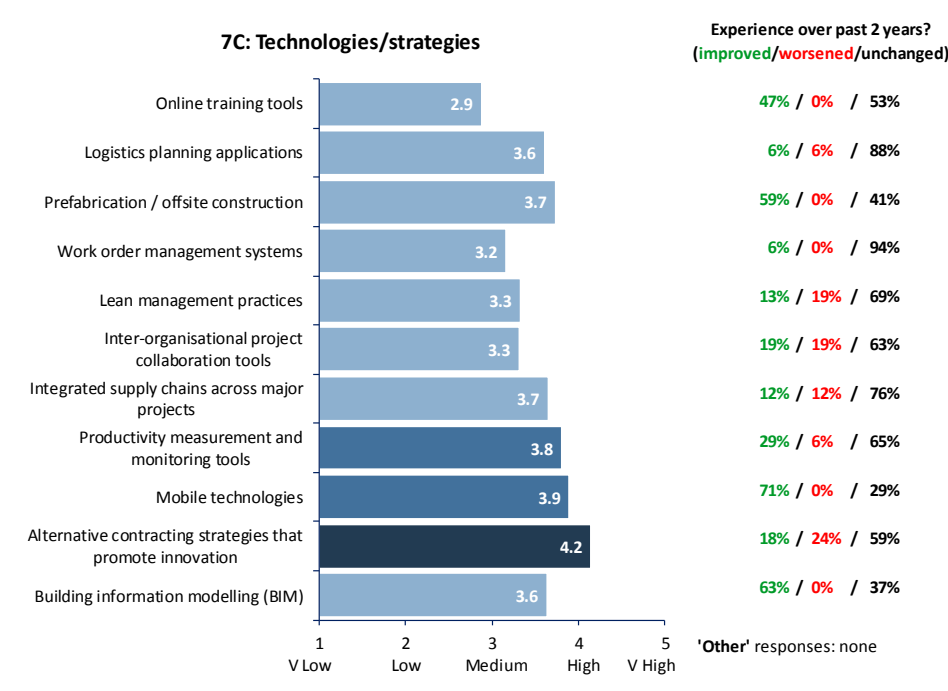
In question 7C. of the survey, respondents were asked the following question:

"In your view, how important are the following technologies and strategies for improving construction industry capability and capacity?"

Respondents were to rate the level of importance of technologies and strategies between 1-5, with 5 indicating 'very high importance', 4 indicating 'high level of performance', 3 indicating 'medium level of importance', 2 indicating 'low level of importance', and 1 indicating 'very low level of importance'.

Respondents were also asked to rate their experience of these measures over the past two years, either as 'improved', 'worsened' or 'unchanged'.

Respondent results were averaged, with results as follows:



Respondents indicated that 'alternative contracting strategies that promote innovation' is the most important strategy to improving capacity and capability, rating this as 'high importance'. 59% of respondents indicated that their experience regarding this measure is unchanged from 2 years ago. Almost a quarter of respondents indicated that their experience over the past 2 years has 'worsened'.

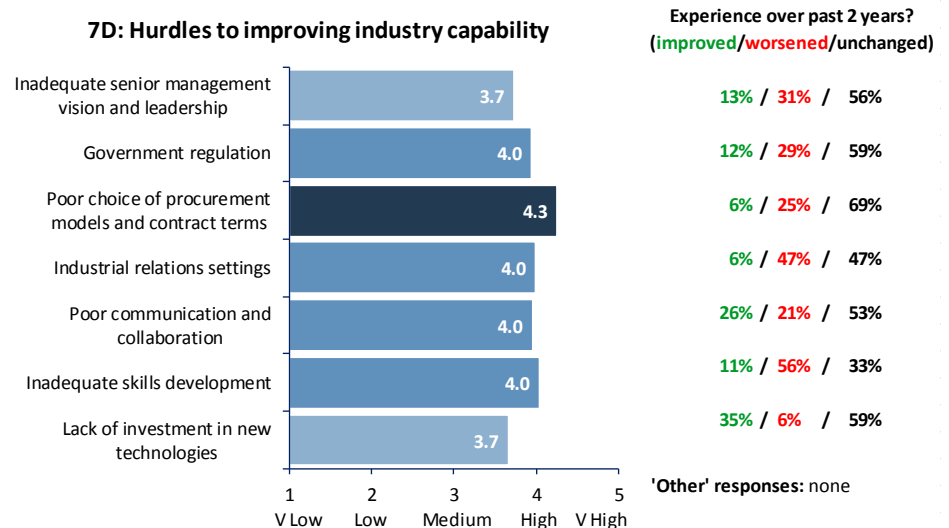
Additional responses listed as close to 'high importance' include:

- Mobile technologies: 71% of respondents indicated their experience has 'improved' from 2 years ago, while no respondent indicated it has 'worsened'.
- Productivity measurement and monitoring tools: 65% of respondents indicated their experience is 'unchanged' from 2 years ago, while almost 30% of respondents indicated it has improved.
- Other responses include: prefabrication/offsite construction, integrated supply chains across major projects.

Interestingly, across almost all results, the majority of respondents indicated that their experience was either improved or unchanged from 2 years ago. This indicates that changes are being implemented in the industry, but there is still progress to be made.

In question 7D. of the survey, respondents were asked the following question:

“In your view, which of the following represent hurdles to improving construction industry capability and capacity?”



Respondents were to rate the level of importance of hurdles to improving industry capability between 1-5, with 5 indicating 'very high importance', 4 indicating 'high level of performance', 3 indicating 'medium level of importance', 2 indicating 'low level of importance', and 1 indicating 'very low level of importance'.

Respondents were also asked to rate their experience of these measures over the past two years, either as 'improved', 'worsened' or 'unchanged'.

Respondent results were averaged, with results as follows:

Respondents indicated that 'poor choice of procurement models and contract terms' is the most important hurdle to improving capacity and capability, rating this as 'high importance'. 69% of respondents indicated that their experience regarding this measure is unchanged from 2 years ago. A quarter of respondents indicated that their experience over the past 2 years has 'worsened'.

Other responses listed as close to 'high importance' include:

- Government regulation: 59% of respondents indicated that their experience is 'unchanged' from 2 years ago, with almost 30% of respondents indicating it has 'worsened'.
- Industrial relations settings: 47% of respondents indicated their experience is 'unchanged' from 2 years ago, while 47% of respondents indicated it has 'worsened'.
- Poor communication and collaboration: 53% of respondents indicated their experience is 'unchanged' from 2 years ago, while, interestingly, 26% of respondents indicated it has 'improved'.
- Inadequate skills development: 56% of respondents indicated their experience has 'worsened' from 2 years ago, while 33% of respondents indicated it is 'unchanged'.

Respondents elaborated as follows:

- *“Poor choice of procurement models is a major issue for the industry along with immature application of selection criteria on project critical infrastructure”.*
- *“There has been a lot of noise in the IR front which generally make businesses like ours nervous as it adds a level of unpredictability”.*



Flexibility and response

Versatility and innovation - by both agency and contractor - will be put to the test by the coming construction wave. And they can potentially make or break the program.

In Part the flexibility and innovation response will rely on industry's willingness to engage, to invest, to optimise supply chains, and to develop smarter ways of delivering.

It will also, depend on policy actions by government, in areas such as streamlining regulatory burdens, coordination across jurisdictions, incentives for adopting new technologies, and promoting industry awareness.

Contractor motivation to be nimble during the program – as well as agency motivation - will depend on incentives, competition, risk, and so on.

The settings need to be right to optimise the industry response, to help industry leverage existing capacity and flex to increase supply. And government agencies themselves need to be incentivised to think flexibly.

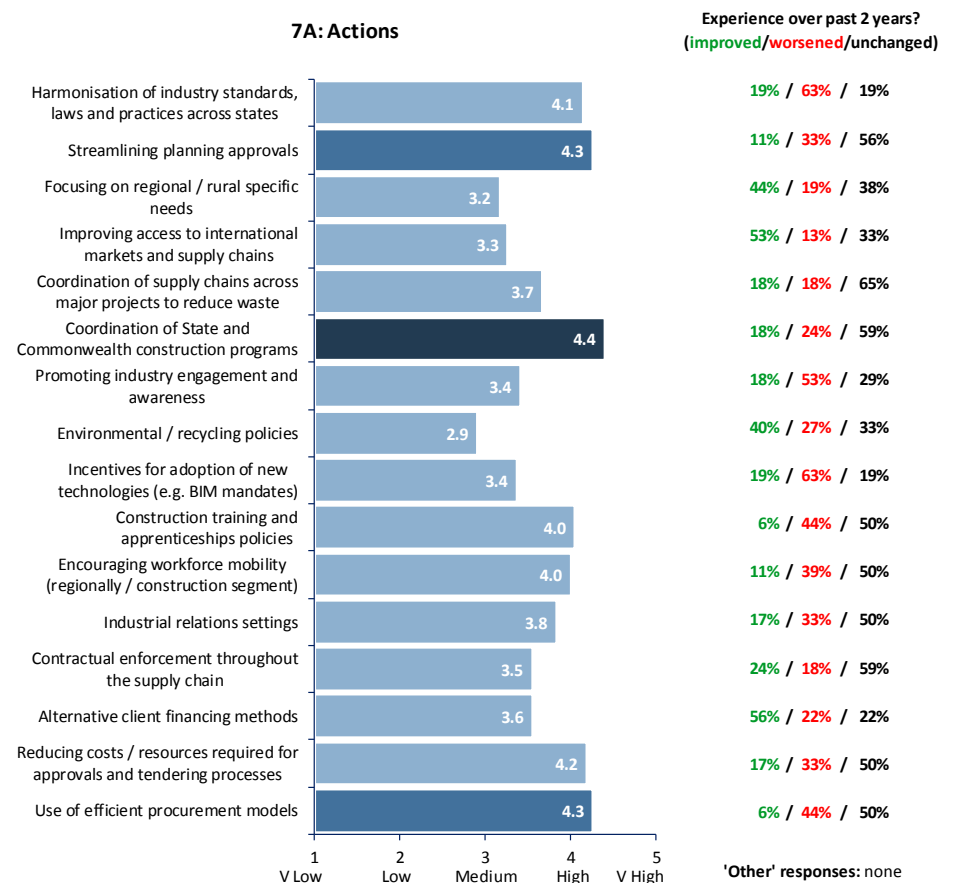
In question 7A of the survey, respondents were asked the following question:

"In your view, how important will each of the following government actions be to minimising construction industry capacity and capability risks? Please also note if there has been an improved or worsening experience regarding these measures over the past two years."

Respondents were to rate the level of importance of government actions between 1-5, with 5 indicating 'very high importance', 4 indicating 'high level of performance', 3 indicating 'medium level of importance', 2 indicating 'low level of importance', and 1 indicating 'very low level of importance'.

Respondents were also asked to rate their experience of these measures over the past two years, either as 'improved', 'worsened' or 'unchanged'.

Respondent results were averaged, with results as follows:



Respondents indicated that the 'coordination of State and Commonwealth construction programs' is the most important action to minimise construction industry's capacity and capability risks, rating this as 'high importance'. 59% of respondents indicated that their experience regarding this measure is unchanged from 2 years ago. Almost a quarter of respondents indicated that their experience over the past 2 years has 'worsened'.

Other responses listed as 'high importance' include:

- use of efficient procurement models: 50% of respondents indicated their experience is 'unchanged' from 2 years ago, while 44% have indicated it has 'worsened'
- streamlining regulatory burdens: 56% of respondents indicated their experience is unchanged from 2 years ago, while 33% have indicated it has 'worsened'
- reducing costs/resources required for approvals and tendering processes: 50% of respondents indicated their experience is 'unchanged' from 2 years ago, while 33% have indicated it has 'worsened'
- harmonisation of industry standards, law and practices across states: 63% of respondents indicated their experience has 'worsened' from 2 years ago
- construction training and apprenticeships policies: 50% of respondents indicated their experience is 'unchanged' from 2 years ago, while 44% have indicated it has 'worsened'
- encouraging workforce mobility: 50% of respondents indicated their experience is 'unchanged' from 2 years ago, while 39% have indicated it has 'worsened'

Interestingly, respondents indicate that 'environmental/recycling policies' are of relatively low importance.

Survey respondents identified the following actions as having worsened over the past two years:

- harmonisation of industry standards, law and practices across states (63% of respondents)
- incentives for adoption of new technologies (e.g. BIM mandates) (63% of respondents)
- promoting industry engagement and awareness (53% of respondents)
- use of efficient procurement models (44% of respondents)

Respondents elaborated as follows:

In terms of 'State and Commonwealth construction programs':

- *"There is no or little coordination between states of their infrastructure programs, for major projects we are in a national market."*

In terms of 'procurement':

- *"Procurement model, tender process and tender costs are a key driver in decision making in relation to whether we as an entity want to bid or not bid..."*
- *"Government procurement models seem to be driven by perceptions of what risk contractors are prepared to "swallow" rather than what is the most appropriate risk model for the project."*
- *"State and Federal governments adopting more complex procurement models that erode efficiency, cost savings, innovation and risk management, driven by new entrants from the mining market."*
- *"Governments are not prepared to share in the risk of "alternate" design options but accept the full reward which reduces a contractor's incentive to develop innovative design solutions."*

In terms of 'training and skills':

- *"A focus on compliance to trainees and apprentices will assist in better practice"*
- *"National harmonisation of licencing is an issue... A range of construction occupation licences (e.g. plumbing, electrical) had been identified as a priority. Apprentice and training responses can assist where adequate workforce planning has occurred well in advance of construction."*

In terms of 'mobility':

- *"The cyclical nature of work in the construction industry and the ebb and flow of workers moving to where the work is could be better managed, and the peaks and troughs "smoothed" with a national level coordination of projects which would assist in reducing skill attritions from one region / state to another."*

Looking further ahead:

THE LONGER TERM

Whilst the focus of this Report is on the current construction wave and the next five years, the longer term horizon is also important.

As the charts in chapter 1 illustrate, beyond 2020 and even 2030 New South Wales will need to deliver sizable construction programs that will continue to test both government and industry.

The survey asked respondents to identify the risk horizon (short term or long term) of certain implications of the expected construction delivery program.

The following percentage of respondents particularly identified the following concerns as long term:

INPUT AVAILABILITY AND COSTS FACTORS

- ▷ Other labour (46%)
- ▷ Steel or steel products (44%)
- ▷ Fuel or other oil products (e.g. bitumen) (43%)

CONSTRUCTION DELIVERY PROGRAM FACTORS

- ▷ Technical or process standards used in construction work (53%)
- ▷ Quality of initial designs and plans (46%)
- ▷ Allocation of risks in contracts (40%)

OTHER INDUSTRY AND EXTERNAL FACTORS

- ▷ Degree of industry competition / barriers to entry (53%)
- ▷ Cost / access to finance (48%)
- ▷ Effective business leadership (47%)
- ▷ Environmental and recycling strategies (47%)

Notably, technical or process standards used in construction work stood out as a longer term issue: 53% of respondents identified it as a long term risk. 53% of respondents also identified the degree of industry competition/barriers of entry as a long term risk.

Often, more than half of respondents identified concerns as being short term risk, rather than long term risk. Equally, respondents were mindful of their industry's prospects beyond the current program and emphasised that decisions made now will have legacy implications for years to come.



5

CRITICAL ISSUES

INTRODUCTION

The previous section of this report details the industry response to the 2016 Construction Delivery Assessment Survey, representing the first round of engagement with industry regarding capacity and capability risks in the New South Wales construction sector.

This was complemented with a second round of engagement, involving 1-1.5 hour interviews with the same industry respondents. Interviews were also held with key government agencies involved in the procurement of industry resources. All these interviews took place in October and November 2016, involving both face to face meetings as well as phone interviews.

The aim of the interviews was to dig deeper into industry concerns expressed at the survey stage, to better understand the nuances of the capacity and capability risks identified. The face-to-face sessions allowed us to probe deeper to gain 'real world' examples of capacity and capability constraints, as well as solutions that could provide a positive legacy for New South Wales.

This Section presents the outcomes of this stage of industry and agency engagement, coupled with some additional research and analysis which places the issues in context.

From this process, five core issues were identified which were perceived to have the greatest impact on industry capacity and capability:

- ① Program coherency
- ② Optimising procurement contracts
- ③ Ensuring essential skills
- ④ Materials and transport
- ⑤ Productivity and innovation

These issues are addressed sequentially in this section. The chapter then concludes with a cautionary discussion of the potential consequences of failure.

CRITICAL ISSUE 1: Program coherency



The first critical issue surrounds the transparency and coordination of the entire construction program in New South Wales.

Capacity and capability imply the *timely* ability of industry to deliver the construction program. In turn, this requires forward planning – by industry as well as government agencies – to secure the necessary raw materials and skills, in advance of when they will be required. Such essential preparation is hampered when industry is uncertain about the future pipeline of work or its timing, potentially resulting in skills shortages or materials bottlenecks, and threatening to result in delays and cost overruns.

The antidote to this risk is clear pipeline visibility that facilitates forward planning, as well as efficient project approvals and a realistic phasing of the work that spreads the demand on resources in a manageable way over time.

New South Wales' substantial construction program – coming after a decade of relative inactivity in major non-mining related projects¹ – makes pipeline visibility critically relevant. It will be essential to ensure industry can best utilise its physical capital (plants, depots, trucks etc) and its human capital (site teams, skills) to meet demand.

A clear understanding of future program demand facilitates better strategic planning by industry and helps with:

- › updating old plant and equipment by allowing enough lead time to order new replacements
- › training or bringing in the specific skills required, to assemble a first class team
- › securing raw materials and overcome logistical hurdles such as transport to the site
- › sourcing selected inputs from overseas where necessary, which can require substantial advance notice
- › innovating and adopt the latest technology
- › appropriately assessing and mitigating risks of complex projects

Better planning means fewer delays during construction delivery, which in turn helps to contain costs. For example, you need detailed forward transparency of the types of steel (say) that will be required and when, such as reinforcing steel vs structural steel vs flat steel and so on. Early ordering, especially when sourcing offshore, is an advantage.

Having plenty of notice is no doubt also welcomed by the public, who want to know what's going on when the future shape of their city or state is at stake (as well as taxpayer dollars). Social media has raised the stakes of the government keeping citizens informed.

Transparency

A number of industry observers noted that pipeline visibility has improved (although, notably, in certain agencies more than others). For example, Roads and Maritime Services (RMS) now publishes its pipeline, with beneficial impact (people have moved to North Coast to work on there Pacific Highway project; concrete suppliers use the publication to plan concrete and quarry supply). A number of agency pipelines are still not published, and are instead simply 'talked about' behind closed doors. In some cases, we were told that contractors have found out from the newspaper that major projects were to be built, too late to tender because they already had major projects committed (the contractor felt it would be wasting significant resources by bidding). The construction program relies on effective communication and constant engagement with industry.

Between now and 2020, industry faces a unique challenge to augment or add capacity to meet the peak. The strongest investment cycle in New South Wales since the GFC will, for some players who need to upgrade or expand capacity, require gambling large amounts of capital but with the risk that the peak may be quite shortlived. It's been suggested that the State may need a planning (or even regulatory) response that helps industry leverage up its existing capacity rather than unnecessarily invest in new, otherwise industry may be less willing to gear up next time – we explore what this may entail in the pages that follow. Increasing prices may already be necessary to recover sunk costs to expand capacity. The scope for further cost escalation will depend partly on how Government partners with contractors. Industry participants report they are already seeing rising prices of both skills and materials alike and perhaps more tellingly, order lead times – it is getting harder in Sydney to source materials like precast, scaffold, reinforcing steel, and you need to give two week's notice, not one week².

'Forewarned is forearmed'

¹ One industry observer likened this to a 'feast of famine' cycle
² The escalation pressure in Perth/WA during the mining boom was about scheduling as much as supply.

Infrastructure Investor Assurance Framework (IIAF)

The IIAF provides a tiered, risk based approach to infrastructure investor assurance and sets a platform for providing Government with a level of confidence that the State's capital projects are being effectively developed and delivered on time, on budget and in accordance with the Government's objectives. Infrastructure NSW is the responsible Gateway Coordination Agency for capital projects and programs.

The IIAF applies to all capital projects being developed or delivered by NSW Government agencies and Government Businesses. Capital projects valued at an estimated total cost (ETC) of \$10 million and above are required to be registered with Infrastructure NSW via the Reporting and Assurance Portal (RAP).

Registration on the RAP includes a risk self-assessment to determine preliminary Project Tier. It is mandatory for these projects to be reviewed to consider the Project Tier and the Project Assurance Plan. This is to determine the applicability of Gateway Reviews and level of project reporting and monitoring required.

The Infrastructure Investor Assurance Framework (IIAF) is issued and administered by Infrastructure NSW. The IIAF was endorsed by the Standing Cabinet Committee on Infrastructure on 30 June 2016.

Source: http://www.treasury.nsw.gov.au/___data/assets/pdf_file/0009/129907/TC16-09_Infrastructure_Investor_Assurance_Framework_IIAF_-_pdf.pdf

If industry hits a crunch point in New South Wales in 2018 and beyond, prices could escalate as producers who have invested in capacity seek to recoup the outlay.

Price escalation would likely have the effect of reducing the real funding available to each government agency. Agency budgets are determined in terms of nominal dollars, and their 'real' (inflation-adjusted) spending power can be eroded by higher prices for the goods and services they need to purchase. This threat can be alleviated by increased supply capacity at industry level, but expanding industrial capacity requires forward planning, actively being out there buying equipment and building business teams to prepare for coping with more projects. For example, consider formworking: a contractor that has been used to running 200 workers, may soon need to ramp up to 400 workers, and will first need to find 20 new foremen, which takes time. To ensure this and similar essential preparation by Industry, forward transparency of the pipeline is critical to building the industry supply chain on which Government relies.

A further advantage to the Government of full pipeline transparency is early detection of industry stress. Some agencies already recognise this. One said *'it's important we have a well-developed radar regarding industry capability, so we keep testing the waters'*. At Transport for NSW, the Asset Standards Authority (ASA) has set up a registry of contractors and is verifying contractors (as Authorised Engineering Organisations - AEOs), and one benefit is so Government can keep tabs on industry capacity, stress and costs as ASA talks to AEOs and takes the pulse of the market. Such intelligence can better inform freight strategy and delivery planning by agencies. It aptly illustrates the value to industry capacity of agency transparency.

The Government's ProcurePoint website provides some information on the overall NSW construction pipeline, at a high level.³ The State Infrastructure Strategy is also published.⁴

While these information sources are noted, it is fair to say that more pipeline transparency could be forthcoming from Government. Ideally, industry wants a ten year outlook for the NSW government infrastructure program, updated at regular intervals. The work ideally should phased smoothly over time to avoid bottlenecks. Otherwise, 'bunching' of the work increases costs which are then passed on in the form of higher prices to the taxpayer.

Government also helps by being consistent. Industry liaison suggests that announced projects can sometimes slip by twelve months, making it harder for contractors to hire and retain specialist staff within a commercial budget.

Agencies as 'silos'

Individual agencies are still thinking in terms of a parochial pipeline, according to industry observers. Each agency has its capital budget, and the feedback is that this fosters a silo mentality. The dots are not always being joined. Construction is becoming increasingly complex, with integrated projects (for example, building an apartment tower on top of a railway station), and New South Wales may need a new way to look at projects. A number of industry commentators see a need to move from single 'silo' authorities to a hub/precinct approach with all stakeholders involved, building things together. Transport for London is quoted as a good example: it operates off a Masterplan, with a single authority, allowing big commerce and financiers to all plug into the same masterplan. New South Wales arguably needs full integration of its major program from planning to delivery.

A single agency for the Government which sees synergies across all construction (for example, take sand out of bored tunnels and recycle into other projects) would go a long way to addressing this. An example might be the Hong Kong Airport model, where one authority handled the entire airport program including associated buildings, hospital etc. Some tentative steps toward this concept may be seen in the recent establishment of the Infrastructure Investor Assurance Framework (IIAF) – see box. And the Greater Sydney Commission, established in 2016, is also an important step in this direction.⁵

Moreover, one state's program in isolation is only part of the picture. Respondents identify an issue around an apparent 'inability of governments to talk to each other'. For example, three major tunnel projects have been launched at same time. The Victorian pipeline is starting to ramp up again, placing pressure on resources. New Zealand also has a major building and infrastructure activity underway, with big projects that include Transmission Gully⁶, Auckland tunnels⁷, and earthquake-proofing roads in Christchurch and Wellington, although these are now in well advanced stages. These are competing for resources with the east coast of Australia, especially for people with key professional skills.

This is having a measurable impact on procurement. One contractor says they get asked why they are not bidding on certain projects? The answer is they are not willing to spend millions of dollars bidding for too many projects that they can't deliver simultaneously. Industry is being forced to make some hard decisions, effectively placing limits on industry capacity and capability, due to program clustering. Some agencies, such as RMS, are making strides to 'decluster' projects, but this is not true of all agencies.

³<https://www.procurepoint.nsw.gov.au/before-you-buy/construction/nsw-construction-procurement-strategy>

⁴For an overview of NSW Government's state infrastructure strategy, see: <http://www.infrastructure.nsw.gov.au/expert-advice/state-infrastructure-strategy-update-2014.aspx>

⁵www.greater-sydney.com.au

⁶<http://www.tg.co.nz/>

⁷<http://www.nzta.govt.nz/projects/the-western-ring-route/waterview-connection/>

Sectors and regions

Variability in the infrastructure workflow can be partly addressed by offshoring. Consider essential skill sets. An example is the engineering profession. With approximately 60,000 engineers employed⁸ – in varying capacities – on infrastructure projects in Australia, uneven market swings can have a severe effect on the overall engineering workforce. In particular, boom/bust cycles of infrastructure procurement and delivery can create acute demand spikes across specific engineering specialisations or locations (such as regions). Industry can respond by hiring offshore. Equally, domestic skills supply needs to be part of the mix. A Victorian inquiry⁹ recommended explicitly linking a state's project planning with its skills planning, and this proposal has merit.

Bearing upon program coherency is the capability that Government displays in managing program procurement.

There is a regional dimension to program coherency too. Regions tend to have smaller projects that cannot always afford a 'tier one' professional (such as project manager), and without a sustained project pipeline it is difficult to attract good people. Towns are relying on an experienced but aging cohort of skilled professionals who are now aged in their sixties. When a big project is on, many of the contractors used are metro based, with major local projects (such as a 1000 bed prison) usually seeing towns bring in resources from the capital city. This has the effect of disrupting the local economy for two years (higher housing rents, for instance) only to see things revert back when the contractors move on. To help build regional capability, there is a need for the coherent development of medium term regional pipelines. Improved pipeline visibility at regional level would help to plan for these movements.

Program transparency and clear timelines are a critical issue. Industry's experience during the current construction program will affect industry's response to future projects after 2020. Within metro Sydney, industry wants to gain some idea of projects beyond 2020. In particular, given its major importance, industry it would also like to see early coordination of work relating to Badger's Creek airport, including the new airport's planned rail services.

Complexity and delays - planning approvals

A recent BCA report estimates there are 31 different pathways for major project approval across Australia. The BCA argues planning approvals can take too long, impose too much cost and create a disincentive to invest. It should take no more than 12 months to assess and approve a major project, but it 'often takes multiple years and sometimes five years or more'.¹⁰

The process has been added to by multiplication over recent years in different permits required (cultural, environmental, sewer, heritage, water, power, roads, gas, etc) by diverse agencies, where the contractor has no control over how quickly they respond yet is expected to obtain the necessary approvals.

This carries significant economic cost. The Productivity Commission estimated the societal cost of a one-year delay in approvals for an average major project is up to \$59 million, and for a large project up to \$2 billion.¹¹

Battling red tape is mentioned by industry as adding to bid costs. Government is not fully geared to coordinate utilities (such as heritage, environment, health & safety) to deliver the approvals in a timely fashion. Industry participants note that a number of projects are currently held up awaiting utility authority approval and that *'the authorities tend to fall behind the eight ball, they are overwhelmed and can't keep up'*.

Dealing with local councils is one of the biggest issues for some contractors interviewed for this Report. Local government is responsible for issuing development approvals (DAs), and during the past eighteen months or so, industry says the time taken to get DAs approved has 'doubled', due to a lack of resources to deal with the increased volume of applications (amidst the apartment boom). Industry notes increasing compliance costs over time (for example: a simple DA for a car space can take three months or more; removing a tree can take three months because of obtaining a flora & fauna permit). Complexity is a barrier. Simply interpreting consents takes up surveyors' time, as each council has its own different regulations. One proposed solution: one basic regulation for all of Sydney and/or NSW (industry noted approvingly that Sydney Water already operates this way).

Local councils

Councils add multiple layers of cost and delay, where a single project can involve 5 or 6 councils each with their own panel of review, which results in duplication. Research commissioned by Stockland on greenfield residential approvals processes found that the adverse impact on building affordability is significant and the economic cost of delays is 'astronomical' due to economic multipliers.

The council delay issue is said to be 'worse in NSW than in other states', partly due to the State's complex planning instrument, and also a lack of district plans means local councillors sit in judgment of projects that have impact beyond their local area.

Industry recommends various actions be taken to improve its efficiency and competitiveness:

- provide additional resources to meet demand
- increase private sector involvement in planning approvals
- introduce a user-pays fast-track approvals process
- amend the Subdivision Act or relevant legislation
- increase the focus of metropolitan planning authorities on project delivery.

Industry notes that Victoria has put together a taskforce to reduce DA delays, by setting up a working group comprising representatives from government and industry to coordinate reform. Can NSW do the same?

Stockland submission to Plan Melbourne Refresh
http://planmelbourne.vic.gov.au/...data/assets/pdf_file/0006/294648/262-Stockland-General-submission.pdf

⁸<https://www.parliament.nsw.gov.au/committees/DBAssets/InquirySubmission/Summary/52973/Submission%2013%20-%20Engineers%20Australia.pdf>

⁹See http://www.parliament.vic.gov.au/images/stories/committees/paec/reports/PAEC_InfrastuctureInquiry_FINAL-Report.pdf. The Committee recommended the state establish a new body, the Victorian Infrastructure and Skills Authority, to identify what competencies and skills the industry needs in its workforce and to foster centrally facilitated knowledge sharing among agencies.

¹⁰http://www.bca.com.au/docs/bed23f8f-ee8c-45be-aa2f-4b94148f77d7/Competitive_Project_Approvals_Report_EMBARGOED_TILL_12.01AM_ON_25.11.2016_FINAL.pdf

<http://www.bca.com.au/media/world-class-model-for-major-project-approvals>

¹¹http://www.pc.gov.au/...data/assets/pdf_file/0003/137280/infrastructure-volume1.pdf

Funding the future infrastructure program

Pipeline coherency also matters for financing the State's future construction program. While industry respondents report that conventional finance is developing as expected, with banks gearing up and government funding available because of asset recycling (which is partly replacing the traditional forms of federal grants plus state grants previously used, on projects like the Transfield tunnel and M2), there is an emerging need for a mix of funding types.

These more adventurous forms of infrastructure funding may include overseas pension funds, once-off levies, value capture, superannuation funds and so on, in a 'horses for courses' approach. These alternative financiers will almost certainly require enhanced program transparency.

Industry is saying that contract faithfulness is also on the line in Australia, in the wake of repudiation of the East-West Link in Victoria. This sends the wrong message and scares off potential financiers, and points to the need to minimise political interference in the public works program, once it has been announced.

Moreover, some NSW agency's project specifications/standards can clash with new finance sources: for example, if the Australian contractor is overseas owned, the offshore parent may balk at certain local government guidelines (eg. local content requirements).

OPTIONS TO CONSIDER

- **Staged program** – There is a view that government is clustering projects together. It's not ideal to bunch major projects; Government should be staging it and probably working together with industry to synchronise.
- **Using private experts** – Industry argues that not all NSW government agencies are fully equipped to handle big projects. Government should consider using private delivery partners to bring the whole program to market, to help steer the scoping, tendering, and delivery.
- **Intra-government visibility** – is there a "super agency" looking at the entire pipeline of NSW government projects – a helicopter view – to assess demand that will be placed on the industry? And can that information be published, covering all construction (private + public, building + civil)? We need one agency in Government that see synergies right across the construction program.
- **Inter-government visibility** – Can state governments coordinate projects? For example, Victoria has Northern Metro and Western Distributor at same time as NSW has Northconnex, with the risk that taxpayers may lose because engineering firms are stretching resources. COAG (Coalition of Australian Governments) might be able to contribute by acting as an information clearing house across all member governments.
- **Minimising sovereign risk** – Avoiding situations such as the failed East West Link in Victoria may require the development of a "Critical Projects List" that, having met appropriate cost-benefit tests and business case hurdles, is agreed on by all major parties.





***'It's important we have a well-developed
'radar' regarding industry capability, so we
keep testing the waters'***

CRITICAL ISSUE 2: Optimising procurement contracts



'If you have 4 or 5 tenders on the run, and another comes through the door, you have to make a call on whether to bid again'

The second Critical Issue concerns the State's procurement and contracting approach and its suitability to enabling the wave of construction engulfing New South Wales.

Capacity and capability will be enhanced by an approach to project contracting that fosters full participation by industry and maximises the legacy for New South Wales. The procurement process chosen by government plays a key role, through its effect on value-for-money outcomes, risk allocation, on-time delivery, staying on budget, and contractor incentives. Besides the project's direct goals (design features, user needs, functionality to be delivered by the project, quality standards, new technology) the contracting model needs also to facilitate broader government outcomes. These may include social, economic, environmental, safety-related, knowledge management, and long term benefits. Risk needs to be allocated and priced in.

If the contracting model is working well, all stakeholders benefit. If not, the project or program could be impacted by failures, delays and cost overruns.

Under the right circumstances, the contracting model used is a positive tool for effective delivery and long term sustainability of the NSW construction program. It can encourage participants – both contractors and agencies – to:

- deliver the best value for the taxpayer
- price and allocate risk appropriately
- increase capacity by investing in new plant and equipment
- enhance capability by fostering essential skills training
- maximise the social benefit to the community
- think longer term, with a more sustainable mindset

By selecting the right delivery model and by fostering an agreeable procurement culture, government can enhance its partnership with the private sector and promote deeper industry participation.

To the Government's credit, a number of agencies we liaised with are aware of the potential gains to be had, and are already evolving their contracting model.

There may still be considerable scope to drive better outcomes, based on our liaison with industry and NSW agencies.

Cost of tendering

The cost of tendering is often raised by industry: this issue scored a high 4.1 weight in our survey (Chapter 3) and 65% nominated it as a short term risk. Tender cost typically may equate to 1.0-1.25% of project value and can take 40% of the entire project process in terms of time. Bid teams can be large (100+ people) especially on big projects, and can include engineers, designers, estimators, schedulers, human resources, lawyers, health and safety officers, quantity surveyors, and so on. These represent a sizable cost, prompting would-be bidders to ask: is it worthwhile spending millions of dollars on a major tender, involving a team of highly skilled seniors plus juniors? Big projects in particular are expensive to tender: for example, larger projects can be of the order of \$10-20 million or even \$50 million to bid. These are huge costs.

Bid teams are also a finite resource that can become stretched when there is a lot of work out for tender. Contractors interviewed confirmed that a lack of suitable bid team personnel has at times prevented them from tendering, including the inability to resource the team leader or key members. One commented: *'If you have 4 or 5 tenders on the go, and another comes through the door, you have to make a call on whether to bid'*. Each company has a limited/set bid budget and participants felt that industry currently does not have the bidding capacity required. For instance, say a contractor does Sydney plus Melbourne plus Brisbane bids all at once, cost will be a pressure (eg. 5 projects may sum to \$10-15 million bid cost or more).

Moreover, it will inevitably dilute the quality of the bid teams, who will become too stretched: contractors keep the "A-Team" in place until the bid is resolved, so if feedback from Government takes too long then the Team is sitting idle which is costly, especially when the bids are extended or the project is altered or duplication occurs in the tender process. Or many of the staff will depart and not be available for the next tender. This can result in players declining to bid.

For some large projects, industry told us that the time available to submit a bid can be too short (3-6 months). According to industry sources, a bidder needs to submit a 'huge volume' of tender documents (for instance: for a \$billion project, upwards of 30 professionals for a 3-4 month period can be required just for the Expression of Interest stage) just to get on the short list of two or three. This suggests NSW needs a simpler system to get to a short list.

Industry suggests that agencies need more resources and an early heads up, to get the services signed up (such as using an Early Works Package - see box). An example mentioned where it was felt this was done well was the Melbourne Metro project, but observers said this approach is lacking on some key NSW projects and this is holding up the momentum of several major projects.

Adding to the problem, Government tends to ask for the same information over and over again (for instance: same department, different project). Industry recommends a more efficient registration system, so contractors are not jumping through the same hoops again and again. Industry says the review process is too often over-managed: the cost of bidding is pushed up by extra layers of experts, first subject matter experts then independent verifiers 'checking the checkers' (on an hourly rate with little motivation for getting the DA through). Repetition also occurs when contractors must respond to one set of questions upon another, where the government's first round response is sometime 'half-baked', prompting industry to ask: should the government organise itself to do the review once, and after that to pay industry for any additional requests?

The upshot is that this effectively curtails industry capacity and capability. According to market sources interviewed, industry can't always afford the bid process as it is currently configured and it is reacting by lessening its participation. For example, for certain Sydney and Melbourne metro projects only two major companies are bidding, in Sydney, whilst two or three other major potential players are not bidding. Some noted that the cost of tendering has lessened marginally with electronic submissions, but also wondered, how can Government reduce tender costs further? Perhaps by only asking for an outline of the contractor's plan initially (with a detailed upfront plan required only for especially complex projects), which would prove more cost effective and will encourage more participation and innovation. Further, on the post-tender side, which can be a drawn out process because changes often need to be negotiated even when the preferred tenderer still hasn't been chosen, Government could streamline and make an earlier choice.

STATEMENT ON VALUE FOR MONEY

The NSW Procurement Board aims to 'ensure best value for money in the procurement of goods and services by and for government agencies' under section 171 of the Public Works and Procurement Act 1912 (the Act).

Value for money is the difference between the total benefit derived from a good or a service against its total cost, when assessed over the period the goods or services are to be used.

Value for money = Total lifetime benefit – total lifetime cost

Benefits, costs and risks include money and non-monetary factors. Achieving value for money does not always mean that the 'highest quality' good or service is selected. A lower cost option that meets quality requirements may be appropriate where an agency has limited funds available for a particular procurement. Value for money is achieved when the 'right sized' procurement solution is selected to meet an agency's need.

Source: <https://www.procurepoint.nsw.gov.au/policy-and-reform/nsw-government-procurement-information/statement-value-money>

The procurement process

The procurement method for a project refers to the choice of contracting model, the tender process, the criteria used to select winning bids, and associated procedures.

The choice of contracting model is a core element in the procurement process and is closely bound in with the recommended delivery model. Agency and market capabilities and capacity may constrain the process. And the contracting procedure used can act as a constraint on industry participation, performance and sustainability.

The Australasian Procurement and Construction Council (APCC) identifies various contracting styles that may be deployed, including Alliance, Managing Contractor, Early Contractor Involvement (ECI), Design and Construct (D&C), Construct only, Public-Private Partnership (PPP)¹.

Project owners may also decide whether to issue a Request for Quotation (RFQ), Request for Tender (RFT), Expression of Interest (EOI) or Request for Proposal (RFP); whether they will use an open tender or selective tender process; whether the procurement will be single-or-multi-stage; and how to structure the evaluation criteria and process.

Approaches such as ECI and alliance are relationship-based delivery models, interactive tendering processes that are often used for high value procurements. These processes use a series of exchanges through the tender period to clarify the contract scope and build a close sense of partnership between project owners and tenderers. It is often desirable to involve key stakeholders and experts as early as possible in the planning and development process.

By using an appropriate delivery model and procurement method, project owners can expect to attain improved value-for-money outcomes and more effectively manage risks, costs and time overruns.

¹<http://www.apcc.gov.au/ALLAPCC/Building%20and%20Construction%20Procurement%20Guide.pdf>

Further suggestions from industry include reducing the amount of early documentation, and introducing a compensation formula to recompense contractors for bid cost. A solution to the duplication issue might be creating a preferred tenderer panel (like Sydney Water has), however this can result sometimes in reduced competition. Early Contractor Involvement (ECI) can reduce suitors to a shortlist. A Cost Reimbursable system for bidders might be an option, where the client pays for delays/variations on tenders at a 'cost plus' rate.

The current construction program is an opportunity for NSW to learn lessons and revise its approach. For instance, if future governments find themselves short on procurement resources, the private sector might get more involved at the front end to streamline and show the way to getting simpler sign-off on projects. Victoria is said to be moving in the right direction, by evolving their procurement guidelines over recent years, especially in seeking industry feedback on the procurement process itself.

The result should be more contractors tendering, broader industry participation, and more competitive outcomes, especially if companies have confidence they will get some of the cost back.

Choice of contracting model

According to industry observers, government goes through cycles of being 'stereotypical' in how it approaches contracts: at one time alliance contracting was popular, now it's design and construct (D&C). Although still being re-used in Victoria, it is rare in New South Wales to see alliance style contracts today because of concerns over project cost.

There is a tendency for Government to go for contracts that (ostensibly) yield the lowest construction price. But will it come back to bite the Government? An example mentioned was of cracking concrete on one 'value for money' project that has resulted in delays and higher overheads, legal costs and administration costs.

It is felt that New South Wales needs a suite of contract options, especially for the approaching boom. Large multidisciplinary projects require sophisticated risk allocation, and alliance or delivery partner models can facilitate better scoping and - when well defined - allow for more nuanced allocation of complex risks.

Industry participants feel that too much risk is being put on contractors under the current 'lump sum' payment system associated with D&C. By contrast, industry feels the ECI or alliance approaches offers a Risk + Reward model that will spur industry to greater participation and leave an enhanced legacy for New South Wales. The example of one utility was given that offers shared 'pain/gain' arrangements during the ongoing operations phase (when the facility involves inherent risks to continued operation).

Industry favours delivery models that use Early Contractor Involvement (ECI). This format is said to be used in about 80% of private sector jobs. There are early signs of a trend toward ECI by NSW agencies, where the contractor is running the design process, not just observing it. Early contractor involvement (ECI) is a two-stage relationship-style delivery model, generally structured to resemble a project alliance model during the first stage and a D&C model during the second:

- Stage 1 (the 'ECI phase' or 'tender phase') sees a concept design prepared by the project owner, and up to two contractors are engaged under a services agreement ('ECI agreement') to work collaboratively to further the design, plan the Stage 2 construction works and prepare a quote delivery of Stage 2 ('Stage 2 offer')
- Stage 2 (the 'construction phase') is typically structured as a lump sum D&C arrangement. However, it is only activated in circumstances where the project owner accepts one of the quotes given in Stage 1

The ECI delivery model embeds a number of relationship-style principles and is specifically designed to achieve good relationship, cost and delivery outcomes by fostering the involvement of construction contractors during the preliminary (design and development) stages of project delivery. The Australian Procurement and Construction Council (APCC) says ECI also provides enhanced opportunities for innovation, promotes a less adversarial culture (with fewer variations and disputes), and improves integration of the design with construction under this model, together with improved constructability outcomes. Synergies typically arise from a high performance design and construction team.

Some agencies are certainly already fostering a more engaged approach to procurement, engaging with industry early, unlike the older approach which was described by one participant as *'popping tenders into the market ad hoc, and the market would respond at arms length'*. Some agencies recognise they are competing with other agencies, as well as with private clients, to attract the best contractors.

Which type of contracting arrangement would help us to get to preferred tenderer faster? This requires Government to know early on what it wants and - by corollary - obtain planning pre-approval. Contractors would not be asked to manage quasi-government entities (eg. utilities) on top of the actual construction. It implies more communication between government departments.



'There is no downside to early engagement'

Delivery models	General description	Risk allocation
Construct only	- Most commonly used delivery model, especially for 'minor works' and straightforward 'major works' projects - Project owner prepares the design - Contractor engaged to construct the works based on supplied design	- Design risks: Project owner - Construction Costs risks: Majority borne by the contractor - Quality risks: Contractor - Maintenance risks: Project owner
Design & Construct	- Project owner provides project brief - Contractor engaged to both design and construct the project works based off the project brief - Contractor uses external designers for the design component - Risk of variation if owner desires changes during delivery	- Design risks: Contractor - Construction Costs risks: Majority borne by the contractor - Quality risks: Contractor - Maintenance risks: Project owner
PPP	- Used when there is a complex risk profile and an opportunity for risk transfer - The project owner selects a private sector partner to finance, design, construct and operate the projects works. - Public sector regulates price and quality of service - Contract based on outcome specification rather than a design	- Design risks: Private sector - Construction Costs risks: Majority borne by the private sector - Quality risks: Private sector - Maintenance risks: Private sector
ECI	- Common in cases where there is site risk or, other significant 'known unknowns' - Contractor is engaged early, in a two stage process - Aids resource planning and procurement - Partnering between contractor and project owner suits complex projects	- Design risks: Partly shared - Construction Costs risks: Contractor - Quality risks: Contractor - Maintenance risks: Project owner
Managing Contractor	- Typically used in large complex buildings where the scope is uncertain - Via a competitive tender process, a contractor is selected for the project management role - Contractor's role is to manage the design, enter into contracts to develop construction and manage the delivery of the works on behalf of the project owner.	- Design risks: Project owner - Construction Costs risks: May fall on managing contractor - Quality risks: Managing contractor may pass through risks - Maintenance risks: Project owner
Alliance	- Project owner and one or more non-owner participants collaborate to work and deliver the project - Shares projects risks and rewards - Often used for highly complex projects where the scope and risk profiles are highly uncertain	- Design risks: Shared - Construction Costs risks: Shared - Quality risks: Shared - Maintenance risks: Project owner

Source: BIS Oxford Economics

Non-price Evaluation Criteria – NSW Government Tendering

'In addition to prices tendered, evaluation criteria shall contain the critical factors to be used in the evaluation of tenders. These factors typically include, but are not limited to:

- › whole-of-life costs;
- › ability to meet Code requirements;
- › innovation offered;
- › delivery times offered;
- › quality offered;
- › previous performance of tenderer;
- › experience of tenderer and personnel proposed;
- › capability of tenderer, including technical, management, human resource, organisational and financial capability and capacity;
- › tenderer's occupational health and safety management practices and performance;
- › tenderer's workplace and industrial relations management practices and performance, and, in relation to tenders in the building and construction industry, compliance with the Implementation Guidelines to the NSW Code of Practice for Procurement: Building and Construction (2013);
- › tenderer's environmental management practices and performance; tenderer's community relations practices and performance;
- › value adding components such as economic, social and environmental development initiatives, if appropriate and relevant to the procurement; and
- › conformity of tender with requirements.

The evaluation criteria should be consistent with the proposed contract requirements and aim to identify the tenderer offering the best value for money. Ideally, the weighting of the evaluation should be determined prior to calling of tenders but shall be not later than close of tenders'.

Source: NSW Code of Practice for Procurement
https://www.procurepoint.nsw.gov.au/system/files/documents/code_of_practice_for_procurement_2013_ir_guidelines_0.pdf

Risk allocation

The issue of risk allocation is perhaps the biggest bone of contention industry has with New South Wales. Risk can be classified into known unknowns (foreseeable and potentially measurable) versus unknown unknowns (unforeseeable and hence an unpriced risk). In the interests of the taxpayers government is trying to pass on as much risk as possible to industry, but the risk-reward tradeoff has arguably become a real barrier. For example:

- › if the contractor hits environmental contaminants they are often required to clean it up, and in some cases not only in the contract area (eg. the tunnel itself) but also the surrounding area, beyond the immediate project zone
- › if equipment fails the supplier can face legal action for 'consequential losses'; contractors can't fully insure against it

These become costly. For 'smaller' projects (<\$100million) the current approach create an onerous risk profile. Effectively, this retards the capacity and capability of the industry.

Industry questions why government sometimes expects the contractor to bear 100% of such risks. The suggestion is that government might say: if a reasonable bidder couldn't have anticipated a given event, they should receive compensation. Alternatively, using an Early Contractor to de-risk will leave the major contractor clear to D&C (design and construct) the main project with the sharing of controversial non-commercial risks agreed.

It is clear that contractors and government agencies – each have their own culture, and that this impacts on how things get done.

'Best value' procurement?

The current approach in New South Wales is mostly the lump sum D&C model, where lowest price is effectively the priority. But does it yield the best value for the taxpayer? And will hidden risks come home to roost? (for example, changes in scope or use of contingency)

Advantages of non-price factors:

- › better quality
- › encourage innovation
- › longer term focus

Advantages of price factors:

- › lower cost to taxpayers
- › hit short term targets
- › clarity of bid priority

The notion of best value often entails thinking long term and about the delivery of the benefits intended by the project. Industry draws a contrast between 'best value' (involving better ideas, for example to put things underground or minimise community disruption) vs 'lowest cost' (with possible quality downsides such as less durability or higher costs in later years for maintenance). Examples:

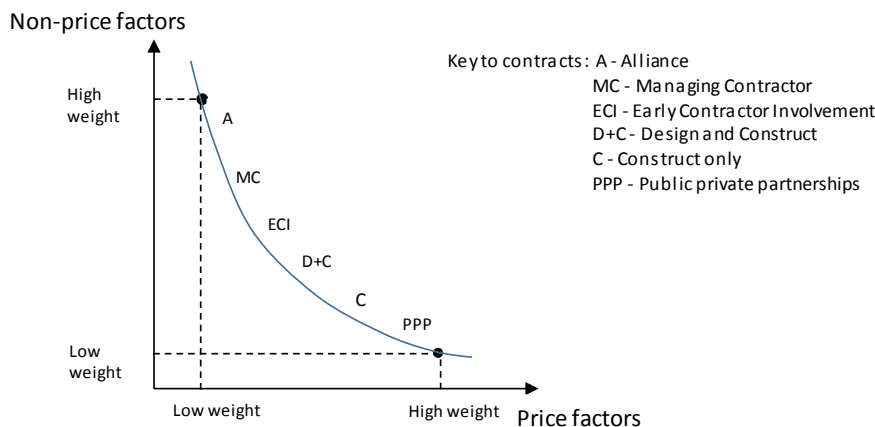
- › making a tunnel longer by stretching the entry/exits – has higher initial construction cost but likely better community benefits (for example, the North Connex project)
- › using corrosion-resistant reinforcing steel – costs more to construct but is cheaper to maintain over the lifespan (eg. 75 years)
- › reinforced concrete pavement – costs more but has a longer lifespan than regular pavement (eg. by considering life cycle costs during procurements)

Industry says there is a need to get government to think long term about cost issues, perhaps by creating incentives for agencies to do so. This may involve outcome-based not just performance-based incentives for agencies, and clarity around legacy performance standards and outcomes. Tenders need a durability report that clearly documents assumptions about project lifespan: for instance, drainage in a tunnel, how do we validate that in 50 years time, taking into account unforeseen shifts in the salinity of water in the tunnel? The contractor is best placed to manage and control these life cycle risks, but needs a reasonable agreement with Government that allows for contingencies.

Lowest-price procurement 'produces a race to the bottom', industry says. It is resulting in too many bit players with low turnover who are lacking balance sheet strength, diluting the quality of the field. This has ramifications, such as less commitment to train apprentices.⁴

In contrast to low-price contracting, 'best value' procurement involves the relative weighting given by Government to price factors, versus non-price factors. Industry claims that Government uses selection criteria 'as a matter of convenience', that the weights are too rubbery and that this amounts to a lack of transparency. The criteria (and their weightings) could be published, thereby limiting agencies' ability to vary the weightings 'at will'.

'Best value' trade-off in procurement



Source: BIS Oxford Economics

Industry acknowledges the buying power of government. Equally, at any one time, there is a lot of private work on offer too, especially in the building space.

While the Government gets to select contractors, it also needs to remember that contractors get to cherry pick between clients.

Industry told us that even across government agencies they prefer clients with the best foresight, and this is largely about contracting and delivery methods. This means that when Government is selecting its contracting method, if the commercial balance is right (price and non-price factors are in balance) then Government becomes industry's preferred client. And that can mean substantial advantages to the agency concerned, based on building up a relationship between agency and contractor that, overtime reduces transactions (menu, search, and contracting) costs, gives priority access to scarce resources (such as sand), shortens wait times, and enhances risk allocation, for the agency concerned.

But, industry also warns that some government agencies are struggling. Tenders can be delayed by lack of agency resources – by months, not just weeks in some cases. The impending clustering of huge projects may mean Government will have trouble procuring all projects with A-teams, because skilled people to deliver the projects are increasingly scarce.

Government as the client

Proactively partnering with industry may mean expanding the government's preferred delivery model, not necessarily going with a lowest price philosophy and being willing to weight the required non-price factors.

This involves the matter of 'client strength'. During the industry liaison process for this report, industry made clear it values having capable and knowledgeable government bodies as clients. A strong client imparts a positive element of discipline to the sector, otherwise certain parts of the industry may behave badly, and the industry doesn't want this.

Being a preferred client of industry is bound up in the contract management and choice of delivery model. Many agencies currently preference D&C contracting, to minimise risk to government. But the emphasis on lowest price creates a short term focus that militates against long term partnership with industry and potentially whole-of-life cost of the asset.

At present the procurement culture in New South Wales is said to be 'front-end loaded', compared with other countries and even other states. For example, compared with the UK, contracts in the Australia quickly go from preferred bidder to financial close, but it's because so much more time and money goes into becoming a preferred bidder here. The problem is the would-be contractor is spending too much management time up front with no certainty of actually getting the job, versus the UK where you're working knowing you've got a deal, for a larger part of the process.

'A price-only procurement approach produces a race to the bottom'

⁴Part of the solution may be the Queensland approach, which links contractors' licences to business turnover. https://www.qbcc.qld.gov.au/sites/default/files/Minimum_Financial_Requirements_Policy.pdf

Case study: Sydney Light Rail (CSELR) project

A new Report by the Audit Office of NSW (November 2016) has found that Transport for NSW did not effectively plan and procure the CBD and South East Light Rail (CSELR) project to achieve best value for money.

The Audit Office found that Transport for NSW's due diligence and probity in the procurement process was detailed and met NSW Government requirements. Also, Transport for NSW is on track to deliver the project. But it will come at a higher cost with lower benefits than in the approved business case.

The project's business case summary was published in November 2013, estimating a cost of \$1.6 billion. However, the budget had increased by \$549 million to \$2.1 billion when Transport signed the main works public private partnership contract in December 2014. Some of this increase was due to scope changes and planning modifications, but the majority - \$517 million - was due to mispricing and omissions in the business case.

The established assurance framework provided that Transport for NSW undertake the assurance reviews of the project. However, this approach did not provide the independent assurance required for such a major infrastructure project. In addition, the planning and governance arrangements, while approved by the NSW Government, skipped important assurance steps. Tight timeframes meant planning was inadequate and normal governance systems were not initially in place.

Transport for NSW did not finalise key third party agreements that affected the design and scope of works before issuing tenders and signing the major public private partnership contract. This has increased the project's complexity and risks, and reduced value for money.

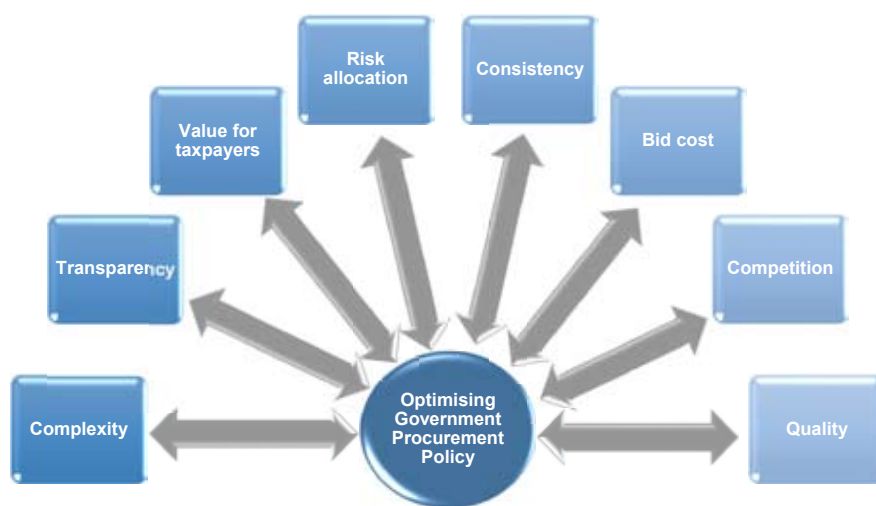
Since the planning stages, Transport for NSW improved the project's governance and assurance framework. It implemented rigorous monthly assessments to monitor risks that may affect the timeframe and budget. There is also stronger external oversight by the CSELR project Advisory Board and Infrastructure NSW. Transport for NSW advised that it has progressively finalised third party agreements, with one outstanding in October 2016.

More generally, since the Auditor-General's reports on WestConnex and Large Construction Projects, the NSW Government has strengthened assurance processes for infrastructure projects. Infrastructure NSW now independently administers risk-based assurance reviews for capital projects, and advises the NSW Government of any risks so they can be addressed.

See <http://www.audit.nsw.gov.au/publications/latest-reports/cbd-and-south-east-light-rail-project>

Allied with this is that tenderers can be expected to reveal too much of their intellectual property (IP) too soon, say industry representatives. They suggest that the bid process should start with a pro forma initial application that is brief and doesn't require giving away IP too early on. This tends to occur when the agency has not yet firmed up what it is looking for, which can express itself in inappropriate forms of contract. In this situation Early Contractor Involvement (ECI) should be used, where the client is still feeling their way. The client may want cost certainty, but has not pinned down a project plan.

Industry says that D&C contracting is placing more risk onto contractors. Example: contractor can't control developer risk but is being asked to take it on. Example: getting permits from government instrumentalities that contractor has no leverage over and can't effectively manage. To industry it seems illogical that government is not taking responsibility for obtaining approval from its own agencies.



Source: BIS Oxford Economics

Agency views

Some of the agencies we interviewed were clearly aware of the issues around the procurement process. Five to ten years ago alliance contracting was popular with NSW procurers, as there was a shortage of contractors (partly due to the mining boom) and it was a way of engaging contractors.

It then emerged that D&C contracts became popular. Agencies generally feel that local firms have now gotten used to D&C, foreign firms less so (the latter are not used to taking on the risk, or the amount of paperwork involved in an Australian public sector bid). D&C today are not like the old 'soft' ones, they are a harder PPP style, with less room for variations and adopted outcome specifications.

Some agencies we spoke to use a contractor consultant model, where everything is outsourced including project management, architecture, engineering and construction. Other agencies use a different approach.

Agencies generally favour sticking with a few contract types, notably government standard formats. They told us the NSW government does not offer incentives/disincentives for selecting particular contracting models. Contract criteria are to 'maximise value, get competition, meet timeframes'. Agencies vary in the weights they apparently give to bid criteria, in terms of the ratio of project assessment that is weighted to non price factors (team, legacy, program load, resource availability etc) versus price factors.

For agencies, one key take-out is the need to apply the lessons learned from earlier projects to large capital projects in the future. This echoes the Productivity Commission⁵ which found that nationally 'there is scope to do much better'.

Agency coordination

On the question of stronger coordination across agencies, some had thoughts in this direction. One urban network 'clearing house' could facilitate collaboration between agencies (involving, say, Transport for NSW, RMS, Urban Growth, and related agencies). Equally some recognise a role for competition between agencies, to improve government's behaviour as 'client'. To this end, some agencies have started providing three years notice to industry so it can plan better, providing expanded 'pipeline of projects out to 2021' publications, and developing ongoing links with identified industry partners to help industry understand agencies' appetite for risk.

Selected agencies are fostering a mindset that asks: are we ready to deliver the huge volumes of work planned? Are we open to new thinking that doesn't have to conform to the old way? Can we see ourselves akin to a construction company, leaner and focussed, delivering world class infrastructure? Are we attracting, hiring and retaining the right people? Are our employment contracts becoming more aligned with private industry?

Ways forward

Industry sometimes struggles with the requirements of government tendering and contracting. Improving literacy about the State's procurement procedures would seem a sensible way forward.

To some degree, the NSW Government's online ProcurePoint website provides guidance to industry participants about NSW policies and procedures.⁶ Equally, there is still room for further improvement in terms of educating stakeholders, particularly in explaining those aspects that are mandated by government legislation versus those that may be subject to greater flexibility.

Other states are also grappling with these issues. The Victorian Government, in a new report *Reforming Public Construction*, identifies reform opportunities for infrastructure procurement with the aim of reducing unnecessary time and cost in construction procurement.⁷ One notion floated is the reimbursement of bid costs where appropriate. This already happens on some large projects in NSW, and further use is encouraged.

Victoria will also look at mechanisms to speed up the preferred bidder selection process, encourage appropriately sized tenders to reduce overuse of the market and explore the inclusion of design standard outlines in tender documents.

Greater standardisation of procurement processes across government, involving the reduction of unnecessary or duplicate information across the Expression of Interest and Request for Proposal phases, is also mooted in the Victorian report, as well as steps to enhance government capability in construction procurement. The recent Business Council report⁸ supports moves in this direction.

Going forward, the procurement approach in New South Wales needs to:

- ▷ minimise long term risks to industry sustainability and costs (eg, by not inadvertently encouraging contractors to take flawed risks on quality)
- ▷ avoid taking up scarce resources through the tendering process or seeing firms simply not bidding for work, in the face of a high risk / low margins approach to procurement
- ▷ encourage contractors to invest in new capability or capacity, so firms are 'tooling up', investing in staff
- ▷ foster innovation and new, 'step changes' in productivity (such as the use of innovative resource-saving materials, or skills development)
- ▷ focus on outcome specifications rather than government designing the solution and artificially restricting the solutions industry can offer

Overall, the issue of procurement points to a possible a change of values in the way government agencies engage with the construction industry, from one that currently yields low pricing yet is at times adversarial, towards a greater partnership approach that maximises the legacy (price and non-price) of the infrastructure program, which encourages investment in capacity and capability, that rewards innovation (and hence productivity), that considers value for money in a 'long term' sense, including whole-of-life-costs and which results in a sustainable industry delivering quality, long-lived infrastructure.

OPTIONS TO CONSIDER

- ▷ **Compensation for bid costs incurred** – Some agencies already reimburse unsuccessful tenderers (can be up to 50% of costs). This could involve a Cost Reimbursable system for bidders, where the client pays for delays/ variations @ rate = cost plus. There is scope to apply this more widely.
- ▷ **Early works package** – Industry suggests that agencies need an early step in the procurement process, to get the vital services signed up earlier rather than later and to address utilities. Using an Early Works Package will satisfy this.
- ▷ **Simpler short listing** – A bidder currently needs to submit a huge volume of tender documents just to get on the short list of tenderers, and Government tends to ask for the same information over and over again. NSW needs a simpler system to get the short list, such as a registration system so contractors are not jumping through the same hoops again and again.
- ▷ **Variety of contracting models** – Large multidisciplinary projects require sophisticated risk allocation. NSW needs a suite of contract options. Alliance or delivery partner models, when well defined, may facilitate better allocation of risks. Ultimately, risks should be allocated to the party best able to manage them.
- ▷ **Using ECI** – The construction program more efficient when industry can plan. Using ECI (early contractor involvement), on one project after another, is proposed. As the contractor is finishing building one ECI-project they can be already in talks about the next ECI-project, allowing enough time for due and proper process, forward planning and probity.
- ▷ **Publish tender criteria** – Contractors can be left in the dark about the relative weighting of price and non-price factors when bidding. Agencies could be fully required in New South Wales to publish criteria for bid evaluation.
- ▷ **One-stop-shop permit approval** – The procurement process has been added to by multiplication over recent years in different permits required by diverse agencies. A potential solution to reduce duplication across multiple agencies, already used in the case of roads, is to provide a 'one-stop-shop' for approval from utilities.
- ▷ **Literacy program** – Improving literacy about the state's procurement strategy and procedures will help industry interact with agency requirements.
- ▷ **Liaison desk** – Be available to consult with industry.

⁶http://www.pc.gov.au/_data/assets/pdf_file/0003/137280/Infrastructure-volume1.pdf

⁷<https://www.procurepoint.nsw.gov.au/before-you-buy/construction/nsw-construction-procurement-strategy>

⁸<http://www.dtf.vic.gov.au/Publications/Infrastructure-Delivery-publications/Reforming-public-construction>

⁹http://www.bca.com.au/docs/bed23f8f-ee8c-45be-aa2f-4b94148f77d7/Competitive_Project_Approvals_Report_EMBARGOED_TILL_12.01AM_ON_25.11.2016_FINAL.pdf

<http://www.bca.com.au/media/world-class-model-for-major-project-approvals>

CRITICAL ISSUE 3: Ensuring essential skills



Ensuring that New South Wales has the necessary construction-related skills is likely to be one of the biggest challenges to capacity and capability going forward. Strengthening construction activity means rising demand for construction and professional skills, with the greatest risks likely to revolve around securing critical “on-site” skills including high quality supervisors, site managers and project engineers. Current constraints to the transferability and mobility of labour suggest that emerging skills gaps will not be closed through simply hiring labour from other regions, sectors or even from other parts of the construction industry. The need to redevelop government agency capability, the regional location of work, and the ageing of the construction workforce add further to the complexity of the challenge. Even so, there is much that can be done to improve the supply of skills for New South Wales construction projects, including implementing targeted retraining programs, removing artificial constraints to labour transferability and mobility, reducing demands on contractors during the tendering process and placing a greater emphasis on workforce development criteria in the procurement phase. Getting these settings right will not only assist skills development over the next five years, but will also leave a skills legacy for New South Wales for future decades.

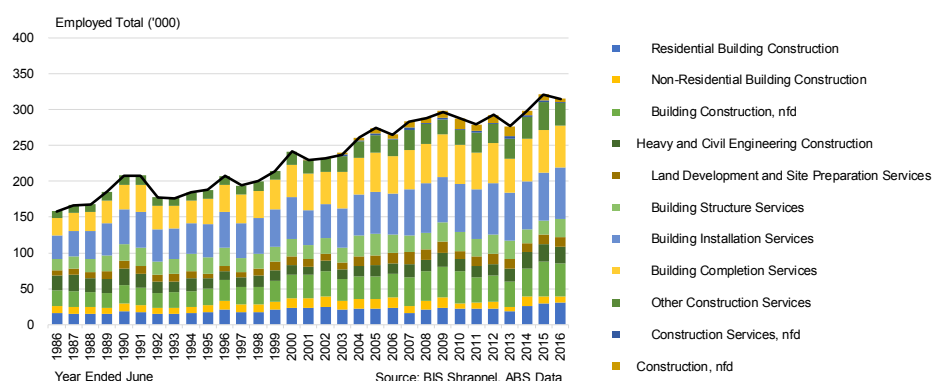
Strong increases in New South Wales' construction activity projected over the next five years are expected to place strains on key occupations and skills at all phases of the investment cycle, from planning and procurement, through to construction activity itself as well as ongoing asset operations and maintenance.

While New South Wales is currently the beneficiary of a national downturn in mining related construction activity – both in terms of the cost and availability of skills – these benefits are likely to erode in coming years as investment activity stabilises in other states and territories, and grows very strongly in New South Wales (and Victoria). In the longer term, a recovery in public and private investment in other states, as well as changing demographics as Australia's skills base ages, will present further capability challenges.

Employment trends and outlook

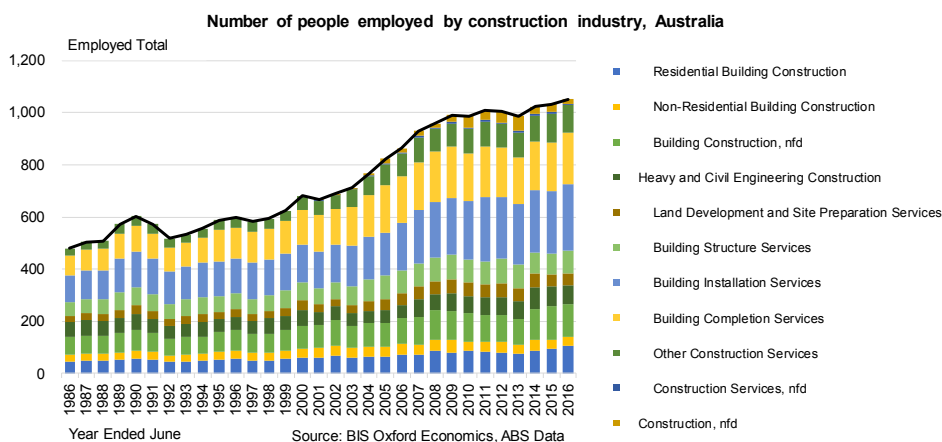
With construction activity rising in New South Wales, employment in construction and construction-related industry sectors (such as Professional, Scientific and Technical Services) has increased strongly in recent years.

Number of people employed by the Construction industry, NSW



The most recent quarterly employment data from the Australian Bureau of Statistics¹ shows that direct construction employment in New South Wales has risen from an annual average of 276,000 persons during 2012/13 to 315,000 through 2015/16, an increase of 39,000 persons or around 14 percent. By contrast, annual building and construction work done (encompassing residential, non-residential and engineering construction) in New South Wales rose around 5 percent over the same period, but is up 14 per cent on 2011/12 levels. Interestingly, construction employment nationally is also up over the past three years, despite a decline in total building and construction work done. Between 2012/13 and 2015/16 national construction sector employment rose from 986,000 persons to 1,056,000 persons on an annual average basis. This is despite measured total construction work done falling from \$220 billion in 2012/13 to \$198 billion through 2015/16.

¹ABS (2016) Labour Force Survey, August 2016, Cat. No. 6291.0.55.003.



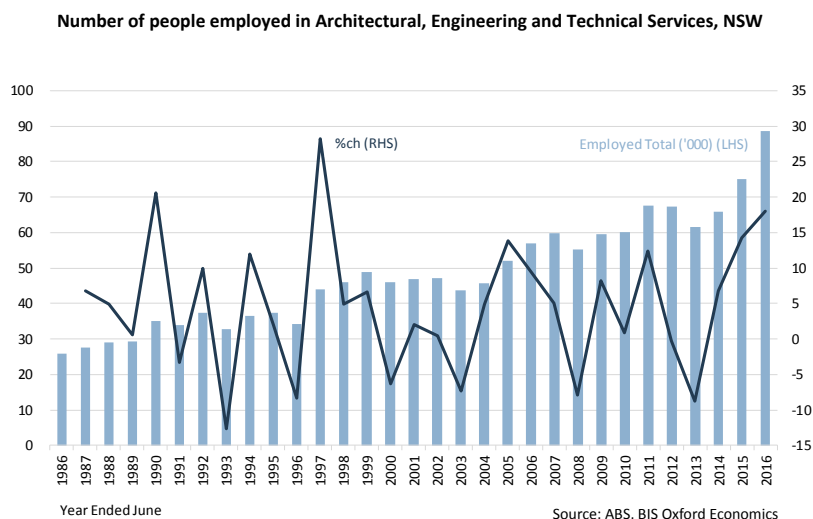
Differences in the growth in construction employment and work done, both at the state and national level, are likely to be the result of the changing composition of construction work. While engineering construction is much lower currently than it was three years ago, residential building work, which is relatively more construction labour intensive, has simply boomed across most of Australia. Furthermore, the broader engineering construction work done data includes LNG-related construction, which is highly capital and import-intensive, with LNG modules fabricated offshore in Asian yards and assembled in Australia onsite using very little local construction labour relative to the value of the modules themselves.

Construction employment outlook

At the national level, construction employment is expected to fall over the next few years as the most labour-intensive component of the industry – residential building – begins to unwind after several years of strong growth. This could see the loss of around 100,000 jobs in the construction industry at the national level, which will be offset only partially by a pickup in the infrastructure segments of engineering construction. A recovery in national construction employment based on BIS Oxford Economics' construction forecasts is not expected until 2019/2020. It is a very different story in New South Wales, however, where the growth in infrastructure construction combined with high levels of residential building is likely to see construction employment rise to over 350,000 persons over the next few years.² Longer term, total construction employment is expected to oscillate around this number based on the path of construction activity. Sustaining this level of construction employment will be challenging.

Architectural, engineering and technical services

Apart from construction workers, the construction industry also relies on professional skills such as Architectural, Engineering and Technical Services, which are a subcategory of the Professional, Scientific and Technical Services industry.



²This is slightly higher than Department of Employment projections to 2020, where construction employment is expected to rise to 344,000 persons – still a strong increase.

Here, the impending recovery in non-LNG engineering construction – including infrastructure investment – may be already having an impact on demand for “pre-construction” skills, particularly engineering-related skills in New South Wales. Employment in the Professional, Scientific and Technical Services sector overall has risen from an annual average of 304,000 persons in 2012/13 to 360,000 through 2015/16, an increase of just under 20 per cent. Nationally, the figure has grown from an average of 907,000 persons through 2012/13 to 1,009,000 persons through 2015/16.

In the important Architectural, Engineering and Technical Services sub-category of the industry, employment has risen from an average of 61,500 persons in 2012/13 to 88,700 persons in 2015/16. At the national level, there has been a similarly strong increase, likely driven by a similar driver – the strong upswing in residential building activity. However, differences are expected over the next few years as residential building activity cools more rapidly in other states (which do not have the degree of undersupply in residential stock) coupled with the very strong growth outlook for infrastructure construction in New South Wales compared to the national average.

Differences between “Off-site” versus “On-site” skills

While the strengthening outlook for construction activity in New South Wales now, and nationally in the future, is expected to impact on both demand for construction and professional skills, recent industry soundings reveal that there is a significant distinction in their perceptions of capability gaps based on whether the skills required are classified as “off-site” or “on-site”.

Here, offsite skills can refer to the (often professional) skills required for either the planning/ design and procurement phases of construction projects. The former includes architects, designers, engineers, surveyors, and project controls skills which are often employed at the front end of engineering and design. However, these, and other skills, also often work at the procurement phase either in bid teams or for the procuring government departments. Offsite skills can also include the professional non-construction labour required whilst working through the construction phase of projects (e.g. administration, project and contract management). Onsite skills, meanwhile, can be defined broadly as those which are demanded regularly on the construction site so that construction activity can take place as planned and budgeted. This typically includes construction trades labour, operators of plant and equipment, transport (truck drivers) and, most importantly, site managers or foremen.

Recent industry soundings revealed that the greatest capability risks were associated with the availability of onsite construction skills and, particularly, high quality site managers. Typical responses from building and construction contractors included:

“In design, we shift people around our offices... either virtually or physically to win or compete on these big projects. But construction is different. You need to have people there in the site office.”

“[On the] professional side of things [there are] less issues finding people. Where it is harder is at the site manager level. They typically come from a trade background – competent trained guys who started in a trade and worked up to be a site manager.”

“The problems we are going to have will be in the physical delivery and supervising of the trade work. There’s two fundamental areas for bottlenecks or just a complete lack of skills. Firstly, in the physical delivery: supervisors, people like foremen and site managers, your typical ‘old salts’. Guys that came up through the trades and knew how to build something”.

“They say there is a skills shortage [in project managers] because they can’t find them, but in fact they are so caught up in the office doing paperwork for compliance reasons they are not actually out on site doing the site supervision jobs.”

“Our biggest issues in New South Wales at the moment are quality foremen, site engineers and site coordinators. We can’t find them. It’s a national issue.”

‘You need to have people there in the site office’

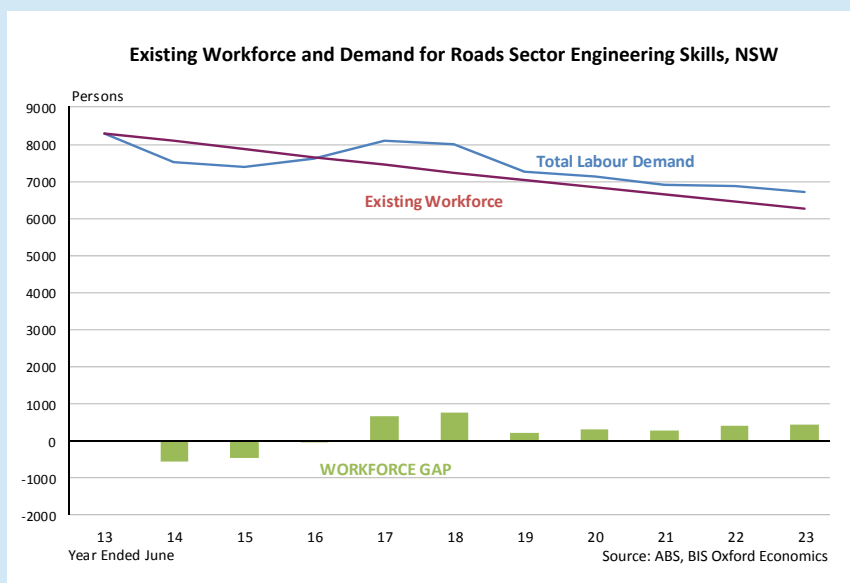
ENGINEERING SKILLS AND POTENTIAL CAPABILITY GAPS

Engineering-based skills are an important subset of skills required to plan, design and deliver infrastructure projects. However, analysis by Engineers Australia (2012)³ and BIS Oxford Economics (2013,⁴ 2015⁵) have indicated that there may not be sufficient numbers of skilled engineers to meet future demands. Engineers Australia's research noted that growing total industry demand for engineers between 2003/04 and 2010/11 had to be increasingly met by temporary and permanent skilled migration given weak growth in engineering degree completions during that time (although degree completions have picked up more recently). Meanwhile, BIS Oxford Economics research was focused specifically on engineering skills for the roads industry (2013) – following earlier analyses in 2006 and 2009 – as well as the surveying industry (2015).

In the case of the roads sector, despite assumptions of sustained labour productivity increases, the projected demand for engineering skills, compared to the attrition of the existing workforce over time through demographic effects (i.e. population ageing) produces a workforce gap which needs to be met through new (albeit lesser skilled) graduates or by importing engineering skills directly from other regions or industries. This study was undertaken when the outlook for NSW road and bridge construction was much lower (i.e. before the Rebuilding NSW program delivered an additional \$20 billion for infrastructure investment). An updated outlook, based on 2016 Census data (when available in 2017) and current (much larger) projections of construction activity, would likely show a larger workforce gap of skilled roads industry professional to meet projected demand.

Meanwhile, analysis for the surveying profession in 2014 showed an even larger workforce gap emerging as unprecedented demand from infrastructure and residential segments of the market drove a shortage of registered surveyors in New South Wales. With falling numbers of surveying graduates nationally each year, coupled with an ageing profile of the existing workforce, the surveying profession will likely remain in substantial shortage through the coming decade. Recent industry soundings have supported these findings, and surveying remains in state-wide shortage on the NSW Skills Shortage list. Reasons given for capability constraints in this segment include:

- The strong phase of productivity growth (driven by new mapping technologies, apps and equipment such as drones) is coming to an end.
- The existing workforce is hampered by rising regulatory burden at council and services levels, while councils are themselves experiencing a skills drain to the infrastructure segment.
- Large projects will “pay what it takes” for skills, exposing surveying shortages to smaller projects and in regional areas.
- Increasing risks of having plans signed off by less experienced surveyors, resulting in costly rectification works.



³Engineers Australia (2012) Statistical Overview, referenced at https://www.engineersaustralia.org.au/sites/default/files/shado/News%20and%20Media/Media%20Statements/2012MediaStatements/new_study_shows_depth_of_engineering_skills_shortage.pdf

⁴BIS Oxford Economics (2013) Australia and New Zealand Roads Capability Analysis, 2013-2023.

⁵BIS Oxford Economics (2015) Determining the Future Demand, Supply and Skills Gap for Surveying and Geospatial Professionals, 2014-2024

'Overall, it will be important for government and industry to understand better how 'whole construction sector' onsite skills demand will evolve'

In our industry survey, the availability and cost of professional skills were rated a slightly higher risk to capacity and capability than trade skills, but both were the highest ranked capability and capacity risks overall, and surpasses risks driven by other production inputs. When drilled down further in the qualitative discussions, the skills regularly mentioned as being most at risk tended to be those with an onsite characteristic. Apart from site supervisors and foremen, other onsite skill sets which were considered at capability risk were:

- Onsite engineers and surveyors
- Finishing trades for buildings (tilers, joiners, carpenters) where there is crossover between residential and non-residential building work
- Vinyl layers (specialisation for hospitals)
- Concreters, formworkers and steel fixers
- Mechanical and electrical trades
- Tunnellers
- Truck drivers

Some of these skill sets, such as surveyors and civil engineering professionals, carpenters and joiners are already on the New South Wales Skills Shortage List as being in state-wide shortage.

With the possible exception of finishing trades for buildings (which may see some easing in pressure if residential building activity were to come back from record levels) it is very likely that the strong projections for non-dwelling construction activity over the coming five years will place strains on the capability of the other skills mentioned above.

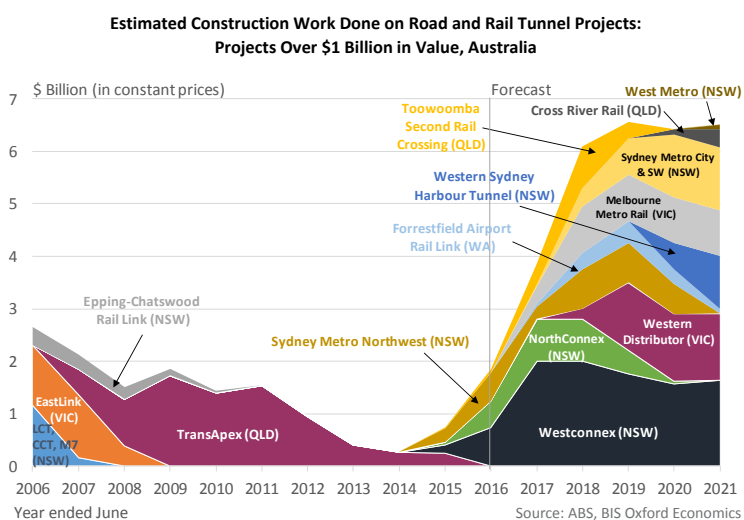
BIS Oxford Economics has already undertaken analysis and forecasts for the engineering professions, albeit in past years, and not with the higher demand projection from the construction industry. Recent interviews with New South Wales Government agencies indicated that modelling is currently being done to better understand the future demand profile of many of these construction-related skills. Of particular focus should be the share of skills in these professions that need to be onsite as opposed to offsite, which can still be significant, even in the surveying profession, according to recent industry interviews.

"Plenty of surveyors are available for planning and original mapping. That's not too much of an issue. But there is a shortage of 'on the ground' people to set these things out and to keep in front of the machinery. That's a combination of people being able to use the technology and be on the ground when and where needed. These projects move fairly quickly and they will do it in stages. They tend to need a bunch of people setting up a whole stage and then there might be a lull. Then they might need another 20 people for the next stage. So it's a continuous rotation of getting people in on the ground."

Overall, it will be important for government and industry to understand better how "whole construction sector" onsite skills demand will evolve into the future across these occupational categories – summing up demands across all agencies and the private sector – and how it could be best met by training, procurement strategies and incentives.

A case in point is tunnelling skills. Of the onsite skills listed, tunnelling skills, along with the mechanical and electrical trades skills (e.g. electrical, heating, ventilation and air conditioning) which are utilised in fitting out tunnels once they are cut by road headers or tunnel boring machines (TBMs) are expected to be under significant pressure. Here, industry soundings revealed considerable concerns of delays and cost blowouts driven by a lack of suitable skills during both the tunnelling and post-tunnelling phase, with the risks amplified by the overlapping of several large projects across Australia as well as the sheer size, complexity and sequential nature of the construction process itself, with limited entry and exit points to sites for these types of projects.

Meeting demand for high quality skills in tunnelling and tunnel fit-out is likely to be particularly challenging given the sheer size of the approaching boom in tunnelling work, and its sharp ramp up over the next five years as multiple massive road and rail tunnel projects get underway as shown in the figure below. BIS Oxford Economics estimates of tunnelling work going forward suggest that a high peak will be sustained in national and state tunnelling activity from 2017/18, potentially placing great demand pressure on these skills sets.



Meanwhile, the same bulge in large and complex tunnel projects has already created pressures in the “off-site”, pre-construction phases, including design and procurement. Here, the challenge has revolved around securing qualified engineering consultant designers, architects, and project controls skills (planning, scheduling, cost estimation and risk management) to work with and alongside procurement agencies, but also contractor bidding teams.

At the design and prefeasibility stages, our industry soundings suggest that lessons have been learned after dealing with previous extraordinary cycles in work during the resources boom, particularly in Queensland and Western Australia, with consultants able to use technology to shift design work interstate (as well as internationally) where there has been spare capacity to deliver. Here, the transferability of skills is important, and has allowed New South Wales (so far) to leverage from spare capability in Queensland, Western Australia and, also, offshore in an increasingly internationalised skills market. In an important sense, New South Wales has already gone through a substantial rise in design work which is preceding the increase in actual work done on the ground. However, even at the design stage there is little room for complacency, given the sustained strength of investment projected for New South Wales and the likelihood that global (as well as interstate) demand for consultant skills will also rise from here:

“Eight years ago we had the same problem and we dealt with it by bringing a lot of people out from the UK, particularly in rail. But now the UK market is quite buoyant. We are losing those expats back to the UK.”

“Even now, we are losing people back to the UK because the market has picked up in Ireland and London. For the previous boom in Australia we brought in a lot of people from Ireland and Europe and other countries but that has gone. We are now actually losing people back to these countries. And it is also being driven ... by property prices. Forty minutes out of Dublin, you can have a four-bedroom house overlooking the ocean with about an acre of land for 250,000 Euros.”

'At the moment the building market in Sydney is hot'

"We have to make a distinction between civils and building. At the moment the building market in Sydney is hot. There's a lot of residential going on, Melbourne too. We believe the heat will come out of the market next year when the likes of Barangaroo will be delivered [but] if you look at the civils market the signs are there. The competition for quality engineers, project management staff, design management and so on ... its going to carry on for some time."

At the procurement stage, the demand for offsite professional skills has been particularly acute, with industry, in their own words, struggling to provide the quantity of skills capability required by procurement agencies at the right times. On very large, complex projects over \$1 billion in value, industry soundings revealed that bidding costs were typically \$10-30 million (or more), with bid team numbers measured in the hundreds. Complexity in tenders, the amount of detail required (typical contractor responses likening responding to tenders to "backing up a semi-trailer" of documents), and post-tender delays where teams are expected to remain available, all add to the demand side pressure and cost. The sheer scale of bidding means that contractors have to be strategic about which tenders to pursue and plan how they are to be resourced well in advance.

Strong demand for limited 'A teams' of procurement talent has created fierce competition between contractors (and sharply rising salaries)⁶ for key resources bidding for work (as well as movements from the private to public sector). Combined with an often highly price-sensitive procurement approach (which does not effectively reward quality, a long term skills legacy, or innovation), contractors have responded by being highly selective about the projects they choose to tender on and where they can add value. This has ramifications for whether, on very large projects with few bidders, the procuring agency is accessing sufficient market skills and achieving value for money.

Here, the offsite skills pressures are highly focused towards quality resources – in particular those engineers and other professionals' skill sets that have accumulated substantial experience:

"Particularly in the five to fifteen-year experience range, that seems to be the key area of concern for engineers. [We have] lost staff to WestConnex and people have jumped... but for those that remember Airport Link, it may not work out well for a lot of the younger engineers who end up working 90 hours per week because these projects couldn't get a sufficient numbers of staff. These projects need a lot of staff and when they don't get them, the staff they do get burn out, then turnover goes up which in turn increases the business risk of lack of accountability for managing the project and leads to loss of control."

As one prominent industry consultant neatly summed up in the industry soundings process: "Industry will whinge about the procurement phase... and they've got a lot to whinge about!"⁷

New South Wales procuring agencies, in general, have taken steps to try to minimise sharp peaks in demand for scarce industry bidding team skills through the timing of their tender processes. During the industry soundings, there was approval of the efforts some agencies, such as RMS and TfNSW, were putting into publishing a detailed project pipeline by construction phase (including procurement)⁸, and acknowledging the timing of procurement, where possible, to avoid clashes with other major projects. However, according to industry there are still substantial bulges in demand for procurement skills, particularly where there may be heavy competition for procurement between different agency clusters or even interstate (or international) clashes.

A case in point was the very high simultaneous demands placed on contractors and consortia teams for metro rail projects in Melbourne and Sydney.

⁶<http://www.afr.com/real-estate/pay-increases-surge-for-developers-and-builders-amid-boom-and-skill-shortages-20160315-gnk1rr>

⁷Apart from skills, other issues surrounding industry procurement are discussed further in Critical Issue 2 of this report.

⁸For example, TfNSW, Infrastructure and Services Division Pipeline of Projects, September 2016

"If you overlay metros in Sydney, Melbourne, Brisbane and Auckland all at the same time you would kill all the industry's proposals teams. We have good teams, but if you stretch them too far you will get the situation like we have just got with Sydney and Melbourne. The government didn't accept our view that if you put out the projects at the same time then some companies would choose to bid one rather than the other. And what's happened? They've got two teams only bidding in Sydney and three companies decided not to bid Sydney. Industry will choose. They have got limits and bid budgets, so governments need to be careful. In the procurement phase, you can stretch the industry and we are doing it right now."

While the largest "mega projects" will always likely take up the bid team resources of Tier 1 contractors, one policy which is potentially conserving procurement skills capability is that of 'unbundling' larger projects or programs into smaller pieces so that they can be effectively bid for by Tier 2 contractors. Examples specifically mentioned in our industry soundings include the Pacific Highway works packages, parts of the Western Sydney Infrastructure Program, and the Regional Hospitals Program (all in New South Wales), as well as examples from interstate such as Victoria's Outer Suburban Arterial Roads PPP. Given the likelihood that "mega-project" procurement will continue to be high in future years as the New South Wales infrastructure program is rolled out (and as procurement picks up interstate and internationally), policies such as these are likely to remain important in keeping scarce procurement (as well as onsite construction) skills available.

A strong client and informed buyer

Part of the reason given for the pressures on procurement skills is the competition for private sector skills from the public sector itself.

In general, industry soundings revealed that the construction industry supports having a strong and capable public sector client who can effectively develop concept designs and reference cases, manage an efficient procurement process, make the best procurement choices and handle contract management and administration. However, over much of the 1990s and 2000s, the public sector lost technical (engineering) as well as management skills as State and Commonwealth public sectors downsized.⁹ As a consequence, in recent years the New South Wales public sector has had to hastily re-develop its own skills base, including both hiring directly from the private sector as well as subcontracting tasks directly to private sector organisations. As noted by one industry consultant:

"The industry wants a strong government – knowledgeable and capable government – as a client. It doesn't mean the government needs to employ people directly. But where it hasn't got the wherewithal for a certain program, then bring in experts from the private sector to assist. For instance, the North West Rail is being contract managed by private companies because the government doesn't have enough contract management expertise for that project."

In the case of the RMS, 200 out of an additional 286 roles had been recruited directly as at August 2016 including almost 100 new roles in regional areas to manage the growth in New South Wales roads activity.¹⁰ There has also been strong recruitment from the private sector in other agencies such as Transport for NSW and Health Infrastructure, based on industry interviews.

While some public sector agencies may have been successful at re-vitalising their own skills base, this has been at some cost to private sector skills capability, particularly in preconstruction and procurement roles and at a time when demand for these skills has also been rising in the private sector given the sharp rise in procurement opportunities in New South Wales. But there are other downsides as one contractor mooted during industry soundings:

⁹Yates, A (2000) Government as an informed buyer: Recognising technical expertise as a crucial factor in the success of engineering contracts, The Institution of Engineers, Australia, Canberra, p5.

¹⁰RMS, Major Projects 2021 Forum Presentation, August 2016. <http://www.rms.nsw.gov.au/documents/business-industry/major-projects/major-projects-2021-forum-presentation-slides-august-2016.pdf>

"When the head of a government agency stands in front of 500 people and says 'If you want a job, come and join me', that doesn't exactly help. It just stuffs up the food chain. It's a middle management drain but they are being dragged into senior roles. So the people who do the work are going into senior management which means the people left who actually do the work are less qualified."

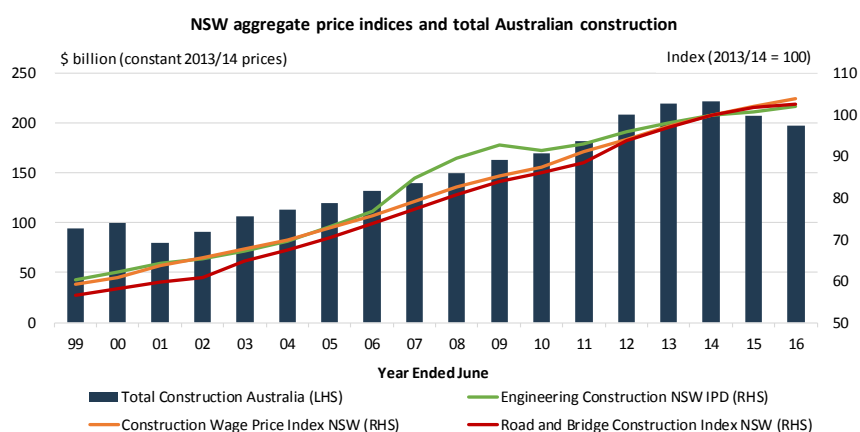
Furthermore, the speedy 'tooling up' of public sector agencies through hiring of contractors can also lead to conflict of interest issues, particularly if contracted staff are asked to review or procure work from potential competitors:

"... the quality of people we are coming across in procurement is really poor and we are finding a whole lot of conflict of interest issues. We have had bids, where we have put in for work for major transport projects in the billions and we have gone into the interview and four people in the interview were employed by three organisations who were direct competitors of ours. They not only see our IP, but they also get to see our rates and our salaries and everything else. We have had massive issues with it. They are just trying to push so much work through these government departments that they can't even man up to handle it and what they are doing ... are shoddy practices to get things done."

Overall, the need for government agencies to improve their own technical capability to handle the growing complexity and volume of work is well established. Recent industry soundings indicate that governments have, in the past, set ill-informed delivery dates for projects before adequate design work, bidding and pricing has occurred. In turn, this has contributed to perceived increases in the scope, cost and timing of major projects. Improving government resources could assist in reducing this risk. However, it should be acknowledged that in competing for potentially scarce resources, this process is having an impact on the private sector's capability to deliver and that, if not done well, can lead to other suboptimal outcomes.

Transferability and mobility of skills

To a significant degree, New South Wales has been a beneficiary of the downturn in investment activity in other states and territories, which has affected the cost and availability of labour skills. This is evidenced in prices (wages) for construction labour (where growth in wages has slowed in New South Wales as well as in other jurisdictions) and as captured in aggregated construction cost indices such as the ABS' Road and Bridge Index and the engineering construction implicit price deflator. It has also been acknowledged anecdotally in recent industry soundings, with contractors and other market participants noting that they have been able to draw on skills from outside of the state – both in offsite and onsite applications.



However, these benefits have not been uniform across all skills in all construction sectors. Nor has it been evident across all regions within New South Wales. Maximising the benefits here requires skills to be both transferable and mobile. **Transferability** refers to the idea that skills can be applied equally in different contexts (e.g. public versus private sector) or construction sub-sectors (e.g. engineering construction versus non-residential building) or under different industrial rules or settings. **Mobility**, on the other hand, more specifically refers to the ability for skills to move geographically (e.g. into New South Wales from other states or into different regions within New South Wales itself). It is possible for skills to be transferable but not mobile, as well as vice versa, but taking full advantage of latent industry skills capability generally requires both criteria to hold simultaneously.

There are many examples where construction skills are simply not transferable – for instance the sharp differences in capabilities required to build a house compared to a coal mine. As put by contractors in recent industry soundings:

“The market capacity here is only so big. There was this notion that as the mining boom slowed down that would suck up the resource into the civils market. To an extent that is true, but you are talking about different people with different skill sets. The idea that those people could transition onto residential, non-residential or other building is a complete fallacy.”

“There is a view... that there is a decline in the engineering and infrastructure space in WA and Queensland, so people aren't a problem. They will simply migrate from state to state... The problem with that is that not all of the roles are transferable. A mining manager may not become a construction manager – they are not transferable skills. There are some which are transferable. They are what I would call foot soldiers, engineers (with a construction background or have a university degree such as a civil engineer) and foremen.”

In general, improving the movement of non-transferable skill sets will require significant re-training. This, in turn, may require government to have a more detailed understanding of the skills required to deliver the construction program against existing capability, so that appropriate retraining targets for the existing construction workforce can be met. The benefit of retraining in tackling transferability issues is that industry and government is not starting from ‘ground zero’. Skilled resources are available, but need support to be ‘re-tooled’ to match required competencies.

Of greater concern, however, is any artificial roadblock that effectively prevents the movement of skills which are or could be transferable. Here, recent industry soundings suggest that there is cause for concern and that New South Wales procurement agencies may not be making the most of latent skills capabilities available, particularly in the professional occupations. As pointed out by one participant (but reflected in the views of many others):

“We really struggle as we can't get really qualified people who come out of oil and gas and mining a gig in transport... if you don't have a transport background, the government departments just won't use them... Project controls, estimating skills, programming skills, risk, some of the engineering skills... But if they haven't got transport on their CV they are all getting rejected. And they are really highly qualified. So we have made quite a few people redundant in the end. Frankly, with a bit of management and a bit of time to pick up some terminology, it isn't that difficult. We have got guys who ran project controls on some of the coal seam gas projects, \$8 billion worth of work, you know Senior Managers in controls, 30-40 years' experience and we had to make them redundant because we could not give them a gig on anything in transport in NSW. It's nonsense.”

‘If they don't have a transport background, the government departments just won't use them’

In turn, policies or approaches which restrict the ready transfer of skills increases the demand pressure (and cost) on those who are deemed to be transferrable – such as transport engineers. In industry soundings, some contractors simply gave up trying to win work in transport because they didn't want to enter a bidding war for relatively scarce roads-experienced engineers from Tier 1 contractors, which is what was effectively demanded by New South Wales agencies in requesting these skills directly at the procurement phase, as well as having successful prior experience in New South Wales road projects. In turn, this impacts on competition and potentially costs.

"It's almost impossible to get into that space. As much as we would like to get into road and rail. We have been beating our heads against a brick wall. [The agency head] said we would love to have us in this space, we are desperate for another Tier 1... At the high level we get "we want you, we want you, we want you". But then you get to the project level ... and they say we can't get you past first base because you haven't done one."

This issue is similar to concerns regarding innovation in public sector authorities. In essence, industry soundings suggest that while procuring authorities may espouse innovation in the use of skills, materials and procurement methods at the executive level, this message is not making much traction at the operational level. To the contrary, authorities tend to be cautious and conservative at the operational level, with a preference for avoiding risk, potential costs and situations which aren't "tried and true". Keeping pressure off capacity and capability, however, requires an acceptance of innovation, with both government and industry taking responsibility for working out practical ways to make skills transferable.

Mobility of skills

Mobility is also an important issue.

While there is robust data on the overall size of construction workforces in each state of Australia over time, relatively less is known about how construction labour moves between states to take advantage of differences in employment opportunities. Recent analysis of 2011 Census data undertaken by the Productivity Commission¹¹ suggests that workers in the construction industry were relatively more likely to have moved residence in the previous year than workers from most other industries (behind the FIFO-dominated mining industry, public administration and safety, accommodation and food services, and arts and recreation) but not substantially higher than the national average. Typically, it was found that higher mobility occurred in industries that have high growth in employment and high vacancy rates, and where the work was more project based or seasonal.¹² Data from the recent 2016 Census (likely to be available during 2017) may offer an interesting comparison to this analysis given the sharp changes in construction activity at the state level in the interim.

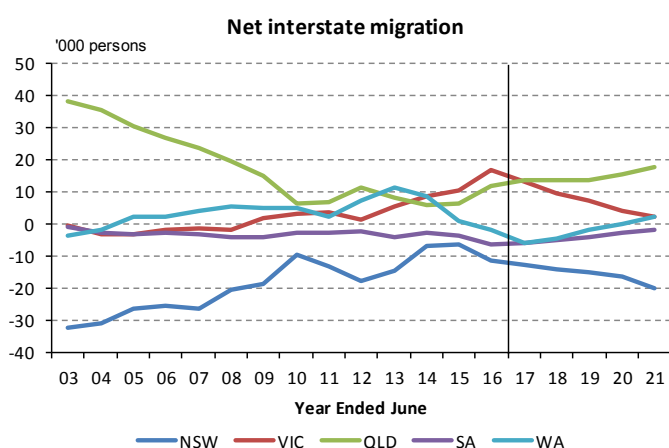
However, the Commission also noted that while around 16 per cent of the labour force changes residence each year, only between 10-17 per cent of these are for work reasons and two-thirds of the total entail a move of less than 10 kilometres. Interstate moves represent just 1.7 per cent if all changes in residence, although there is also evidence of an increasing number of mining and construction workers participating in "long distance commuting" (a substitute for residential moves) to mining regions through FIFO initiatives.¹³ Even so, this data suggests that there are limits to the extent interstate markets can be tapped for construction skills, with mobility impeded by lack of affordable housing, transitional costs (such as the imposition of taxes such as stamp duties), differences in costs of living, and differences in the quality of social and economic infrastructure (e.g. education, health, communications and transport).

Interstate mobility trends over time (albeit not at the industry level) can also be observed through net interstate migration statistics collected by the ABS. Historically, New South Wales has recorded a net interstate outflow for at least the past thirty years, with housing affordability and lifestyle considerations likely to be the primary determining factors behind this outflow. The most significant outflow is traditionally to Queensland, with a net exit of over 25,000 persons from New South Wales making the trip in 2002/03, at the height of that trend.

¹¹Productivity Commission (2014) Geographic Labour Mobility, Research Report, Canberra.

¹²Ibid, p13.

¹³Ibid, pp12-13, 15-16.



The net interstate outflow from New South Wales has trended downwards since its peak of 32,500 persons in 2002/03, and is estimated to have recorded just 8,500 persons in 2015/16. A steady weakening in the net outflow to Queensland has been the key driver of this downwards trend primarily due to the relative weakness in the Queensland economy compared to New South Wales. Sharp differences in the direction of construction activity between New South Wales and Queensland in recent years may also have been a driver. Victoria is emerging as a potential competitor for labour, with net interstate migration inflows rising to an estimated 11,000 persons in 2015/16 based on net outflows from all other major states including New South Wales.

With regards to mobility, the biggest constraint to capability as borne out in industry soundings is the cost of moving itself (personally as well as financially) and the generally higher cost of living in Sydney (where much of the next phase of construction is taking place), particularly in terms of housing. As one well known construction contractor stated in interviews:

"Queensland is a basket case... but people don't want to come to Sydney because of the cost of living here. The boom in WA was tempered by a lot of people from Sydney and Victoria going there. If I look at our management teams in WA, 30 per cent of them were from the eastern seaboard. We've just transferred them over. And they love it. I can't get them back!"

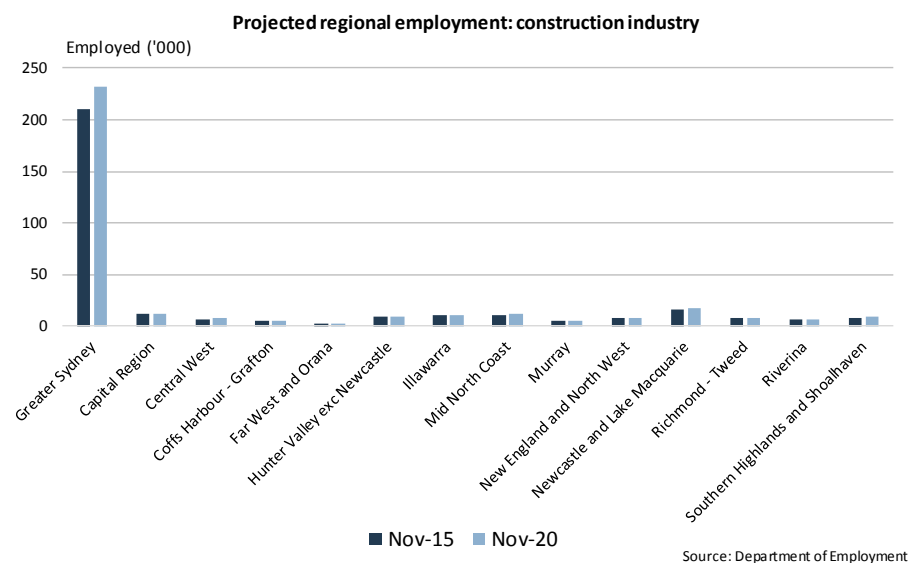
'People don't want to come to Sydney because of the cost of living here'

For critical senior positions, accommodation is just another cost which can be borne by employers to attract skills. However, when the cost of moving and housing (particularly in the Sydney region) has to be borne by the employee (as is the case with most non-critical positions), there is a considerable disincentive to move presenting a constraint to mobility and hence skills capability. This means that these skill sets often need to be "home grown", based on local training, education and experience, rather than simply relying on mobility from interstate or overseas. In several industry interviews, non-NSW contractors said they were not bidding for work in Sydney given the cost of accommodation, but were interested in winning work in other regions of New South Wales. In turn, this is having an impact on competition.

Finally, it should be noted that skills transferability and mobility goes both ways. While New South Wales has (or ought to have) benefited from falling investment in other states and territories, this situation is not expected to persist. Already, contractors are noting that the current glut of transferable skills in the market is being absorbed, particularly as Victoria ramps up its own infrastructure investment plans, as investment starts stabilising in the resources states of Queensland and Western Australia, and as infrastructure investment activity picks up globally. Here, there is considerable concern that, within the next few years, New South Wales will be facing much greater competition for mobile skilled resources, particularly engineers, consultants, controllers and site managers which will put capability to deliver at risk.

Regional skills risks

Differences in the transferability and mobility of skills brings regional risks into play. Currently, the strong profile of work projected in the Sydney metropolitan region is, according to industry interviews, creating a skills drain in other New South Wales regions. During recent industry soundings, engineering and surveying organisations typically expressed concerns that they are currently losing regional staff to deal with the very high demand for skills on metropolitan projects, with premiums being paid for skills to counter Sydney's higher cost of living. This is particularly challenging for regionally-based businesses who are used to a more stable, year on year, demand. Currently, these businesses are coping by hiring new graduates (from universities or technical colleges) and training them as replacements, but even with the same numbers of "arms and legs" there is a considerable loss of expertise and skills which is difficult to measure as staff with decades of experience are replaced by staff with little or no practical experience.



Attracting skills into regional areas can be challenging at the best of times. As noted in the recently released *NSW Intergenerational Report 2016: Future State NSW 2056*, population growth is expected to be slower in the regions outside of metropolitan Sydney over the next 40 years, population ageing is expected to be greater, and the proportion of people living regionally is expected to decline slightly.¹⁴ These are not the longer term drivers that would encourage working age skills retention in New South Wales regions. Indeed, the future New South Wales pictured in the report is one of much higher urban density (extrapolating recent trends), with many more working aged people living in Sydney itself while the semi-retired retreat to the regions to "help pay the bills".¹⁵

To a substantial degree, this is an extrapolation of long term demographic trends. However, it should also be recognised as the long term realisation of the series of investment choices made by governments over time (e.g. heavy investment in Sydney transport, housing and other infrastructure compared to the regions) which facilitate the long term outcome. The desire for – or acceptance of – urbanisation will direct the geographical location of skills and hence each region's capability to meet investment and infrastructure challenges. While technological developments may continue to support regional capability in offsite skills, it will not necessarily counter a potential growing skills gap in onsite skills and capability.

¹⁴NSW Intergenerational Report 2016: Future State NSW 2056, p6.
¹⁵Ibid, p17.

However, the capability risk in New South Wales regions is not just a long term issue – it is happening now. Contractors are generally more comfortable with tendering on projects in the Sydney metropolitan region compared to regional areas – particularly for more specialised work – knowing that it will often be easier attracting project-critical skills such as foremen and project managers. As one consultant expressed it:

“The regional projects are more challenging in the building market. All the large building companies say without question that it is a struggle to get the right project managers, project directors to go to Dubbo or to Wagga because you are talking a two-year contract and they have families. They prefer the jobs in Sydney, Brisbane, Melbourne because there is a greater chance of getting the right team...”

Some regions coping better than others. The Pacific Highway Upgrade Program has provided important regional benefits along its route and has allowed the training and development of local skills which have then moved, stage by stage, along different sections of the project. Currently, the large, final stage of the project – the Woolgoolga to Ballina section – is also attracting skills from nearby South-East Queensland.

The challenge, however, will be in retaining a skills legacy in these regions once the highway projects are finished. Here, comments in industry soundings suggested that governments and procuring agencies could be doing a better job in understanding the profile of all projects happening in each region (not just in transport, or health, and taking into account private sector projects that are using skills) and looking to take advantage of skills capabilities which may be available once existing projects move to completion. That is, governments could target the ‘gaps’ in construction activity as individual regional projects wind down. As one contractor noted:

“Health infrastructure has been really well planned, but with prisons it felt like panic. At the end of the year we said we can’t tender, we haven’t got the resources, we haven’t got it planned into our program. Whereas we actually have a shopping centre very close to one of the prospective jails... If they had simply said, “When is that retail project finished?” and if it was scheduled and they asked “Could that team go from there to there?” we would have said yes.”

‘The challenge will be in retaining a skills legacy in the regions once projects have finished’

In practice, such a policy would require each procuring agency having a sound knowledge of the range of significant projects happening in their region and retaining flexibility in the timing of procurement so as to maximise the opportunity for skills transfer.

The demographic challenge

Apart from increasing urbanisation, another other long term challenge facing the New South Wales economy outlined in the NSW Intergenerational of Report is the ageing of the population.¹⁶ While this is expected to have a dampening impact on state economic growth as well as fiscal implications for government assistance and support, it also presents significant challenges for construction skills.

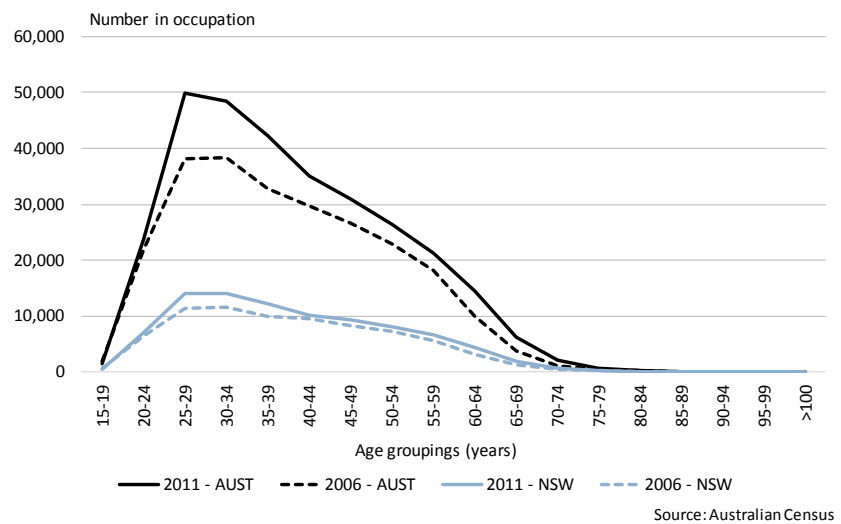
The loss of industry capability through ageing is also front of mind with construction contractors and other industry suppliers, according to our recent industry survey (see Section 4). Overall, evidence from the 2006 and 2011 Censuses reveals that key construction-related skills cohorts are ageing along with the general population, with a rising proportion of these populations moving into over-55 and over-65 age brackets.¹⁷ While all major professional and trades skills categories are showing the impact of ageing, it is particularly noticeable across Design, Engineering, Science and Transport Professionals as well as Mobile Plant Operators, as shown in the charts on pages 70-71, with both distributions showing a movement to the right along the age axis. However, the effect is also noticeable across engineering technicians, construction trades workers and construction and mining labourers.

¹⁶Ibid, p20-22

¹⁷2016 Census data will be available during 2017, and it will be instructive to see how these distributions have changed since the end of the resources boom, with ageing likely to be even more apparent.

Skills capability is expected to be heavily affected as more of the baby boomer generation enters key retirement age brackets, and this is particularly noticeable in the professions (both onsite and offsite) where capacity was augmented through high rates of immigration post World War II, especially in engineering. However, these waves of immigration are now adding to the demographic challenge. For example, original BIS Oxford Economics research into engineering professions in the roads sector (which has one of the strongest construction

Number of Design, Engineering, Science and Transport Professionals by Age

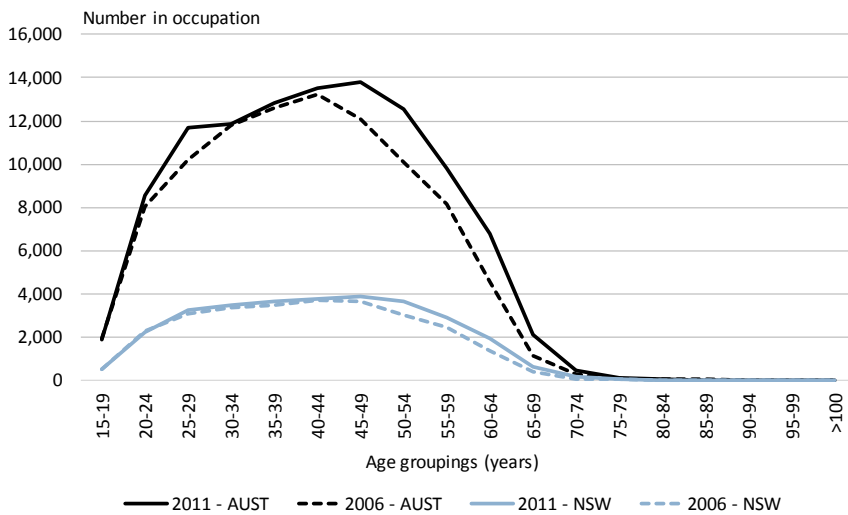


'Productivity growth through better use of technologies will play a role'

growth profiles over the next five years) suggests that this skilled workforce will decline by around one quarter between 2012/13 and 2022/23, resulting in a loss of approximately 8,000 roads engineering professionals nationally, with around one-third of these based in New South Wales.¹⁶ These skills will naturally be at the most highly-skilled and experienced level, and will need to be replaced over the coming decade just to meet existing demand, let alone meeting increasing demand. Productivity growth through better use of technologies will play a role in mitigating the impact, as will extending careers beyond typical retirement ages (possibly utilising 'semi-retirement' approaches to skills retention such as mentoring) but there will also be a need for raising the number and quality of skilled graduates in both the professions and the construction trades – and providing further 'on the job' development through cadetships and apprenticeships.

¹⁶BIS Oxford Economics (2013) Australia and New Zealand Roads Capability Analysis: 2013 to 2023, pp14-15, 65.

Number of Mobile Plant Operators by Age



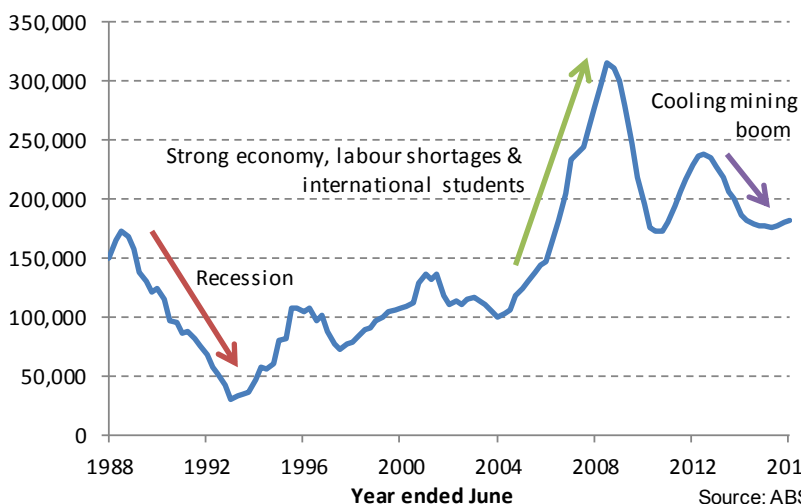
Source: Australian Census

Training and development

"We got the mining boom wrong. We didn't train enough people and prices went through the roof. We have another infrastructure wave coming through now. We need to invest very early on in training and workforce development."

A revealing consensus which emerged from recent industry soundings was that many mistakes were made during the recent resources boom, particularly in relation to building and maintaining local skills capability. Pressure to build new resources facilities very quickly (to take advantage of high commodity prices) meant that, in many cases, skills had to be imported to meet the breakneck pace of demand, rather than through a gradual build that would enable training and developing the existing workforce. This is evidenced in the sheer numbers of people who migrated to Australia, particularly during both stages of the resources boom (2004/05-2008/09, and 2010/11-2013/14).

Net Overseas Migration, Australia



'We are turning out too many graduates and not enough tradesmen'

Following the completion of resources projects, many migrants returned to their countries of origin, or to work on other projects overseas, leaving little in the way of a skills legacy for Australia that could be called upon to meet future challenges.

While a wave of infrastructure construction is now emerging, unlike the previous resources boom there is no compelling rationale (apart from, perhaps, a political one) for this wave to be rolled out at a similar breakneck speed. Governments should have the opportunity to time and schedule the investment pipeline so as to take the greatest advantage of industry capacity when it is readily available, but also to be flexible enough to shift development where capability and capacity constraints emerge. However, in recent soundings, there were many instances where industry felt that nascent capability and capacity issues were given little attention; that projects were "operating to political timetables, rather than engineering ones." In other words, in the perspective of industry, there is a significant risk that the mistakes of the resources boom are being repeated.

Meeting a growing skills capability challenge that can leave a legacy for the future means investing in local people and businesses (including overseas-owned entities which operate here) and, in particular, increasing workforce development through education and training.

Recent data collected from NCVER (National Centre for Vocational Education Research) for the VET (Vocational Education and Training) sector suggest that while completions in key construction-related occupation programs have trended up over the past five years (to 2014, latest available year) at the national level, this was driven principally by a growing enrolment profile in the preceding three to four years. The risk looking forward is that enrolments in these occupation programs have more or less plateaued or been falling since 2011 or 2012. Unless completion rates substantially improve, this would indicate that growth in VET completions will also plateau or decline in coming years, just at a time when demands for these skills – particularly in the infrastructure space – will start rising. The NCVER VET data shows a similar story for NSW, with enrolments falling (in some cases sharply) for all occupation programs since 2013, with the exception of mobile plant operators.

Meanwhile, in terms of professional engineering education, there is encouraging data which shows that domestic students completing four year civil engineering degrees in Australia (both single and double degrees) has risen from 890 in 2001 to 1,246 persons in 2014, a 40 per cent rise.¹⁹ However, on the downside to this result, the number of women completing these degrees has risen by just 18 persons over the same timeframe (to just 198 persons), suggesting that a large source of capability for the profession is not even being tapped.²⁰ By contrast, the surveying profession is dealing with a contraction in geomatics completions, with geomatics engineering graduates falling to just 94 persons in 2014, from 162 persons in 2001.

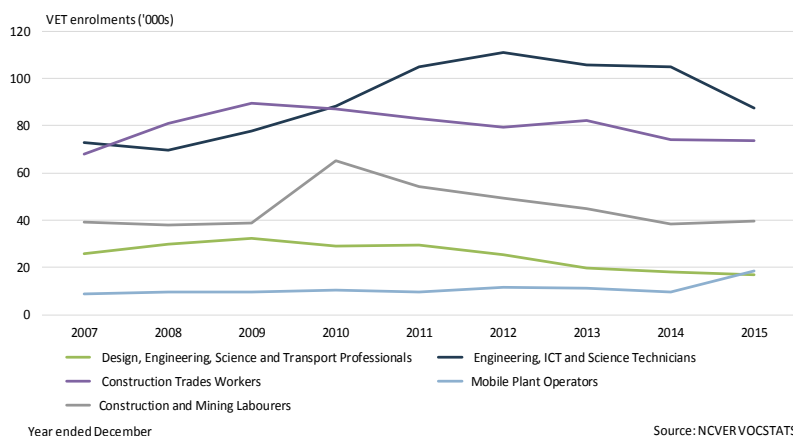
For some industry participants in the recent soundings, the rise in graduate positions in the civil industry reflects changing aspirations, with "parents wanting a better career for their children than they had". But, in the context of a potential shortfall in meeting actual construction trades jobs (with the Department of Industry reporting Master Builders Association figures that an additional 300,000 construction workers will be required over the next decade) the balance may be already uneven. Said one supplier to the construction industry in recent interviews:

"In terms of training, we are turning out too many graduates and not enough tradesmen. If you haven't got the tradesman, the whole quality of our life will collapse. We put out a job for a graduate position and we are swamped. Eight hundred applicants for one job. But a tradesman or a brickie; he's earning \$150,000 a year when he is 20."

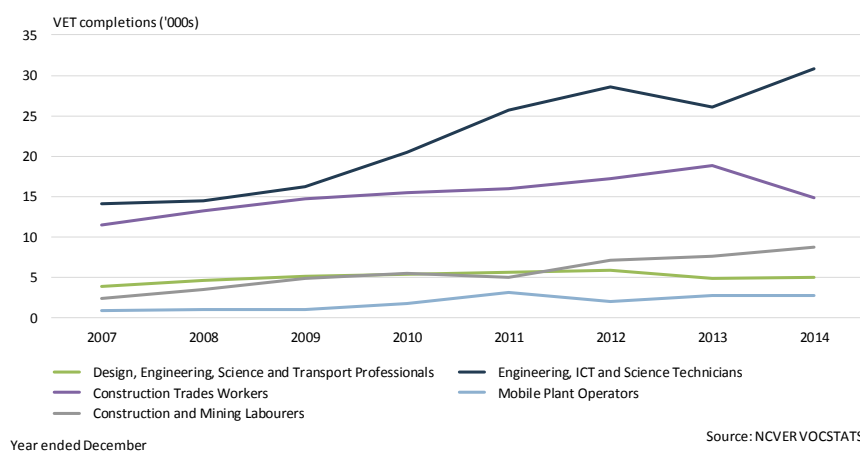
¹⁹Engineers Australia (2015) The Engineering Profession: A Statistical Overview, p50.

²⁰In turn, this likely the result of a falling proportion of women studying STEM subjects at high school, despite performing better than their male counterparts, according to a recent University of Melbourne analysis. <http://www.theaustralian.com.au/national-affairs/education/girls-avoiding-science-and-maths-at-high-school/news-story/5ca07e64424786f4bd6c16aaed64fc2c>

VET Enrolments by Program occupation (ANZSCO) Group, Thousands, Australia



VET Completions by Program occupation (ANZSCO) Group, Thousands, Australia



Growing the future supply of professional engineers involves more than just growing the number of people with engineering qualifications, however. It also requires these people to move into engineering jobs. As at 2014, only 59 percent of engineering graduates were employed in engineering occupations, down on the 63 per cent recorded in 2010 (during the resources boom).²¹ Consequently, an important part of any policy aimed at boosting engineering skills capacity should target the retention of engineers within the engineering profession, such as offering cadetships and other career pathways with both the public and private sectors, recognising that the “bulk of engineering professional skills formation is acquired on-the-job”.²²

The emerging risks regarding skills capability (particularly in the face of a substantial infrastructure investment program) has led to the development of the NSW Procurement Board, who now demands all NSW Government agencies with a major construction program to publish and maintain a Construction Skills Development Plan.²³

²¹Engineers Australia (2015), pp20-21.

²²Ibid. Industry soundings revealed that government agency’s themselves used to be significant providers of engineering cadetship opportunities but this role diminished, along with the capability and size of government agencies during the 1990s and 2000s.

²³NSW Government, Procure Point, April 2016, <https://www.australiantrainingawards.gov.au/finalists/the-skills-exchange-barangaroo-and-darling-harbour-%E2%80%93-new-south-wales>

The NSW Government, through the Department of Industry, has also launched new education and training policies designed to grow the skills base. Foremost of these is the Infrastructure Skills Legacy Program (ISLP) which targets:

- 20% of the total labour force of a project to be made up of 'learning workers' (defined as trainees and workers who need to update their qualifications to meet the needs of the infrastructure project)
- 20% of all trades positions on a project to be made up of apprentices
- Doubling the number of women in trade-related work (up from the NSW average of 1% to 2%)
- 1.5% of the total contract value of a project to support Aboriginal and Torres Strait Islander participation
- 8% of the total project workforce aged less than 25 years
- Strategies to ensure projects employ and train people from the local region

The ISLP is to be trialled on both a regional (Lismore Base Hospital, Stage 3B) and metropolitan (Sydney Metro) basis and extended to other projects. In addition to this, there are also other training and education initiatives sponsored by both the NSW and Commonwealth Governments, including the NSW Aboriginal Participation in Construction (APIC) policy and a Commonwealth Indigenous Procurement Policy. In general, these strategies have been met with the support of industry in recent soundings – indeed, industry believes that indigenous schemes should be extended to include apprentices, and that similar schemes should be encouraged for professions to encourage the retention of graduates.

However, while these schemes offer an important legacy which can help mitigate the long term risks of falling skills capability, it may not mitigate against skills risks in the nearer term (the next five years) particularly where shortages exist for quality foremen and site managers, and experienced trades and professional skills. Ideally, these current skills programs should be strengthened and broadened beyond apprentices, focusing on the skills and competencies required to meet challenging construction timetables – particularly onsite skills. But it represents an important start.

Some industry representatives sounded a caution as to how successful these programs may be in boosting apprenticeships where the current industry policy is simply to utilise general labour skills:

“But where are [apprentices] coming from? They just don't exist. There is no such thing as an apprentice bricklayer anymore. They are bricklayers, but they are not apprentices. There is not an apprentice bulldozer driver. Not an apprentice truck driver. There is no apprenticeship for reinforcement fixing or concreting. They are just labourers. There are no apprentice carpet layers, no apprentice plasterers, no one's an apprentice glazier anymore. So how do you generate 20% of the work being done by apprentices? Therein lies the problem. And how do you enforce that?”

Similarly, concerns were also raised about the industry's ability to contract 4 per cent of the work to indigenous suppliers:

“But there are not enough organisations and they don't have the skillset. And what if they then subcontract 95% of the work to a non-indigenous subcontractor? Then it's not a benefit, it's just a pass through. For every scheme or policy or innovation, there is a loophole.”

Using procurement as a workforce development strategy

While broad industry targets for “learning workers” are accepted by industry overall, there is also often a disconnect with the objectives of stated skills programs such as the ISLP and the procurement process itself, which has been noted during recent industry soundings.

In particular, several contractors in our industry soundings suggested that the procurement process itself should include broader measures of “value for money” than currently being captured which, essentially, is heavily focused on the direct cost of the project. As pointed out by one major contractor (but repeated by many others):

“Where is the value for the taxpayer of New South Wales in just looking at the capex? Surely the Government can lead the way in having a more sustainable approach to this. But if you are going down this path, you need to look at the procurement process itself. Because if you want to get the greatest benefit out of it, then it needs to be some sort of partnership as to how you get the best value out of the investment.”

Part of this broader measure of “value” could, according to industry, include a greater emphasis on workforce skills development as a criterion during the procurement phase, particularly for scarcer ‘onsite’ skills. One such example is the Northern Connector Road Project in South Australia. There, the South Australian government worked in partnership (and shared the costs) with the winning tenderer to establish a Skills Exchange for the project so that local workers in steel production and auto manufacturing (who were located close to the project) could be retrained and employed onsite in the construction sector. In turn, the benefits for the contractor and the broader industry is that these people could then be moved onto other construction jobs on the completion of the project.

Similar Skills Exchanges have been undertaken in New South Wales, but at their own cost, including Barangaroo and Darling Harbour Live (winning a national industry collaboration award)²⁴ as well as NorthConnex. 10,000 workers have already undertaken skills training through these projects, resulting in over 16,000 accredited training outcomes. It is also used successfully in the United States and the United Kingdom. The main features of the Skill Exchange model is that it is a partnership with TAFE which is designed to bring education to the workplace itself, where it is more likely to be utilised by construction staff, further developing their skills and competencies and providing qualifications.

However, while NSW government agencies are highly supportive of the Skills Exchange model at the executive level, it is yet to gain any traction at the procurement level. In the words of the contractor:

“We have been doing a lot of work with Transport and RMS to explain the benefits of this legacy, that will allow people to move from job to job as they have the skills. Putting this into the evaluation criteria for jobs is important. The private sector will respond, but they will have to expect that it won't be the lowest price for construction because there is an additional component there... the feedback from agencies is ‘this sounds fantastic’ but when we go into a bid process, it is all about keeping costs down. What the executive are saying about legacy, and what is reality, are two different things.”

Overall, ensuring appropriate education and training for skills to avoid potential capability gaps can come by a variety of policies and approaches, and there is no “one size fits all” approach. However, while policies such as ISLP are supported by industry, there is much more that can be done across education, training and recruitment, productivity and procurement policies to boost skills capability into the future.

OPTIONS TO CONSIDER

- **Undertaking consistent quantitative research and analysis across the whole of NSW Government to better understand the demand and supply profile for key construction skills.** Industry soundings suggest that a lack of onsite skills, such as foremen and site managers, tunnellers, mechanical and electrical trades, concrete formworkers, and onsite engineering and surveying skills represent the greatest risk to industry capability. A regular modelling of supply and demand for these skills will assist agencies in quantifying the extent of the issue and point towards appropriate policy solutions.
- **A complete, clear, coherent and flexible project pipeline.** Industry can prepare their workforces if given time to do so and have given positive feedback on the more detailed project pipelines published by Transport for New South Wales and RMS. However, the published pipeline should include all NSW projects across all agencies and note major competing projects interstate (e.g. Melbourne Metro). The pipeline should also retain an element of flexibility, so major projects can be moved if capability or capacity issues arise.
- **Development and implementation of targeted training and retraining programs** which focus on identified mismatches in skills demand and supply going forward based on the construction pipeline. This would ideally move beyond apprenticeships to target a range of key onsite skills, with retraining programs building on existing knowledge and boosting transferability of skills within the construction industry, and tailored to fit in with work responsibilities (e.g. bringing training to the workplace through further use of Skills Exchanges).
- **Greater intra-agency awareness of the timing of public and private sector funded regional projects** can help avoid capability gaps in regional areas and potentially reduce costs. Projects can be better timed in regional areas to take full advantage of the periodical availability of contractors and skills.
- **Removal of artificial constraints to the transferability of skills.** Contractors reported that they have been unable to compete for work in transport-related construction jobs in New South Wales because of a bias against the use of skills brought in from non-transport applications at the procurement phase. As such, New South Wales is not benefitting as much as it could from the downturn in resources-related construction, and valuable professional skills are being lost offshore or to other states.
- **Providing employment pathways that retain engineering skills within the profession.** Currently, only 59 per cent of engineering graduates work in the profession upon leaving university. Boosting agency cadetships for core engineering skills could improve the supply of skills in the construction industry and, over the coming decade, help counter the loss of engineering skills through population ageing – both within agencies themselves and in industry.
- **Reducing demands on contractors during the procurement phase,** particularly to conserve the capability of scarce, high quality, bidding teams and reduce bid costs overall, so that more contractors can bid on a greater number of projects. This can be done through different procurement models (such as early contractor involvement), reduced upfront scope and tender requirements, and speedier bidding and decision timeframes.
- **Placing an emphasis on workforce development in the procurement phase.** Contractors recognise the importance of skills development for their own success, as well as industry, but are not incentivised to do this at the procurement phase. This may involve an acknowledge from procuring agencies that a broader measure of “value for money” beyond just project price should be implemented if a skills legacy is to be developed and sustained.

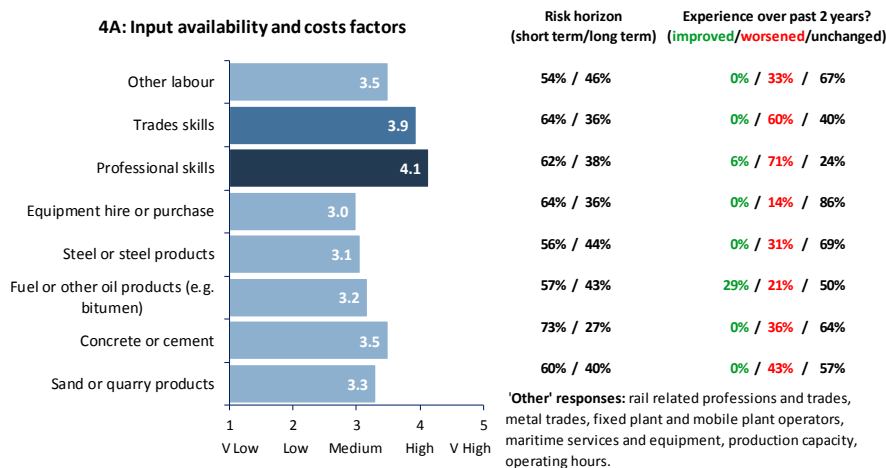
²⁴ <https://www.australiantrainingawards.gov.au/finalists/the-skills-exchange-barangaroo-and-darling-harbour-%E2%80%93-new-south-wales>

CRITICAL ISSUE 4: Materials and transport



The construction industry’s capacity and capability to deliver requires ready and economic access to non-labour construction inputs and materials – as well as an efficient transport network that moves these materials to construction sites and takes away spoil and waste. While the greatest challenges will likely revolve around the adequate supply (and transport of) locally sourced construction materials – particularly concrete and quarry products such as sand – an increasing reliance on global supply chains will also bring its own unique challenges and risks. Regional hotspots in construction work create further threats to capacity and capability. In particular, the heavy concentration of work planned for Sydney is increasing pressure on more distant regional supplies of construction materials. Developing new supplies, meanwhile, can take up to a decade from project inception to production given lengthy approvals processes. Rising construction activity also inevitably means more truck trips and congestion. Reducing capacity and capability risks entails making the most of existing capacity (e.g. through longer operation times and appropriate waste and recycling strategies), speeding up the development of new capacity, and developing strategies to protect and improve key transport corridors.

Construction Input Risks to Capability and Capacity



'Regional 'hotspots' in demand are likely to add to the pressure'

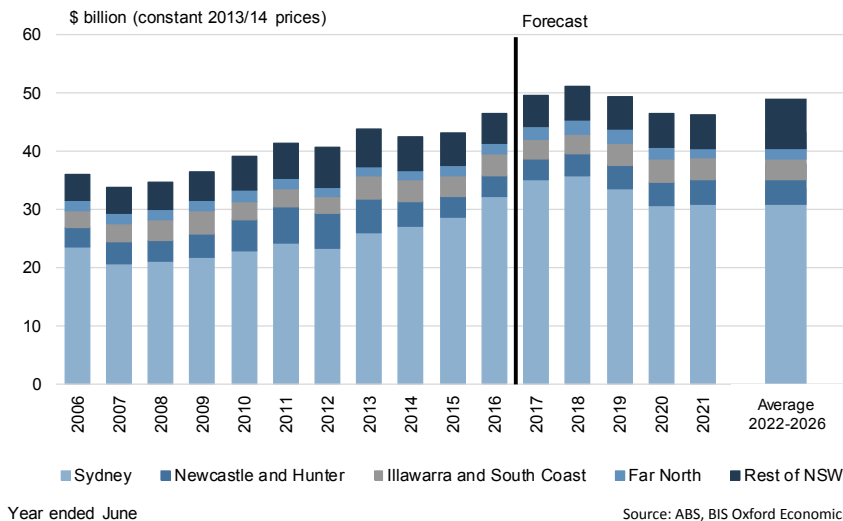
Construction activity in Australia utilises a mix of locally sourced and imported materials. Our recent survey of the construction industry revealed that, while perhaps not as pressing as skills capability, the availability and cost of material inputs to the production process are generally perceived by industry to have a medium to high risk to industry capacity to deliver in New South Wales.

Furthermore, with the exception of fuel and other oil products, this risk has not reduced over the past two years, a time when total construction activity – both nationally and in New South Wales including building and engineering construction – has fallen back from “boom time” experience. In the case of concrete and cement, sand and quarry products and even steel and steel products, input availability and cost risk experience has worsened, according to around one third (or higher) of survey respondents, indicating that threats to capacity from these material inputs are already rising. Much of this risk is weighted to the short term (i.e. the next five years).

The development of new regional ‘hotspots’ in demand is likely to add to the pressure. Construction activity in New South Wales is expected to rise further over the next few years, and remain at high levels through the next two decades – boosting demand for construction materials. A particularly heavy concentration of activity is projected for the Sydney metropolitan region which will have implications for locally sourced material inputs, as well as the ability to deliver construction materials through the transport network.

In recent soundings, industry remains confident that, in most cases, risks to materials capacity can be minimised so long as there is clear and coherent industry messaging – and, in particular, a long term pipeline of projects is developed across the whole of government and the private sector so that industry can plan and invest in materials capacity effectively.

Total Construction by New South Wales Region



However, challenges and risks remain, even with relative pipeline certainty. By far the biggest immediate challenges relate to satisfying demand for locally-sourced construction materials – particularly concrete and quarry products in the Sydney metropolitan region where construction demands are expected to be most focused. By contrast, internationally sourced construction materials, including steel and steel products (both flat and long steel products), oil products (such as diesel fuel and bitumen) and equipment hire is considered to have slightly lower capacity risk. Even so, loss of industry in these segments in past decades has led to the drying up of local supply chains with unintended consequences for the construction industry.

Equipment hire or purchase

Availability of plant and equipment, while ranked as a medium risk in our industry survey, is considered one of the lesser risks to capacity, but may have cost implications for the construction industry. Overall, industry concentration in the equipment hire industry is low, with the four largest players estimated to make up around 19.5 per cent of total industry revenue in 2015/16.¹ However, the larger players, including Tutt Bryant, Boom Logistics, Freo Group, Coates Hire and Onsite tend to be more heavily involved on large building and construction projects.

Since the peak in national construction activity in 2012/13, hire companies in Australia have been taking steps to reduce their excess capacity of construction equipment, ranging from mobile plant to traffic management equipment (barriers, fencing etc), lighting and power. These strategies have included reselling equipment to overseas markets as well as rebalancing stock within Australia between high and low growth regions. The latter strategy has involved shifting equipment from Western Australia and Queensland into New South Wales and Victoria. Northern New South Wales is already benefitting from the downturn in construction work in Queensland in terms of plant and equipment hire capability, according to one Queensland contractor bidding for work on the various Woolgoolga to Ballina Pacific Highway packages.

While there are no available published statistics which measure capacity utilisation within the equipment hire market, industry soundings suggest that this rebalancing process may be reaching an end. Furthermore, the sheer volatility of the previous construction cycle – with still significant fleets of equipment coming off the large LNG projects in Western Australia – has led to cautiousness in the purchase of new stock. With rising demand expected along the East Coast, this is likely to have implications for the cost of equipment hire moving forward, but as equipment tends to be sourced globally, is not expected to have major implications for capacity and ability to supply to meet the market.

'The biggest immediate challenges relate to satisfying demand for locally-sourced construction materials'

¹BIS (2015), E3292 Construction Machinery and Operator Hire in Australia Industry Report, p20.

Railway steel – uncertainty over Whyalla Steelworks

The future of the Whyalla steelworks has been surrounded in uncertainty for some time now after the parent company, Arrium, fell into voluntary administration in April 2016. Whyalla steelworks is a notably case study of the possible capacity constraints that may emerge if an important business were to close down. As the only domestic manufacturer of rail in Australia, such an event would expose the Australian construction industry to considerable risks. The industry would have to be reliant on imports, where the quality of the products combined with the timing of the delivery would be additional issues to face.

As we import, currency exchange risk will be a constant concern. Companies may be subject to increased local content rules which would place a barrier on importing such vital goods.

As mentioned before, NSW is facing a growing construction profile with a substantial infrastructure project pipeline. Increased levels of activity will exert additional pressure on the railway system. If the closure of the steelworks were to eventuate, potential capacity limits would be placed on successfully delivering major infrastructure projects.

But there is room for optimism. The Federal government has essentially intervened in saving the Whyalla Steelworks, by awarding a major Australian railway contract. The contract is to upgrade the 1,200 kilometres of rail between Adelaide and Tarcoola, by supplying tens of thousands of tonnes of rail over the next three years.

Australian East Coast Passenger Rail Rollingstock Contracts

State	Date	Project	Source	Quantity	Consortium (Manufacturer)
NSW	2006	Waratah	China / Australia	626 cars	Reliance Rail (Changchun Railway Vehicles / Downer)
NSW	2014	Sydney Metro Stage 1	China	132 cars	Northwest Rapid Transit (Alstom)
NSW	2016	New Intercity Fleet	South Korea	520 cars	RailConnect (Hyundai Rotem)
NSW	TBA	Additional fleet	TBA	TBA	TBA
VIC	2016	X'Trapolis	Australia	54 cars	Alstom
VIC	2016	High Capacity Metro	China / Australia	65 trains	Evolution Rail (CRRC / Downer)
VIC	2015	Vlocity Regional trains	Australia	119 cars	Bombardier
VIC	2015	E-Class Trams	Germany / Australia	70 cars	Bombardier
VIC	TBA	Next Generation Regional Train	TBA	TBA	TBA
QLD	2016	FLEXITY 2	Germany	18 cars	GoldLinq (Bombardier)
QLD	2014	New Generation	India	450 cars	Qtectic (Bombardier)

Source: Various, BIS Oxford Economics

Rollingstock

As opposed to plant and equipment used in the construction process, the very strong profile for urban rail construction in Sydney (as well as in other capital cities), coupled with rising patronage, is resulting in rapidly rising demand for the manufacture of passenger rail rollingstock equipment– including locomotives, passenger cars and trams – to provide services on rail assets.

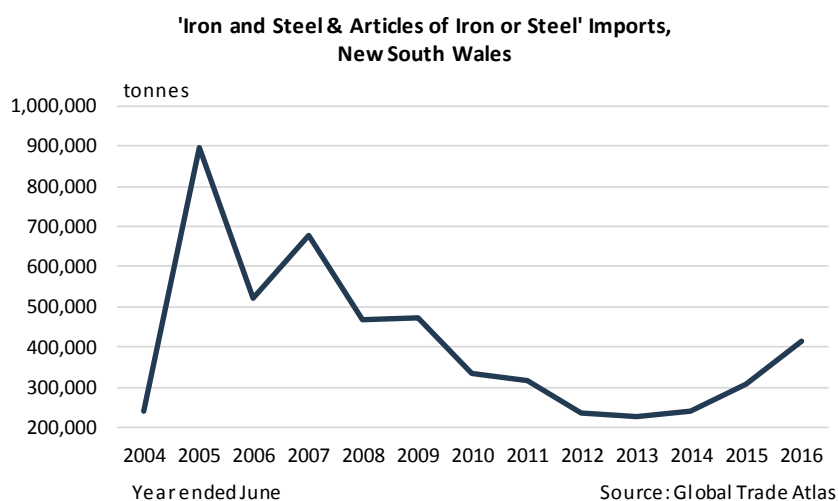
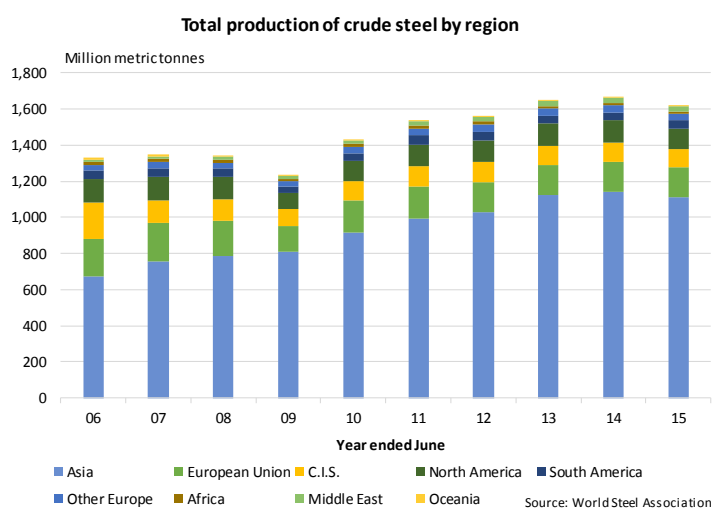
Australia has lost local manufacturing capability for rail rollingstock, with the main suppliers being Downer Rail, Bombardier, Alstom and UGL. This sector faces strong overseas competition from countries including China, South Korea, Germany, India and the United States where manufacturing is relatively cheaper. Australian input to supply is focused on design, fit-out and "cradle to the grave" services based on a strong understanding of local conditions and requirements. Australian requirements for rail rollingstock tend to vary significantly from region to region due to climate, gauge and specialised customer requirements, which can sometimes lead to complications with overseas manufacturers who may be more used to a "one size fits all" approach.²

Firms involved in recent industry soundings indicated that, despite the recent strong growth in passenger rail rollingstock orders (as shown above), capacity and capability is not being stretched. Previously strong demand for new rollingstock and locomotives from the mining sector has fallen away, with only periodic replacement of stock filtering through to local manufacturers. Manufacturers are also able to offshore significant parts of the manufacturing process, including shell fabrication, bogies, propulsion systems and electronic systems to save on cost. The biggest challenge facing rollingstock suppliers is not global manufacturing capacity and capability but integrating overseas-manufactured product with Australian rail controls and signalling systems, requiring substantial testing before units are put into service.

Typically, the share of work undertaken locally versus overseas comes down to cost as well as government procurement policy, with Victoria, for example, currently demanding 60 per cent local content on its High Capacity Metro cars to boost local skills and training to help compensate against auto manufacturing skills losses.³ However, there may also be concerns as to whether Victoria is achieving maximum value for money as imposing local content rules on rollingstock inevitably reduces competition to the few industry players with local facilities. While some industry participants indicated that local rollingstock capacity could come under greater pressure if the Victorian procurement policy were extended to other Australian states, this would only be a significant risk if there was little warning of policy changes. In general, the suppliers stated they "would welcome any increase in local content", with the main challenge for government to provide a better pipeline of rail projects and understanding of how and when existing train sets will be replaced.

²BITRE (2016) Trainline 4, pp108-109.

³According to the Victorian Government, the decision to specify 60 per cent local content will "create 1,100 highly-skilled jobs, further cementing Victoria's reputation as a global hub of rolling stock manufacturing."



Steel and Steel Products

Steel is a key ingredient in many construction applications. Australian steel production has steadily fallen over the last few decades as lower cost production has ramped up overseas, facilitating imports. With the closure of BHP's Newcastle steelworks in the 1990s and sale of its core steel operations, steel production in Australia is now confined to the two major players which were spun out of the BHP business: Arrium (Onesteel) and BlueScope.

Arrium's steel production is focused at its blast furnace in Whyalla, South Australia and electric arc furnaces at Rooty Hill (NSW) and Laverton (Victoria), and is Australia's only producer of long products (wire, rods, rails and rebar, including structural and reinforcing steel sections). In a recent submission to the Senate Inquiry on the Future of Australia's Steel Industry, Arrium noted that its share of the domestic steel market was approximately 75 per cent, with a total steelmaking capacity of 2.6 million tonnes per annum.⁴ In its own submission to this Inquiry, BlueScope noted that its own capacity was also 2.6 million tonnes, but focused in "flat" steel products for the building and construction industry including sheet and rolled coil products, coated and plate steel. BlueScope now operates only one of its two blast furnaces at the Port Kembla Steelworks, having closed the other in 2011.

⁴Arrium (2016), The Future of Australia's Steel Industry, Submission 16, Senate Economics Committee, p2.

'There is only one domestic source of slag going into Sydney now'

Currently, both Australian steel producers are under significant pressure from a global oversupply of steel which has seen steel prices fall significantly since the GFC. Arrium estimates the current global supply to be approximately 700 million tonnes per annum, with about one third of this driven by excess production in China. In the absence of a policy to quickly curb production in China, there is a significant risk that the market will be rebalanced through the closure of unprofitable operations elsewhere, including in Australia. Currently, Arrium is under voluntary administration, with debts of around \$4 billion, with the steel business to be either sold as a going concern or closed down in early 2017.⁵ Meanwhile, BlueScope has also indicated that without recapitalisation it may also be forced to close its remaining blast furnace at Port Kembla,⁶ although heavy cost cutting has enabled its survival to date despite rising coking coal and iron ore prices.⁷ The prospect of rising energy prices in Australia, however, remain a threat to local steelmaking operations as well as steel fabricators.

Construction industry soundings conducted by BIS Oxford Economics for this report point to a growing consensus that steel production in Australia is not a long term proposition, with the industry likely to require some form of government support (e.g. local content rule in construction or direct subsidy) to remain viable over the coming decade. While there is no shortage of steel globally, further cutbacks or closure of the steel industry in Australia does have implications for the construction industry's capability to deliver, in particular:

- **Being able to deliver a consistently high quality steel product to construction projects.** Submissions to the Senate Economics References Inquiry into non-conforming building products in 2016 revealed many examples of non-conforming or compliant imported steel products that could cause catastrophic failure on infrastructure projects, including substandard welding and corrosion protection, and laminations in plate steel. There are also incidents of pre-painted and metallic steels not meeting Australian standards and regulations, such as thickness of the coating and excessive levels of lead.⁸ These concerns were also reflected in our industry soundings. While many local construction contractors prefer to use Australian steel for its consistent quality and lower delivery risk, the highly price competitive construction market in Australia is encouraging a greater use of imported steel in construction projects, particularly from China. Local contractors are, in many cases, setting up engineering teams in China to test steel products before shipment as a countermeasure to reduce this risk.
- **Providing low cost waste materials such as slag which is an important input to cement and concrete production.** As pointed out during recent industry soundings, Australian manufacturing continues to decline and this loss of industry capacity and knowledge is having "unintended consequences" in other sectors of the economy including construction. Such a situation is emerging with steel production and slag. According to a major concrete producer in discussing critical materials for concrete production in Australia:

"The two [materials] of most concern are fly ash and slag. Both are substitutes for cement. These products are accounting for 20-30 per cent of the demand for cement in NSW. In other words, if these products are not available, you are going to increase your direct cement requirements by 25-50 per cent from where we are right now.... Both fly ash and slag are also specified in a number of products now. For example, any concrete that has high requirements for durability typically has a slag requirement going into it. There is only one domestic source of slag going into Sydney now and that is BlueScope in Wollongong. If that blast furnace goes, then the price of slag would change radically from being a waste product disposal a channel for BlueScope to being an import from South East Asia and you would not use it as a means of reducing the cost of your concrete mix – you would need to be paying a premium for that capability."

⁵<http://www.abc.net.au/news/2016-11-04/arrium-administrators-say-less-than-five-possible-bidders/7997162>

⁶<http://www.abc.net.au/news/2015-07-15/bluescope-steeling-for-port-kembla-furnace-shutdown/6621928>

⁷<http://www.theaustralian.com.au/business/mining-energy/costcutting-allows-bluescope-to-weather-high-coal-iron-prices/news-story/2724cc871979fc898736db82e1d48f39>

⁸Australian Steel Institute, Submission to Senate Economics References Inquiry into non-conforming building products, p 6

Overall, while the loss of steel production in Australia may not lead to a capacity issue in slag for concrete, it will very likely increase its price in the production process. This may become an issue if construction contracts are awarded strictly on a price basis, where contractors may take increasing risks on quality to meet the market.

➤ **Reliance on longer and riskier overseas supply chains.** Overall, any loss of Australian steel capacity will likely place more pressure on construction contractors to manage and supervise global supply chains from the origin of input materials, to production and shipment to Australia. While it is not expected that this would have capacity implications for the Australian construction industry, the lack of a domestic supply chain may increase the risk of capacity disruptions if at any future point there is a break in global supply (e.g. natural disaster, regional security issues, shipping constraints) as well as cost implications if there were a sharp depreciation in the Australian dollar and supply contracts were not effectively hedged.

Fuel and Bitumen

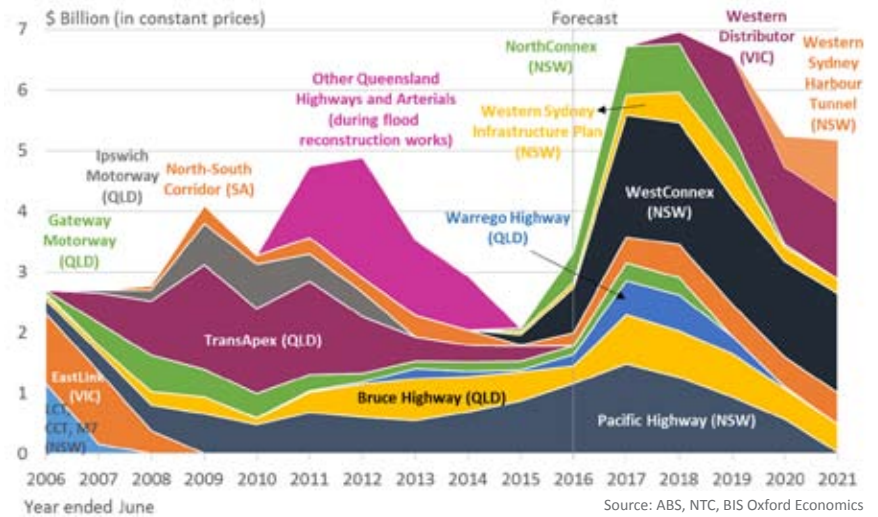
As with steel, which is becoming more global in source, Australia mostly imports the oil products used in the construction industry, notably diesel fuel (for mobile construction plant) and bitumen. This process accelerated with the closure of three oil refineries in Australia since 2012, including the Clyde (Shell) and Kurnell (Caltex) refineries in New South Wales in 2012 and 2014 respectively, as well as the closure of the Bulwer Island refinery (BP) in Queensland in 2015. With the Port Stanvac refinery (ExxonMobil) having closed in 2009, the only remaining refineries operating in Australia are at Geelong (Vitol), Altona (ExxonMobil), Lytton (Caltex) and Kwinana (BP).

Overall, the closure of oil refining capacity in Australia is not expected to be a major capacity issue affecting the construction industry in New South Wales, despite the closure of the two refineries in the state. However, as with the possible closure of steel production, this process is increasing the reliance on global supply chains for valuable oil products such as diesel fuel, as well as the “waste product” of bitumen, used to make asphalt concrete commonly applied in road construction. Consequently, fuel and bitumen are now fully exposed to global supply risks as mentioned above. In a similar vein to the issue of slag from steel production, one contractor noted with respect to bitumen:

“We don’t have a refining industry in Australia anymore... the global supply chain and how we manage that is going to be critical moving forward... How does it help the country when nothing is available for recycling, nothing is available for reuse? If we are not generating product, then we can’t recycle product. We are buying recycled product, waste product. It doesn’t make sense. [When Shell shutdown] there were unintended consequences. When you brought in a litre of crude, you refined it and the bit that dropped out of the bottom was bitumen and there was a market for bitumen. And that held the prices down here. Now, of course, we don’t refine in Australia. We import from Singapore. And where does Singapore sell to? The highest price.”

While there is no global capacity shortage for bitumen, the overall terminal capacity for importing “hot” bitumen into Australia and price formation for local bitumen supply may warrant closer inspection. While import prices for bitumen (sourced from ABS customs data) tend to correlate with the oil price (with a slight lag), there appears to be a growing disconnect between these prices and prices for asphalt published by state road authorities including VicRoads and Queensland’s Department of Transport and Main Roads. This is particularly relevant to New South Wales, which is expected to see a large wave in road construction activity over the next five years (implying strong import demand for bitumen), with high levels of road construction expected to be sustained in the longer term.

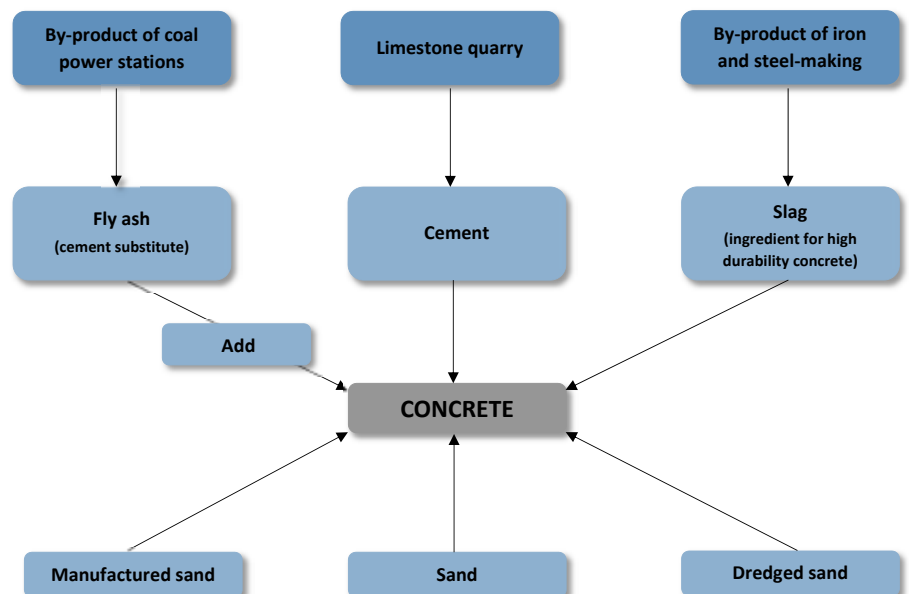
Major Road Construction Projects, Australia



Concrete and Quarry Products

Concrete and quarry products (including sand) are extensively used in the construction industry. Quarry products include hard rock aggregates, gravel and sand which are key ingredients in the manufacture of products such as concrete and asphalt, as well as being utilised as road base. Aggregates are combined with water and cement to produce concrete. Cement used in construction projects is derived from heating limestone and clay in a kiln to produce clinker, which is then ground to a fine powder whilst adding other minerals to produce cement.

Concrete ingredients and substitutes



Source: BIS Oxford Economics

Overall, recent industry surveys and soundings revealed that concrete and quarry products are perceived to hold the greatest risks for construction industry capacity in New South Wales (when compared with other material inputs), with our survey ranking the risk between medium and high. Furthermore, over the past two years, the availability and cost risk associated with concrete and quarry products is perceived to have worsened according to 36 to 43 per cent of industry respondents, with the remainder of respondents saying the availability and cost risks had not changed. From our analysis, and subsequent industry interviews, the key reasons for increasing availability and cost risk in recent years are:

- The regional characteristics of current and projected construction demands, coupled with local supply constraints.
- The potential for reduced production or closure of other facilities which produce inputs for the manufacture of concrete and
- Transport and logistics issues in moving concrete and quarry products from their source to construction sites.

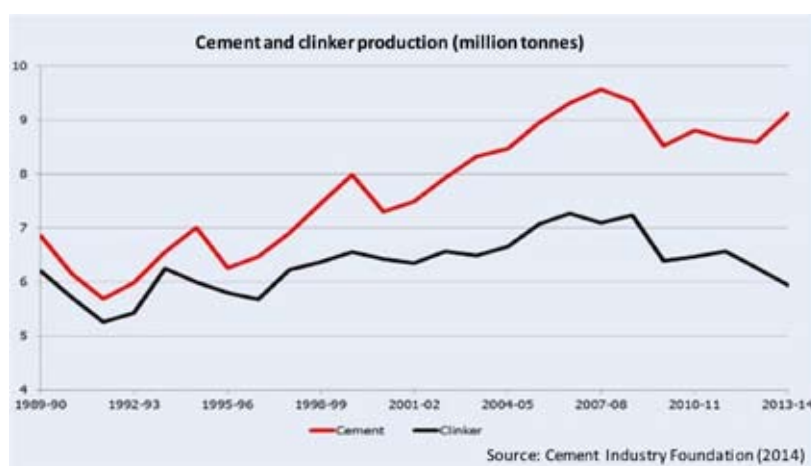
Regional characteristics and impacts

Concrete and quarry products businesses tend to be highly regionalised given that a large share of the cost of supplying these construction materials is transport (typically rail and road). Consequently, it is important that quarries and concrete batch plants are located as close as possible to markets so as to reduce materials costs to the construction industry.

In this respect, the strong pipeline of construction work projected for the Sydney metropolitan region (after a relatively long period of dormancy) is creating new, high demand for quarry products which is outstripping local capacity to supply. As stated by a major concrete and quarry products provider:

"The overall sequencing of projects is not ideal. The risk that companies are now being asked to take is that to add capacity to meet the peak requires gambling fairly large amounts of capital on the probability that this is likely to be fairly short term demand spike. So you have to recover that capital quite rapidly and your prices will be high. Sequencing large volumes of work all at once that will not be indefinite is not good for anyone".

'To meet the peak requires gambling fairly large amounts of capital'



NATURAL SAND SUPPLIES IN SYDNEY: A CRITICAL RISK FACTOR FOR CONSTRUCTION CAPACITY

Natural (or virgin) sand is a critical input to cement and concrete products. However, as expressed by one major materials supplier, there is, remarkably, not a lot of sand around Sydney, for a city that prides itself on its beaches, and this will represent a critical capacity issue within the next five years given the volume of construction activity expected to be focused in the metropolitan area.

Kurnell and Emu Plains have been the historic industry source for construction-grade natural sand in Sydney, but both facilities are now winding down, presenting a step change for the industry. This risk was identified in a geological survey and supply/demand analysis for the NSW Department of Natural Resources in 2001.⁹

With these facilities winding down, the only other natural sand source left in Sydney is Maroota, as well as importation of sand from the Stockton sand beds near Newcastle. However, these too are not bottomless resources, are environmentally sensitive areas, and are unlikely to meet metropolitan construction demands over the next five years. In the absence of alternative natural sand sources, some materials suppliers are examining the potential to barge sands from interstate locations such as Tasmania, where natural sand sources can be located close to barging facilities to reduce transport costs. However, any sand importation schemes require access to a central bulk unloading facility in the Sydney metropolitan region to make them economic, such as the Bays Precinct within the White Bay redevelopment. Here, conflicting land use requirements (residential versus industrial) represent a serious threat to ongoing natural sand supplies for the metropolitan region, certainly at current cost.

In the absence of new sources of natural sand, materials suppliers are increasingly looking to use more synthetic or manufactured choices, such as crusher dust from aggregates operations or from spoil coming out of the various road and rail tunnels being built in Sydney. Currently, manufactured sand accounts for a substantial share of all sand use in the Sydney construction industry, according to recent industry interviews, with the share being higher still in regional areas which do not have as many sand quarries.

The main challenge to manufacturing sand from crusher dust is obtaining approvals in time to establish recycling operations, although this is not expected to be a long lasting issue. In the case of recycling from spoil, several further issues arise including: a current lack of capacity for construction and demolition ("C&D") recyclers in Sydney to handle the sheer volumes of spoil being generated with several projects being still in the approvals phase, a potential lack of capacity to park spoil for recycling over the next

five years given the sheer volumes of spoil being produced, and finally the relatively low spoil disposal gate fees compared to fees for C&D processing.

However, even increasing the use of manufactured sands will not be a complete solution. Generally, manufactured sands have a poorer shape for use in cement compared to natural sand. Natural sand is generated by erosion so the particles tend to be rounder, improving its lubrication and flow qualities. When using increasing amounts of manufactured sand – regardless of source – higher quantities of (scarce) fine sand or fly ash are required to create the lubricating effect to be able to handle and pump the concrete. In other words, reducing supply for natural sand, increases demand significantly for other products.

The long term supply of fly ash, itself, is subject to risk. In New South Wales, fly ash is sourced from the operations of three coal fired power stations in New South Wales – including Mt Piper (near Lithgow), and Eraring (Central Coast). However, these stations are being run more variably as peaking plants than straight baseload which is affecting the quality of the fly ash produced. Furthermore, RMS concrete specifications are strict in requiring a single source for fly ash. This means that materials suppliers cannot substitute Mt Piper for Eraring fly ash if the latter specification is used, even if that source is unavailable. Finally, in the longer term, the potential winding down of coal-fired power station operations in Australia will see this valuable local construction by-product eliminated entirely, requiring the importation of fly ash from Queensland, or from overseas at very high cost.

The solution to Sydney's sand supplies will likely require a multipronged approach, with materials suppliers investing further in research and development to improve the qualities of manufactured sand, and governments taking a lead in speeding planning and approvals for recycling centres including coordinating spoil from major road and rail projects and reducing costs for spoil disposal and recycling. This will require coordination between local councils and the State Government. Ultimately, however, there will remain a demand for natural sand for construction in Sydney which will require maintaining a central bulk unloading facility to keep sand imports economic.

⁹J. T. Pienmune & J. Whitehouse (2001) Supply and Demand for Construction Sand in the Sydney Planning Region, Geological Survey of New South Wales, Department Of Mineral Resources

This situation has been intensified by the closure of two key quarries at Penrith Lakes and Kurnell which, along with smaller quarries at Georges River, Maroota and Somersby accounted for around 85 per cent of metropolitan Sydney's "typical" natural sand demand. This demand figure is likely to be eclipsed by the strong demand for sand and quarry products due to Sydney's construction program over the coming five years and beyond.

The closure of Penrith Lakes and the associated Emu Plains quarry facilities, coupled with rising demand for the upturn in residential building in Sydney, appears to have caught metropolitan quarry materials suppliers off-guard. While new quarries are being developed to meet Sydney projected demand – including the Bass Point Upgrade (Shellharbour), Lynwood and Gunlakes Expansion (Marulan) – these projects are not expected to be fully operational for another two years. Consequently, quarry materials are now having to be sourced from well outside of the metropolitan region to service the Sydney market. Industry interviews revealed that 10mm aggregate is being sourced as far west as Dubbo for the Sydney market, with rock also coming from Canberra, Orange and Newcastle. In turn, with the focus of these regions' quarries shifting to Sydney, there is correspondingly less capacity to meet demands within the regions themselves. This may result in capacity and or cost issues in these regional markets if strong construction demand pressures (such as from Canberra and Newcastle's Light Rail projects, or other building projects) emerge.

The delay to covering the supply loss from Emu Plains can be partly blamed on uncertainty as to the timing of investment to meet future demand, particularly given the very lengthy approvals processes to get new quarries developed, as well as bad luck. Investing in new quarries is an expensive and time consuming process, and it can be difficult to time the investment decision well given the high volatility of construction industry activity in regional areas. Sydney quarry products supply, for instance, is being sustained by decisions made over the past 10-15 years (and more) to invest in new quarries south of the city, particularly near Marulan.

In general, recent industry interviews indicate that it takes about a decade for a quarry to progress from conception to operation, and up to fifteen years before a new quarry reaches full capacity. Much of this time (3-4 years) is taken up in garnering community support through the consultation process, and there are many other planning consents to work through to ensure the projects are not impinging on heritage sites, indigenous sites, proximity to residential areas and reserves, as well as satisfying environmental, noise, access and operational restrictions. Delays to quarry start-ups can also emerge as a result of geological errors, however, which may have played a role in the decision to move the Lynwood quarry pit from its original location in the Towrang Valley, necessitating at least another 12 months of planning and approvals for the modification.¹⁰

Reduced local production placing reliance on overseas supply chains

Apart from the closure of Sydney based quarries, the cement and concrete industry is also being transformed with the closure of related input industries. While, in most cases there is ample global capacity to meet New South Wales demand, this increases the reliance on overseas supply chains as well as increasing exposure to shipping and foreign exchange risks.

One example is the production of **clinker** for cement. High energy costs in Australia relative to the rest of the world has seen the number of lime kilns in Australia shrink by two thirds over the past fifteen years, to just five currently, with the only New South Wales kiln being Boral's Berrima facility. New South Wales now imports the bulk of its clinker requirements, as it is far more cost effective to ramp up imports this way to meet demand than to invest in new local production facilities. Imported clinker is ground at mills at Port Kembla, as well as Berrima and Maldon. Overall, clinker is a cost issue for the market, not so much a capacity issue, with significant grinding capacity available and a relatively deep global clinker market (100 million tonnes compared to New South Wales' current imports of less than 1 million tonnes) available. Cement also travels further economically than aggregates, in that capacity can be drawn from other states in a way which typically cannot be done with sand or aggregates. Aggregates typically cost \$20-30 tonne at the gate, whereas cement is \$160 a tonne, with cost per tonne-kilometre of cartage being the same.

'It takes about a decade for a quarry to progress from conception to operation'

¹⁰<http://www.goulburnpost.com.au/story/3150833/holcim-quarries-rocky-future/>

As previously noted, bitumen for making asphalt concrete is also now fully imported in New South Wales with the closure of the Clyde and Kurnell refineries. Again, this is likely to represent a cost rather than capacity risk for the New South Wales construction industry going forward, although there may be a need to examine what appears to be a substantial and growing gap between imported bitumen prices and domestic prices for asphalt, particularly since the sharp decline in oil (and bitumen) prices over the past few years. According to recent industry soundings with major concrete producers, **Slag** is also likely to be increasingly imported into New South Wales for making durable concrete specifications, particularly if BlueScope were to close down its remaining blast furnace in Port Kembla. This would result in sharp increases in prices for premium durable specifications, but would not be a direct risk to capacity.

Finally, the increasing variability of **fly ash** quality and production volumes in New South Wales' coal-fired power stations is also providing challenges to the cement and concrete industry. In this instance, the issue is likely to be one of capacity rather than cost in the long term, given the potential winding down of coal-fired generation in New South Wales as existing facilities age and new non-coal capacity is brought on stream. Unlike clinker and slag, there is not a global market for fly ash: supply chains would need to be established with coal-fired power stations and quality would have to meet strict RMS standards. In the absence of fly ash, the industry in New South Wales will need to return to full cement blends, with implications for the demand on other necessary inputs such as natural sand.

Transport and logistics constraints

Potentially one of the greatest risks to the supply of materials to the construction industry – particularly concrete and quarry products but also other materials – is the logistical challenge of transporting materials to construction sites, as well as the removal of spoil and waste. While this is true of any region in New South Wales which is contending with a large construction program, it is likely to be amplified in the Sydney metropolitan region given the sheer size of the construction program forecast and the limited transport options available in dense, inner city construction locations.

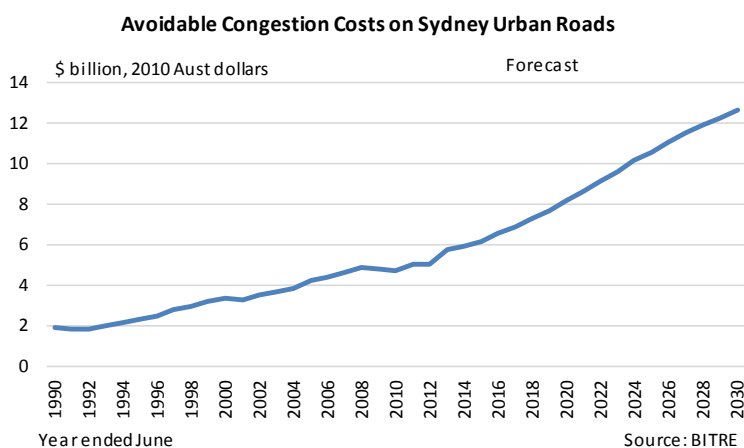
According to BITRE data, Sydney's urban road network is already under significant capacity pressure with avoidable congestion costs estimated at approximately \$6.1 billion in 2015 (out of \$16.5 billion nationally). By 2030, BITRE projects this cost will rise to between \$9.5 billion and \$12.6 billion, with national congestion costs rising to around \$30 billion.¹¹

However, increasing construction activity entails even more truck movements on Sydney's increasingly congested urban road network. This is likely to slow down work on projects, with knock-on impacts to productivity and costs. According to recent industry interviews, rising road congestion and delays is reducing the maximum number of loads that can be delivered to the metropolitan region each day from around 5-6 loads on the past, to 3-4 loads presently. Meeting existing demand means investing in more trucks and drivers. Rising construction demand amplifies the pressure.

Construction materials often need to be delivered on site at the start of the day (during the morning peak) and, in the case of concrete, must be delivered within two hours of supply to maintain product integrity. Having efficient transport and logistics networks will be vital in keeping projects on time and budget. As one major materials supplier stated in recent industry interviews:

"As far as capacity goes, I think we are coping. Its more our logistics, the delay is the logistics – getting the trucks to and from sites. There is capacity to dig stuff up, it's just delivering it. Everyone wants stuff at peak hour times and there are lots of delays. So this is compensated for by getting more trucks. But this is unsustainable commercially."

¹¹BITRE (2016), Traffic and congestion cost trends for Australian capital cities, p24.



Currently, regulations and approval processes work against the efficient delivery of construction materials to sites. In many cases, approvals processes limit construction times or delivery times for projects in a window between 9am and 3pm to minimise peak hour truck movements for commuters. The downside is the interface to the construction site usually becomes highly congested, with trucks often “circling the block”.

Regulatory constraints also dictate the hours of operation of facilities such as quarries and batch plants which supply construction materials, creating inefficiencies even when the construction projects they service (such as NorthConnex) are granted 24-hour operation. In the case of NorthConnex, restricted hours of operation at the Peats Ridge quarry necessitates preloading of a large stock of metropolitan-bound trucks at Peats Ridge which are parked at the quarry, then ferrying drivers back and forth during the night to simulate 24-hour operation but at large inefficiency and cost.

While quarries may be able to apply for longer hours of operation in less populated non-metro areas, the same may not apply to concrete batch plants which need to be positioned in close proximity to construction sites. According to industry, there are 18 concrete batch plants which service the Sydney region, with approximately another 40 servicing regional areas of New South Wales. Six batch plants were located along a spine in Alexandria, but two of these are being resumed for the WestConnex project, while a third plant is being resumed for residential development. Apart from the direct loss of capacity to service the metropolitan market, the hours of operation of the remaining batch plants is determined by local council regulations. While demand may be met in other ways, operating restrictions on batch plants effectively determines construction times in the metropolitan area.

Minimising transport and logistics constraints facing materials suppliers and the wider construction industry will be vital, and is well within the scope of government capability to effect meaningful and productive change. Potential solutions include:

- **Allowing 24-hour operation for all large scale projects.** In the view of many construction industry participants interviewed, 24-hour operation was seen as one of the most efficient ways of reducing capacity constraints in the heavily trafficked Sydney metropolitan area. Such a policy would see more movements occurring at quieter times of the day, allow for lower numbers of trucks to meet demand, and may see projects completed faster. Similar policies have been used in other major city centres, such as Tokyo and London, although it is noted that London maintains noise restrictions regulations. Where local government is responsible for issuing consents, a State Government declaration of a project being a 24-hour project could be used to drive negotiation with local councils to have CBD-located supplying plants also approved for 24-hour operation.

'It's less about supply, and more about logistics'

Such a policy could also help keep construction material costs down over the longer term as it will involve maximising the use of existing quarries, plants and manufacturing facilities rather than requiring expensive investment in new facilities (which need to generate a return to owners). Furthermore, given that transport costs tend to be embedded in materials prices (with transport costs making up approximately one-third the cost of bricks, for instance), reductions in transport times and delays through 24 hour operations could directly reduce these input costs for metropolitan projects.

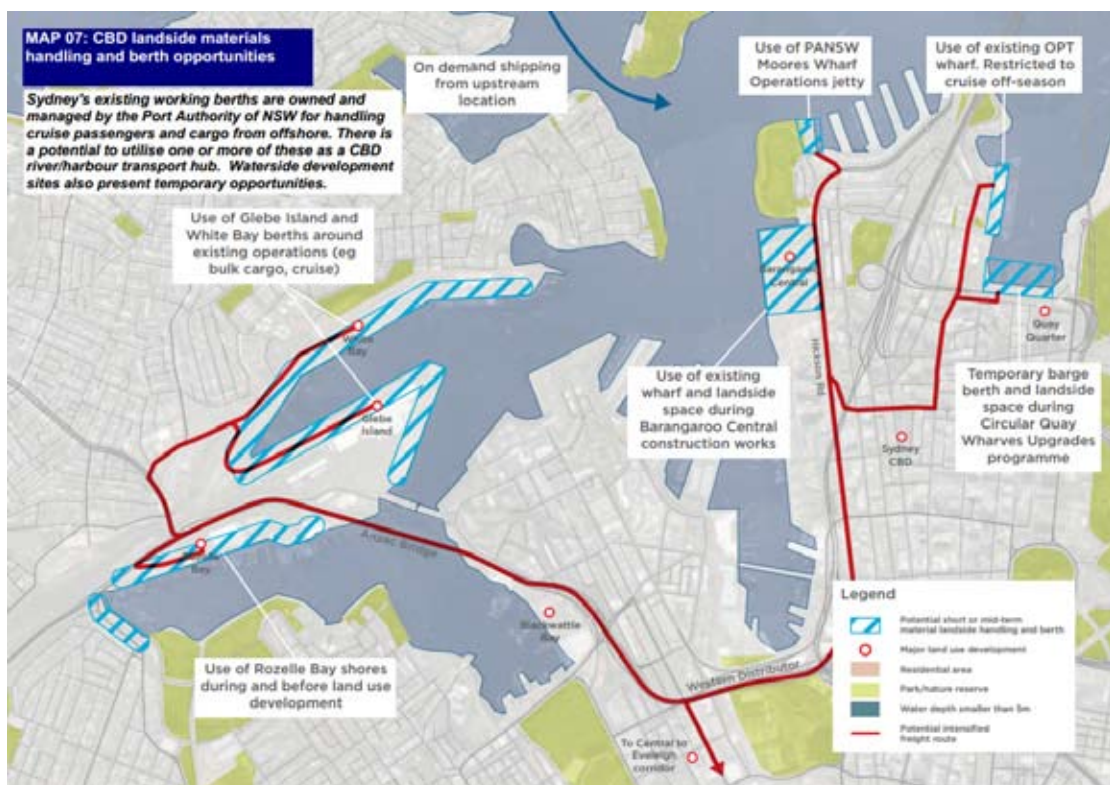
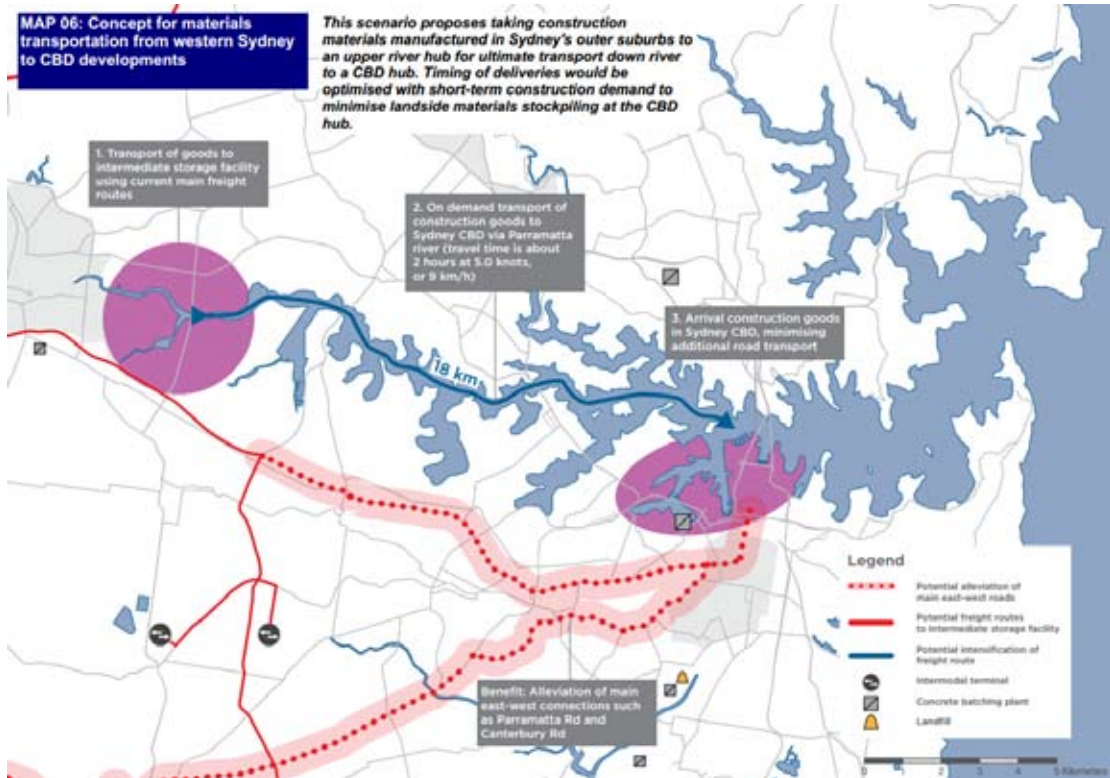
- **Improving the productivity of existing transport infrastructure.** Apart from 24-hour operation, industry interviews suggested that much could still be done to improve the efficiency of the existing road and rail transport corridors in the metropolitan region, ranging from increasing the use of Intelligent Transport Systems (ITS) to improve traffic flow (e.g. smarter traffic light systems, variable speed limits, on-ramp traffic smoothing etc) to utilising dedicated lanes for construction traffic, changing traffic conditions around major construction sites, fixing pinch-points and providing alternative road routes, and promoting the use of alternative transport modes (such as rail or shipping). As with the previous point, improving the productivity of existing infrastructure assets will have wider impacts than just reducing transport times and costs. In this case, the implementation of systems that more efficiently manage demand on Sydney's transport networks has the potential to delay the need for more costly capital investment in new transport infrastructure, providing better value for money for the NSW infrastructure investment program.
- **Making use of alternative transport corridors.** Without an effective road pricing system (such as that proposed by Infrastructure Australia's Infrastructure Plan in 2016), developers and the construction industry are likely to continue to use roads, primarily, to transport construction materials, at the expense of traffic congestion and road asset damage. Given the location of construction works, this is likely to see a substantial increase in traffic on major freight arterials connecting to and around the Sydney CBD.

A possible alternative which makes use of Sydney's geography has been proposed by ARUP in a recent discussion paper.¹² Invoking the 2013 NSW Freight and Port Strategy which championed actions to expand the use of coastal shipping, ARUP proposes utilising Sydney's own waterways for construction materials delivery to minimise transport delays, congestions and disruptions. In particular, the scheme involves establishing intermediate materials storage facilities at upstream industrial precincts (such as at Camellia) utilising existing road and rail freight routes, then barging materials approximately 18 kilometres to bulk unloading facilities in the Bays Precinct where they can then be distributed by road to CBD locations. According to ARUP, this will alleviate traffic congestion along main east-west connections including Parramatta Road and Canterbury Road. ARUP notes that similar transport schemes are used in London and Paris to transport construction materials as well as goods. In London's current Crossrail Project, around 5.6 million tonnes of spoil from the Crossrail tunnel has been transported by rail and barge, the equivalent of removing 150,000 truck trips across London.¹³

The main challenge to utilising Sydney's waterways to transport bulk materials is the potential loss of critical loading and unloading sites. The Camellia precinct near Parramatta has traditionally been an industrially-zoned area, but has been earmarked for future residential development. Meanwhile, downstream unloading sites in the Bays precinct are also at risk of residential development, particularly in White Bay and Glebe Island where there is existing bulk handling infrastructure as well as terminals. Meeting the transport challenges of the metropolitan construction boom may well require that both upstream and downstream sites are protected from redevelopment so they can be utilised as a key freight transport corridor. This concern has been mirrored by several materials suppliers in the recent interview program given the high cost of transport for bulk construction materials (which is inevitably embedded in their cost) and given Sydney's need to import materials such as natural sand due to a lack of local capacity within the next five years.

¹²ARUP (August 2016), Intra-Harbour Freight Movement - a sustainable alternative during Sydney's construction boom, Discussion paper.
¹³<http://www.crossrail.co.uk/news/articles/crossrail-will-move-five-million-tonnes-earth-via-river>

ARUP's Potential Inter-Harbour Freight Transport Scheme



OPTIONS TO CONSIDER

➤ **Develop strategies for quarry products based on rigorous updated supply/demand data** – industry soundings and analysis suggests that in most cases, material input risks are more likely to revolve around the cost of supply rather than outright market constraints. In the case of quarry products, however, where supply tends to be more localised, the risks of capacity constraints emerging within the next five years are more pronounced. Long lead times to establish new quarries, coupled with sharply rising demand is likely to see not only rising costs but possibly shortages of specific quarry products such as natural sand. Further analysis of construction materials demand and supply to quantify the extent of the problem and develop strategies (including transport) should be considered. While the NSW Department of Mineral Resources undertook an analysis in 2001, this work should be updated based on current projections of construction activity, intensities of use across different construction segments by product, and available supplies based on recent sand quarry audit data.¹⁴

➤ **Waste products and recycling** – given risks to quarry products supply, greater attention could be focused on appropriate strategies to promote recycling of spoil from the large tunnel projects currently underway (and projected) over the coming decade. Here, several issues will need to be addressed including quantifying the current capacity for construction and demolition (“C&D”) recyclers in Sydney to handle the sheer volumes of spoil being generated, a potential lack of capacity to park spoil for recycling over the next five years given the sheer volumes of spoil being produced, and finally the relatively low spoil disposal gate fees compared to fees for C&D processing which make recycling uneconomic.

On the broader issues of waste products, government and industry need to be aware of the “unintended consequences” as a result of ongoing closures in Australian and New South Wales manufacturing. As a consequence of these closures, important by-products for the construction industry – including bitumen, clinker and potentially slag – are now being imported instead of being produced locally, opening up quality, shipping and exchange rate risk. In the long term, the eventual shutdown of coal generation plants will also remove a valuable source of fly ash.

➤ **Risks to steel quality** – while the Productivity Commission (2014) has questioned making specific local content plans in public sector procurement,¹⁵ steel production in Australia would be drastically reduced if Arrium (OneSteel) or BlueScope were to close existing steel-making blast furnaces. While this is not a direct threat to capacity given existing global oversupply, recent industry soundings and evidence presented to the Senate Inquiry on the Future of Australia’s Steel Industry in 2016 suggest a growing quality risk as more steel is imported for major construction projects. This suggests the need for greater auditing and regulation of imports to ensure that construction standards are being met.

➤ **Making the most of existing capacity** – a key contention of industry throughout our interviews is that materials capacity could be substantially enhanced if restrictions on the hours of operations of existing facilities were relaxed. Given the length of time to plan and obtain approvals for quarries, plants and other manufacturing facilities, moving to longer hours of operation (up to 24-hour operation for designated critical projects) could have substantial logistical benefits (with more deliveries being able to be made during non-peak periods), reducing demand for trucks and drivers, and lowering construction timeframes.

➤ **Developing strategies to protect and improve key transport corridors.** Overall, given the concentration of construction work in the Sydney metropolitan region (which is already suffering from significant growth in urban traffic congestion), and the increasing share of transport costs which is embedded in the price of construction materials, the NSW Government should articulate a New South Wales Infrastructure Transport and Logistics Policy that is coordinated to the infrastructure investment strategy. Industry soundings repeatedly revealed that rising costs and delays caused by the transport network were the greatest risk for materials supplier’s capacity to deliver. Here, two key policies stand out. Primarily, existing transport corridors available to the construction industry should be protected – including critical bulk materials loading and unloading facilities in the Bays Precinct (which may be the only remaining economic ‘landing point’ for future imports of natural sand). Secondly, existing metropolitan road transport infrastructure should be managed better (e.g. use of demand management tools such as road pricing) or upgraded via smart technologies (e.g. smart traffic lights around major construction sites) or rules of use (e.g. access to bus and taxi lanes) to provide greater road capacity to the construction industry.

¹⁴NSW Department of Planning and the Environment (February 2016) *Summary of the Compliance Audit Campaign of NSW Sand Quarries* (May – August 2015).

¹⁵Productivity Commission (2014) *Public Infrastructure Inquiry Report*, Volume 1, p27.

CRITICAL ISSUE 5: Productivity and innovation



In a world where construction labour and capital inputs are limited, and where demand for construction output is rising, productivity improvements offer an important route to minimising the risk of capability and capacity constraints. The Australian construction industry has generally lagged other industries in terms of productivity growth, but considerable “step changes” can be observed over time. The challenge for industry and government is to look at ways in which productivity can be improved, such as through higher quality supervision and project management, harnessing new technologies and processes, and adopting a more innovation-friendly culture. For governments, this may involve giving contractors more room to innovate in the procurement phase, and encouraging the development and adoption of new materials and construction processes. Large, complex construction projects are likely to offer the greatest scope for innovation that may deliver both short and long term benefits to the construction industry.

As noted by the Productivity Commission in its 2014 inquiry into public infrastructure:

“Improved productivity (when this also encompasses quality improvements) is the key method for reducing the costs of output to customers, improving business returns in the shorter run, and providing more infrastructure for a given spend.”¹

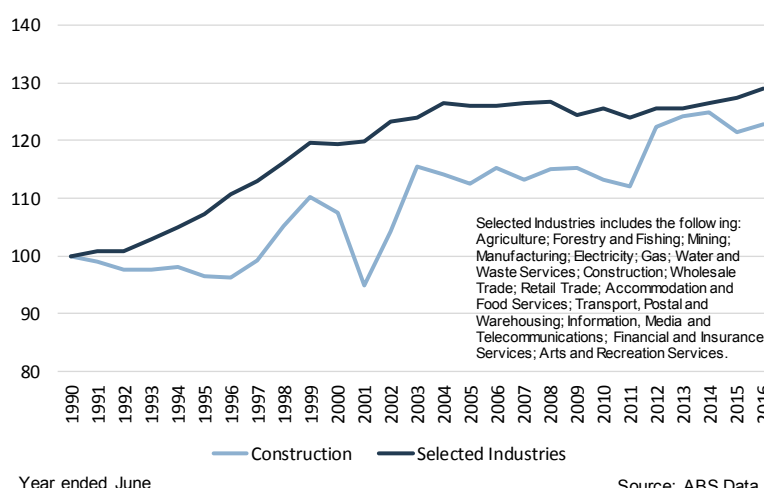
While productivity can be difficult to measure in the construction sector, data suggests that the industry in Australia, similar to its overseas counterparts, has had a chequered history in achieving sustainable, strong growth in productivity over time. Relatively slower growth in productivity, compared to the rest of the economy, means that greater pressure is placed on boosting the quantity of labour and capital inputs to achieve higher levels of output, rather than improving the way they are used together. Where labour and/or capital is scarce, this itself can lead to increased demand pressure on resources, increasing construction costs.

Even so, emerging technologies and construction processes can make a difference to productivity performance, reducing the construction industry’s reliance on key skills and materials. Embracing these opportunities, however, requires a culture across both the private and public sector which demands and rewards innovation.

Recent productivity trends

Productivity can be defined as the ratio of a volume of output to the volume of inputs; that is output per unit of input.² Output, in the current context, is usually referenced as the “gross value added” by the construction industry over a period of time. Growth in productivity implies that output has grown by more than the growth in inputs. For the construction industry, it is useful to consider both labour productivity as well as multi-factor productivity (MFP). The former considers how output changes with a given change in labour inputs, while the latter represents changes in output driven by changes in the combined value of inputs, which effectively means “doing things better than in the past”.³ The link between the two measures is capital deepening, which refers to increasing the share of capital used in production which allows the (lower) share of labour to be more productive. Growth in both productivity measures over time for the construction industry are shown in the next two charts.

Gross Value Added Multi-Factor Productivity Indexes, Australia, 1989-90=100

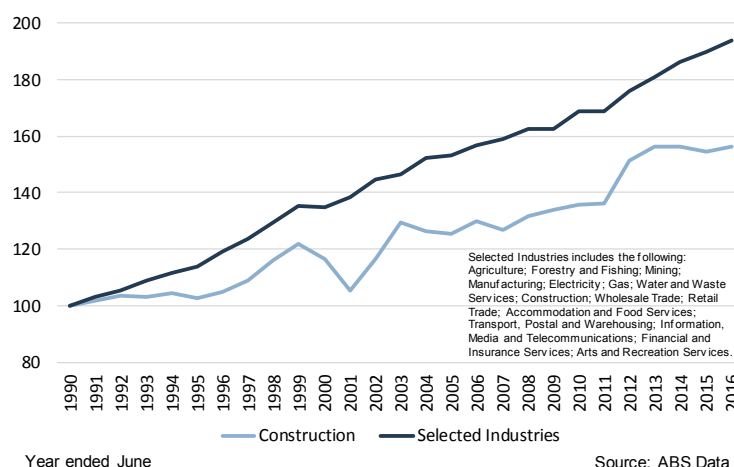


¹Productivity Commission (2014) Public Infrastructure Inquiry Report, Volume 2, p417.

²ABS (2016) Estimates of Industry Multifactor Productivity, 2014-15, Cat. No. 5260.0.55.002

³Ibid.

Labour Productivity Indexes, Australia, 1989-90=100



'Over time, productivity in the construction industry has tended to lag other industries'

There are some caveats to interpreting construction productivity data. Firstly, it focuses exclusively on the construction industry itself, and so does not include labour working in construction-related roles in other sectors such as Professional, Scientific and Technical services (e.g. engineers and designers), Manufacturing (materials supply) as well as Public Administration and Safety (infrastructure-related agency staff). Secondly, construction output is not a tradeable good and, as such quality improvements in construction output over time (such as improved safety outcomes which increases labour hours) may not be adequately reflected in productivity statistics.⁴

With this in mind, national ABS productivity data shows that construction industry productivity growth – both multifactor and labour – has tended to lag that of the broader “selected industries” measure. Over time, productivity in the construction industry tends to stall for several years before experiencing a step change (such as in the late 1990s, and again in the early 2010s). While there is some uncertainty regarding the causes of these step changes, one possible explanation is rising capital intensity, which could have boosted both productivity measures. In the early 2010s a likely candidate for rising capital intensity may be the start of the phase of oil and gas construction in Australia which, apart from the sheer scale of construction, also brought with it highly capital-intensive methods of construction, such as prefabrication and modularisation on a massive scale. Overall, however, labour productivity in the construction industry has grown at just 1.7 per cent per annum on average since 1989/90, compared to 2.6 per cent per annum for selected industries. Multifactor productivity growth has been closer: 0.8 per cent per annum on average for the construction industry compared to 1.0 per cent per annum for selected industries.

Avenues for future productivity growth

Despite lagging broader market productivity, the construction industry *has* become more productive over time, thanks to sudden bursts (step changes) in productivity growth at points in time. But, as noted by the Productivity Commission (2014)⁵, there is room for improvement.

Based on recent industry soundings, as well as further research, achieving stronger construction industry productivity outcomes ultimately depends on:

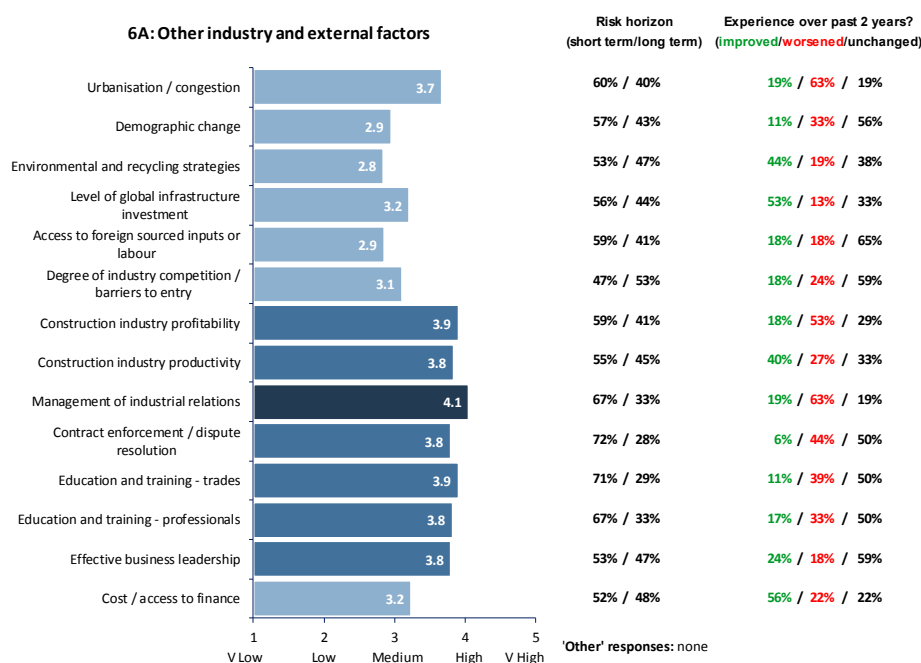
- Reducing current sources of inefficiency in the construction activity
- Harnessing new productivity enhancing technologies and processes (which can provide future step changes in productivity performance),
- Utilising offshore capacity and capability, and
- Adopting an innovation-friendly culture

⁴Productivity Commission (2014), p392.
⁵Ibid, p406.

Ultimately, construction is a supervised activity and the extent of reworking required (through inadequate training and supervision) has a significant impact on industry productivity. This is especially so with complex, sequenced, infrastructure projects, where the need to rework one stage has flow on effects to future stages. Consequently, the availability of high quality onsite staff such as foremen, supervisors and project engineers can be critical to industry productivity.

Improving inefficient practices

Our survey of the construction industry indicates that productivity growth (or lack of it) is one of the more significant factors which will drive risks to industry capacity and capability.



A consistent theme which emerged during industry soundings was that current inefficient practices and processes should be improved to boost productivity in the sector. These ideas were wide ranging and included both firm and procurement agency suggestions (with many covered elsewhere in this report) including:

- Boosting education and training of current employees, particularly on-site staff
- Minimising interruptions / improving coordination of activities on the worksite
- Providing greater coordination between projects in adjacent regions
- Improving transport and logistical links to sites
- Minimising unnecessary tasks (in planning and procurement)
- Setting realistic construction timeframes to avoid rushes and bottlenecks
- Using procurement methods which encourage innovation
- Actually measuring and benchmarking productivity performances across projects
- Reducing administrative tasks and “red tape”

Some of these issues are amenable to government policy, while others require industry itself to lift its performance, including their own approaches to workforce development and supply chain management.

'Prefabrication and modularisation was consistently mentioned as a key source for productivity benefits in industry soundings'

Harnessing new technologies

Both the Productivity Commission (2014) as well as other industry reports in Australia⁶ and overseas⁷ point to a range of new technologies emerging in the construction sector which can potentially provide step-change productivity outcomes over the coming decade, including:

- Prefabrication and modularisation
- Robotics and automation
- Use of advanced materials or processes
- Digital technologies (including BIM)

Digital technologies refers to the digital representation of the physical features of an asset or construction project and, importantly, can be shared by designers to construction contractors and eventually asset owners so there is a single source of “truth” regarding the asset’s characteristics. Use of digital technologies during the design stage may offer substantial productivity benefits as (i) 3D, 4D (time) and 5D (cost control) design modelling can minimise mistakes and costs during the construction phase of projects, as well as potentially minimising costs at the operations and maintenance phase; and (ii) over time, digital designs can be used as a benchmark for future projects, speeding up design and improving cost estimates.⁸ BIM is particularly useful for complex building projects that have significant utilities/services conflicts. Our survey indicated that increasing use of digital technologies is ranked a “medium to high” source of future productivity benefits according to the construction industry, behind mobile technologies, prefabrication, productivity measurement tools and alternative contractor methods.

Recent industry soundings indicate that designers are using digital technologies such as digital engineering (DIM/3D) for project modelling plus pre-testing via software (including cloud based 360-degree design packages), which can now generate a fully integrated project design. This is allowing design to take place globally and can potentially speed up the design process (for example, industry indicated in interviews that it may have helped deliver the North West Rail Link months earlier than originally planned). Digital advances in logistical planning can also improve flexibility of trucking and cranes, generating better predictors of when materials need to be shipped.

Prefabrication and modularisation was consistently mentioned as a key source for productivity benefits in industry soundings. The main feature of this approach is that key parts of the construction process are undertaken offsite and then transferred and installed as a single module or component. While this approach has been building momentum over many years in parts of the construction industry, the technique was widely employed during the recent resources construction boom given the sheer cost and complexity of building large assets (such as LNG processing trains) completely on site in the short time frame required. Apart from civil construction applications, it is also gaining popularity in the residential and non-residential building space, where entire rooms (bathrooms, kitchens etc) can be prebuilt offsite as a module before being installed into the larger project. The key advantages of this approach are:

- Production of the modules is more akin to a manufacturing process, rather than construction, with activity undertaken in a controlled environment by trade specialists, with the production process itself amenable to both specialisation and economies of scale
- Avoids having large numbers of subcontracted trades on the construction site, with “manufacturing” facilities established in nearby regions. Data suggests that imports of prefabricated buildings are rising substantially, as shown in the chart below, and this may place downward pressure on demand for traditional trades
- Reduces loss of productivity through idled equipment on site
- Delivery is independent of trade skills availability or the weather
- Production is subject to different industrial relations settings

⁶For example, Quezada G, Bratanova A, Boughen N and Hajkowicz S (2016) *Farsight for construction: Exploratory scenarios for Queensland's construction industry to 2036*, CSIRO, Australia.

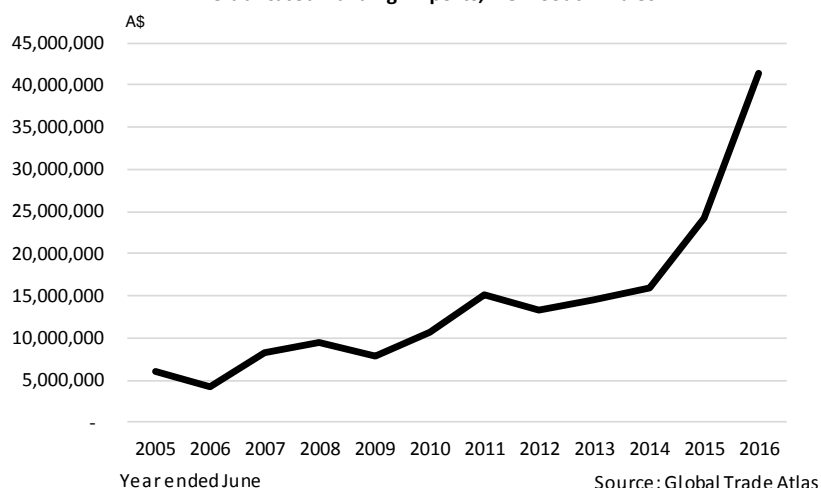
⁷National Research Council (United States), 2009, *Advancing the Competitiveness and Efficiency of the U.S. Construction Industry*, National Academies Press, Washington D.C.

⁸Quezada G, Bratanova et al (2016), p61. Facility management and performance monitoring have been recently added as sixth and seventh dimensions.

Against these benefits, prefabrication and modularisation also presents challenges to the construction industry. Ideally, prefabrication facilities are located in close proximity to construction sites, provide appropriate quality and depth to handle complex engineering projects and do not present logistical challenges, high costs or long travel times, in moving large sections from facility to site.

Robotics and automation technologies are starting to play a role in construction applications, following large strides in the manufacturing and mining industries. Rio Tinto and other miners are increasingly using autonomous vehicles (trucks and rail) for moving overburden and ore, while plant operators control machinery in the Pilbara from an operations centre in Perth.

Prefabricated Building Imports, New South Wales



Similar applications of this technology could apply to the construction industry, particularly for earthmoving (which is already happening in Japan through Komatsu as construction activity ramps up for the 2020 Olympics)¹⁰. While construction sites are more complex than manufacturing for robotics to flourish easily, there are signs that repetitive tasks such as bricklaying could also be automated in the future, with one company in Perth (Fastbrick) developing robots that could increase the speed of bricklaying by up to 20-30 fold.¹¹ Similar robotic advancements, using 3D printing and GPS technologies could see other trade tasks automated in coming decades, particularly in conjunction with modularisation / manufacturing approaches. In turn, the rise of automation and robotics has implications for skills training and development, with those who have skills more complementary to the technology commanding greater opportunities for employment and higher wage growth.

Finally, broader productivity benefits could also be derived by utilising or developing **new materials or construction processes** which increase the pace of construction, substitute for scarce or less 'environmentally-friendly' resources, make structures more durable, or reduce future operations and maintenance expenses. While this is an ongoing process in the construction industry, recent industry soundings suggest that more can be done here to encourage the uptake of new productivity-enhancing materials by New South Wales agencies, support designs which make use of more readily available resources or promote more capital intensive (rather than labour intensive) construction methods where scarcity of labour skills is a key capability risk. One such process is 3D printing (also known as "additive manufacturing") which is increasingly finding construction industry applications, such as building walls and facades, as well as entire residential structures.¹² Such technologies can also reduce the cost of construction by minimising the transport of materials, skills required, shorter production times and minimisation of waste.

¹⁰While currently only available in Japan, this technology could soon spread to other countries. Presently, it is assisting Japan in overcoming a severe shortage of construction workers due to an ageing workforce. <http://www.theverge.com/2015/10/13/9521453/skycatch-komatsu-drones-construction-autonomous-vehicles>
¹¹<http://www.businessinsider.com.au/video-a-one-armed-australian-robot-can-build-a-house-four-times-quicker-than-a-brickie-2016-7>

Environmental innovation is a further important dimension of industry adaptability. Industry sources note that some NSW Government projects have already specified inbuilt requirements for green materials (eg. steel), facilitated by early contractor engagement (ECI) which has allowed coordination of products and procurement with project parameters. ProcurePoint requires projects over \$10million to share an environment management system (EMS).

In its 2015 report¹³ Infrastructure Australia (IA) endorses the view that environmental considerations should form a fundamental aspect of infrastructure project selection and planning processes. IA also argues that 'ineffective and inconsistent regulation has had adverse outcomes' for infrastructure users and the Australian community. These include high costs in parts of the electricity sector, poor pricing decisions leading to potential problems in the future in the water sector, and poor levels of cost-recovery in the transport sector. Greater independence of regulatory oversight would improve the quality of decision making.

Predicting the pace of development and adoption of all these technologies by the construction sector is very difficult, but over time they can be expected to continue the trend of broad growth in productivity which has been observed over past decades. It should be expected that rapid adoption of new technologies and processes will not only produce step changes in productivity, but also have implications for the range of current skilled occupations in the construction industry, and hence policies which target and promote skills development.

Offshoring

Offshoring can directly augment domestic capacity and capability and, though harnessing global innovations and intellectual property (IP) is another avenue for productivity gains. However, there are benefits and costs to offshoring which should be considered. Importantly, offshored

ENVIRONMENT MANAGEMENT SYSTEM (EMS)

Contractors seeking to work on major projects (all projects of \$10 million or more and projects under \$10 million if they are environmentally sensitive) will need to have an acceptable corporate Environment Management System (EMS). Corporate environmental management systems must comply with the documentation requirements of AS/NZS 14001:2004 Environmental management systems.

Source: ProcurePoint
<https://www.procurepoint.nsw.gov.au/policy-and-reform/construction-policies>

inputs and the presence of international contractors can help expand the industry's capacity and capability when most needed. For certain skill sets and capabilities, such as tunnelling, Australia is likely to remain heavily reliant on world-leading overseas-sourced talent and IP. Absorbing and retaining these learnings within the domestic industry will be both a challenge and a once-in-a-generation legacy opportunity.

In recent soundings, industry is generally supportive of the need for international competition provided such competition is fair and value-adding. Equally, however, overseas imports and competitors can also lead to problems if not properly integrated.

Issues identified from recent industry soundings suggest:

- Imports of construction materials are in some cases essential because they are not produced domestically (for example, scaffolding, bitumen) and in other cases are discretionary depending on competitive advantage (such as modular pre-fabricated units from China). But there are also issues around quality and potential for 'dumping' onto the local market. Dumping of low quality imports could depress prices and frustrate return on moral effort by local companies to maintain/improve quality. The consequence of this is that local firms would either shut down or sell subsidiaries, reducing industry capacity. Legislation may be needed in some cases to safeguard against poor quality imports or dumping.

¹²Quezada G, Bratanova et al (2016), p64.

¹³Australian Infrastructure Audit: Our Infrastructure Challenges 2015, Canberra <http://infrastructureaustralia.gov.au/policy-publications/publications/Australian-Infrastructure-Audit.aspx>

- Offshore players tend to come in with financial capital, but relatively less human capital (particularly construction labour) looking to joint venture with local firms. To operate in Australia, should they be required to bring in more systems and expertise ('arms and legs'), for example?

For many projects in the NSW pipeline, government will rely at least partly on the overseas supply chain. This makes compliance with Australian standards vital, with industry sources suggesting that non-compliance may be an issue. The advice from industry is that Government needs better regulation of the quality standards of imports – in other words, a suitable certification system.

Offshoring is likely to continue in New South Wales (and Australia more broadly) given ongoing losses in local manufacturing and production. For instance, industry notes that Australia is increasing its reliance on overseas cement. One Victorian kiln closed eighteen months ago and a NSW plant closed twelve months ago (because the cost of production exceeded the import parity price), and that material is now sourcing from Asia. Clinker¹⁴ is increasingly being imported, and industry expects that the remaining four kilns in Australia will probably close over the next few years. Similarly, oil products such as diesel fuel and bitumen are almost exclusively imported. Risks surrounding the financial feasibility of local steel production could make this industry the next contender for offshoring. In all cases, the cost of maintaining a local production presence is becoming increasingly uneconomic. Rising costs for key manufacturing inputs such as gas and electricity do not help.

While loss of local industry through a lack of competitiveness is one thing, industry noted that wholesale dumping of offshored product is quite another. Sporadic episodes of dumping disrupt the local supply chain, with local equipment suppliers going out of business or selling their equipment supply subsidiaries due to evaporating margins. The result is a less competitive industry, and a less flexible and adaptive industry. According to industry interviews, dumping has happened in the past – with a 'flood' of imported equipment (such as scaffolding) coming into Australia around the time of construction for the 2000 Sydney Olympics, then again around the GFC – and it could be repeated with the upcoming construction program. Overall, industry observers say it is too easy to flood the market with light equipment imports and there needs to be better regulation of dumping of poor quality or unsafe foreign product.

Encouraging innovation

Ultimately, the degree to which current inefficient construction practices are reformed, or new productivity-enhancing technologies adopted, depends on fostering an innovation culture. In such a culture, firms are encouraged to undertake research and development and promote new products and methods because, crucially, procurement agencies are willing to reward and accept them. As argued by Quezada G, Bratanova et al (2016: p80) in examining future technologies in the Queensland construction industry:

"Developing a bold innovation culture is ostensibly Australia's biggest conundrum. Many contributors to our interviews and workshops suggested that shifting the construction industry's cultural set-point on innovation will require a significant external force."

Innovative solutions can often give better value immediately for construction projects, particularly when they are complex and amenable to improvement through industry "smarts". Even when innovation does not necessarily offer the lowest price in the short term for a project, it can often promise a lower long run cost to procurers, governments and asset owners – such as through promoting new "lower maintenance" materials in the construction phase, utilising new construction processes which can then be replicated on other projects, or promoting industry training which can leave a skills legacy for the future.

In practice, however, NSW government agencies often dictate construction processes based on "tried and true" methods which leave little room for innovation. Furthermore, when government asks industry to take on a fifty year or one-hundred year risk (for example, for a tunnel), recent soundings suggest this de-motivates the contractor and results in the contractor over-

'There are more foreign accents on project sites; big projects attract the best people from around the world'

¹⁴Clinker is a precursor to cement, cooled with limestone from a high temperature and then ground to make cement.

designing and being too conservative, avoiding innovation and in turn pushing up cost. In some cases, this is seen as offering an advantage to foreign companies who could exit the domestic industry during the risk period, despite giving a longevity risk guarantee in tendering.

In this respect, a significant driver of productivity going forward – and hence the degree to which the New South Wales construction industry meets capacity and capability challenges – may well be how successfully New South Wales industry and government foster innovation.

Our industry soundings revealed many good examples of innovation in the construction industry, such as the increasing use of prefabrication and modularisation, or improving workforce development. Much of this was initiated by the private sector.

However, there were also examples where innovation was stifled. In one instance, an innovative patented guard rail system that uses 40 per cent less material, while eventually approved for use by RMS, is still not being taken up. As mentioned by one industry supplier:

“Government’s talk a lot about innovation. But realistically, whenever we bring something new to market it takes them an eternity to actually get it approved... There is this ‘copy and paste’ mentality saying ‘this is what we’ve used in the past and this is what we are going to continue to use’. If there was a bit more risk-sharing, some of that innovation might be able to flow more quickly... to be fair to RMS it has been approved for a period of time but there is still a lot of [people] in RMS who don’t use it. We talk to contractors about it too, but because they are on such tight margins, their ability to use alternatives is limited.”

In other circumstances it is often the procurement process itself, with its focus on short term price instead of longer term benefits, which is perhaps one of the greatest inhibitors of innovation in the construction industry:

“The government talks a lot about wanting innovation, but in reality there is no mechanism to buy that innovation. The government wants cheapest price and commercial compliance.”

“Silos” between NSW Government procurement agencies may be a barrier to innovation.¹⁵ Major companies reported facing barriers to entry when attempting to tender across different construction segments. For instance, if a big contractor with a huge balance sheet and long experience in the commercial building sector (even if it includes building surrounding roads) tenders for a road project, the agency will ask ‘when was the last road project you worked on?’. It’s ‘almost impossible’ for the major contractor to transition to a new construction sub-segment, despite having completed major landmark projects in another sub-segment. While the contractor may have fresh ideas to bring to the road space, they are not given a chance to air those ideas. This is occurring, despite government agencies saying ‘we want more competition, especially more Tier 1 contractors in this space’.

Increasing the use of joint ventures is also unlikely to solve this issue as there is no incentive for a Tier 1 firm used to operating in roads to partner with another Tier 1 firm from a different sub-segment that is trying to break into roads work. Partnering with Tier 2 or 3 players may not work either where the smaller partner offers little value to a Tier 1 [or, indeed, may increase the risk of financial failure in the eyes of government]. Domestic Tier 1 contractors are also less likely to joint venture with an overseas player when the foreign operators only contribute dollars, not staff, materials or ‘smarts’, unless it is for a very large project.

In several interviews, construction contractors suggested that government does not always appreciate the innovation process, and how innovation typically carries quite onerous costs in terms of time and money. In many cases an innovative solution has to be tendered as well as the (prescribed) reference case, so investing in an innovative solution simply leads to the contractor increasing their own bidding costs and questioning ‘why bother to innovate’ at all.

¹⁵Other issues at the procurement phase are discussed in Critical Issue 2 of this report. A recent discussion of procurement issues from the Business Council of Australia can be found here: http://www.bca.com.au/docs/bcd23f8f-ee8c-45be-aa2f-4b94148f77d7/Competitive_Project_Approvals_Report_EMBARGOED_TILL_12.01AM_ON_25.11.2016_FINAL.pdf
<http://www.bca.com.au/media/world-class-model-for-major-project-approvals>

Industry also mentioned that contractors 'are highly time sensitive' but that 'government can seem to not realise the importance of this' due to convoluted and repetitive procurement stages. For instance, an agency produces a project scope, the contractor takes on the design (services/systems) and how to translate it into urban development, only to find they have to go back through another process (including aspects previously approved) that requires some modification to the first round, requiring pulling in new people and adding time and cost that is ultimately borne by the taxpayer (as well as adding risk for the developer).

Contractors also expressed the view that they are sometimes seen as a free 'evaluation service' and this weakens the 'good faith' between government and industry, with negative ramifications for fostering innovation. For example, an agency may seek submissions then may, in some cases, not even proceed with the project, costing a contractor potentially millions of dollars in soft costs for its own staff and hard costs such as external contractors. In such cases, if government were to pay a fee-for-service, then industry is more likely to remain motivated in forming innovative partnerships with government.

In several soundings, the cost of an innovative solution at the project level – such as including workforce development options in the tender response, or use of different products – was high enough for it to be rejected, even though it offered longer term benefits for New South Wales. In other cases, firms with the capability of offering better value simply did not bid for work as there was no effective reward for developing a better way to undertake the project.

Industry participants suggested state government can play a role driving industry reform through its buying power, by embedding certain values in the tender requirements. For example, it could lift the quality of contractors' – and agencies' – management and reporting systems, by using public works contracts to set benchmarks for performance monitoring. Government can also build a longer term legacy perspective into the bid process, by rewarding lasting innovation. Industry says government should focus on long term partnering with industry.

For this, ECI (early contractor involvement) contracts have a vital role to play, and "relationship contracts" where the government picks its contractor early on under certain parameters, may be better than straight design and construct arrangements. But according to industry leaders, these models are not being used enough by government in NSW because of a focus with lowest price. The 'current obsession' with 'hard dollar tendering to extract the lowest price' is 'squeezing margins' and driving contractors out of business. Industry argues that, by working against innovation, this reflects a misguided sense of probity.

In a recent industry survey the Alliance procurement model scored the highest nationally for market attractiveness, risk profile, operational efficiency and project delivery performance.¹⁶ Alliances, however, also have their limitations, typically requiring sustained high level management commitment and time to succeed. They are generally best suited to long term and highly complex projects (where risks are inadequately defined) and where efficiency gains can be accumulated over time. Examples of successful alliance contracting in New South Wales include the SewerFix Wet Weather Alliance (SWWA) established in 2007 between Sydney Water, Manidis Roberts, MWH, Parsons Brinckerhoff and UGL, and the Novo Rail Alliance established in 2008 between Transport for NSW, Aurecon, Laing O'Rourke and RCR Infrastructure O'Donnell Griffin.

Innovation is possible with the right procurement approach. A case in point is Darling Harbour Live. This project involved the construction of the new International Convention Centre (ICC) in Darling Harbour for Infrastructure NSW and the Sydney Harbour Foreshore Authority. While starting out as a Public Private Partnership (PPP) at its core, it also asked for value added options – Project Development Agreements (PDAs) – involving improvements at the site owned by the government. In this case, the winning tender included PDAs for the construction of a hotel of up to 900 rooms on the northern precinct of the development, as well as a new city neighbourhood / residential development in Haymarket.¹⁷ By structuring the tender in this way, bidding teams were motivated to deliver the value added options as well as the core scope. The challenge, however, is for procurers with government agencies to understand the value which is created by this approach and to try to replicate it in future tenders.

'The current model is 'lowest price plus transfer the risk onto the contractor', but it's unsustainable'

¹⁶Dan Reeve (General Manager Transport, SMEC Australia), Procurement and cost of bidding: where can we do better?, presentation to Roads Australia Annual Forum – Brisbane, June 2016

Innovation can also be encouraged by not over-specifying the project in the early stages of procurement, and allowing “industry smarts” to work out more productive ways of delivering the core “outputs” of the project. Industry soundings suggest that government projects teams may go too far with their reference designs, and may not focus enough on specific outcomes. Sometimes it is better to leave the details to the market.

An example of this approach was the way the NorthConnex project was tendered by Transurban and Project Sponsors.¹⁸ Instead of publishing a detailed reference case (which, unbeknownst to the market, was for two lane tunnels in each direction, all 3-4 metres high and 7 kilometres in length), the market was only given details of the total cost constraint (\$2.6 billion) and key outcomes required (for example, connections from the M1 and M2 roads in Sydney, requiring a tunnel under Pennant Hills Road). Subsequently, the market bid back a 9 kilometre tunnel, 5 metres high and up to three lanes in each direction (two initially which can be expanded to three) for the budgeted cost. By not publishing a detailed reference case, and only specifying the budget and key outcomes required, the market was given room to use their skills to innovate a higher quality solution.

Not all projects are conducive to innovation at the procurement phase, particularly those with little design input by tenderers (such as ‘construct only’ tenders). However, given the range of large, complex infrastructure projects on the horizon – such as the Western Harbour Tunnel and Metro West – there is considerable scope to specify the outcomes required (a set cost, workforce development, lower long run operating costs) to harness industry innovation and let the market determine the optimal solution.

***'Innovation is possible
with the right procure-
ment approach'***



¹⁷https://www.industry.nsw.gov.au/...data/assets/pdf_file/0004/54517/reLstoner_20130322_darling_harbour_redevelopment.pdf
¹⁸http://sr14.transurban.com/casestudy_02.htm

OPTIONS TO CONSIDER

- **Using procurement as an enabler to industry innovation.** In a world where construction skills and materials may become constrained in supply, productivity-enhancing innovation will be vital. For governments, perhaps the best opportunity to incentivise innovation in the construction industry is to demand it in the procurement process. Not every project has the characteristics to offer substantial productivity improvements through innovation, but for large, complex projects – with room for ingenuity in design and construction – more can be done to encourage innovation. Ultimately, this means moving away from a focus on price in procurement to broader measures of long term value. This may include strategies for workforce skills development, further options for site development, or simply reducing details of the reference case to give more room for innovative approaches.
- **Maximise use of digital technologies.** Industry has indicated that these technologies have the potential to provide long term productivity benefits to the construction industry. While digital technologies are becoming more widely used, they are still far from ubiquitous.
- **The take-up of new technologies and materials** can be improved by speeding up approvals processes within agencies regarding use of innovative products or processes. Agencies should respond to new technologies, outlining the technical or Commercial reasons why the innovation is not acceptable. Where possible, the benefits of using new products should be communicated to agency procurement teams and encouraged in their uptake.
- **Be aware of the impact of technological change on skills strategies.** Productivity-enhancing technological change is very likely to alter the mix of skills required in the construction industry over coming decades, and skills policies will need to change with them. In particular, the increasing use of robotics, automation and modularisation will require new competencies and strengths in digital technologies, new manufacturing processes, and artificial intelligence, while repetitive and dangerous tasks will become more automated.
- **Offshore entry.** Appropriate regulation to ensure the quality of imported materials, and to require meaningful participation by overseas firms operating in the local market will help reduce dumping and improve the quality of overseas inputs.
- **Learn from innovative projects.** Examples of successful innovation provide a template that can inform future projects, and help avoid the 'short-termism' that inhibits new ways of doing things.

Review:

Potential costs of failure



Failure to meet capacity and capability challenges in the construction industry as identified in this report is likely to have a range of deleterious impacts, ranging from highly publicised project failures to project (and project pipeline) delays and higher costs, reducing “value for money” construction delivery for New South Wales. Of these, cost escalation is often the most visible and well-known negative impact, given past experiences in construction cycles. In recent soundings, industry repeatedly noted that while it can rise to the meet the construction challenge, the combination of tight project deadlines and supply constraints are nevertheless likely to see an acceleration in construction costs. Recent data indicates growth in construction costs is currently weak. However, increasing demand for locally sourced inputs (such as concrete and quarry products), rising oil prices, stronger global construction activity and a reversion from unsustainably low industry margins all present upside risks to cost escalation as the New South Wales construction program is rolled out.

Construction cost escalation is the growth in costs for construction projects (of a given scope) over time, and tends to be driven by three distinct forces:

- 1 **Changes in prices for locally sourced inputs**, such as quarry products, equipment hire and labour (both professional and trades-based). This, in turn, is linked to the amount of construction activity going on at any time. High and rising levels of demand (i.e. construction activity) can place pressure on the existing supply of local inputs (including labour), boosting input prices. Where capacity constraints exist, rising construction activity can lead to strong increases in input prices as investment in new capacity is itself costly and takes time to come on stream.
- 2 **Changes in the prices for key imported commodities** (including steel and oil products such as diesel fuel and bitumen) which are determined in global markets. In turn, these price changes are driven by changes in global demand and supply for these commodities, as well as fluctuations in the value of the Australian dollar.
- 3 **Changes in profit margins for construction contractors**, which tend to be driven by the state of the construction cycle (demand) as well as changes in the degree of competition for work (supply). In boom periods, increasing margins can magnify the impact of increasing input prices on overall construction cost escalation.

COST ESCALATION VERSUS COST OVERRUNS

It is important to recognise that a perception of cost escalation on major construction projects can also occur where there are significant changes in scope on projects, or where there are substantial differences between initial estimates of project costs (often before more rigorous detailed scoping or a proper business case is undertaken and announced by proponents) versus the final actual cost of delivered infrastructure projects. The latter effect has been recently examined by the Grattan Institute which concluded that, based on an analysis of 836 transport projects planned or built since 2001, Australian Governments have spent \$28 billion more on construction than initially advised, a 24 per cent increase on the original cost estimate.¹ Here, the biggest culprit for cost increases was premature announcements of costs before projects were sufficiently developed (accounting for 74 per cent of cost overruns). Scope changes, meanwhile, accounted for just 11 per cent of cost overruns. There was also found to be a correlation of cost overruns with project size and complexity and, potentially, the type of contract used to procure the work.

Cost overruns caused by premature announcements or changes in scope are a separate issue to cost escalation caused by changing input prices and construction margins over time, and require different policy solutions. In particular, the Grattan Institute recommends that the frequency of premature announcements should be reduced, with governments unable to commit public funding to projects until a rigorous business case has been tabled in state or federal parliament; that standalone legislation be used to foster a bipartisan approach on very large and complex projects (valued at over \$1 billion, for example), recording final cost outcomes against cost expectations, and improving and harmonizing cost estimation practices across jurisdictions.

¹Terrill, M. and Danks, L. (2016) Cost overruns in transport infrastructure, Grattan Institute

NSW cost escalation through the 2000s

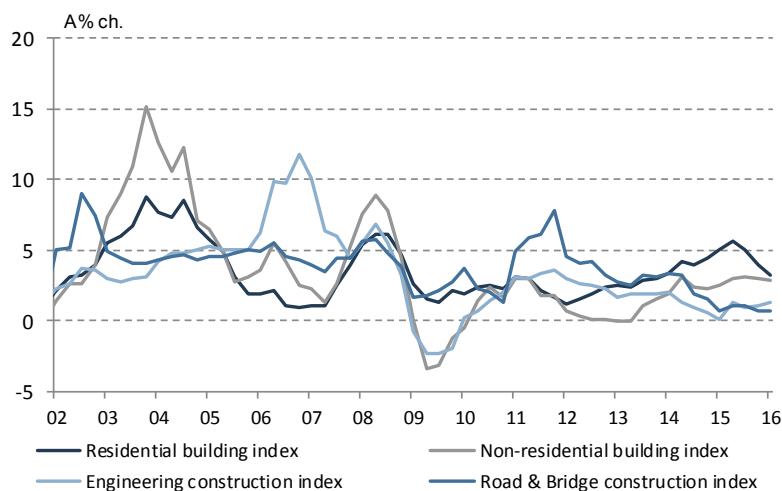
Construction cost escalation over time is captured at an aggregate level through construction price indices as shown in the adjacent top two charts. In Australia, the most commonly used indices are the implicit price deflators for building and construction work done (derived by dividing official Australian Bureau of Statistics current price measures of construction work done by their corresponding constant price series, hence isolating changes in the price of construction work).

As well as these, the ABS also publish explicit output price indices for construction on a quarterly basis via the Producer Price Index, such as the index for Road and Bridge Construction. These indices, as far as possible, include builders' selling prices and so incorporate movements in margins.

The New South Wales construction market has previously experienced cyclical episodes of rapid cost escalation, and these have generally – though not always – occurred in conjunction with cycles in domestic construction activity (both at the state and national level).

For New South Wales residential and non-residential building, cost escalation was particularly acute through the early 2000s given the boom in building activity and generally rising prices for key inputs including labour and materials, as shown in the adjacent charts. Building cost escalation slowed during the mid-2000s driven by sharp downturn in housing construction, before a surge just prior to and following the Global Financial Crisis in 2008/09. The pickup was likely the result of surging global fuel and steel prices (the latter more intensively used for non-residential building) at the peak of the commodities super-cycle, which reversed in subsequent years with the onset of the GFC. Between 2011/12 and 2014/15, building cost escalation gradually accelerated again, with rising residential and non-residential building a key driver.

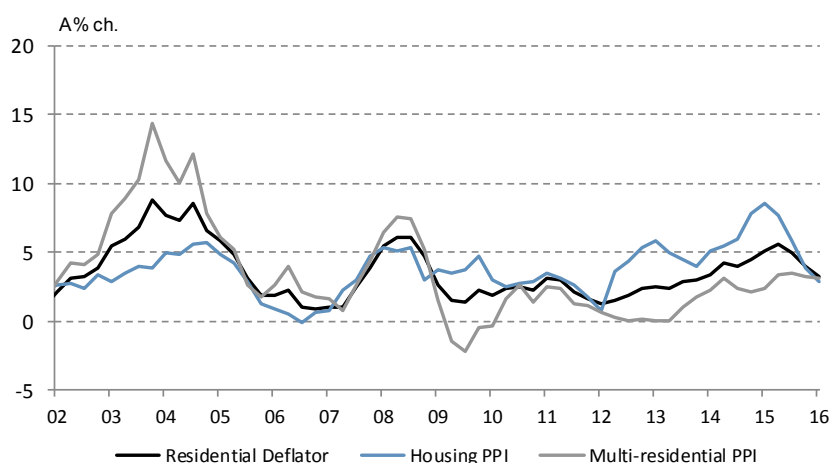
Construction Price Indices, Annual Percent Change, New South Wales



Year ended June

Source: ABS

Residential Building Price Indices, Annual Percent Change, New South Wales



Year ended June

Source: ABS

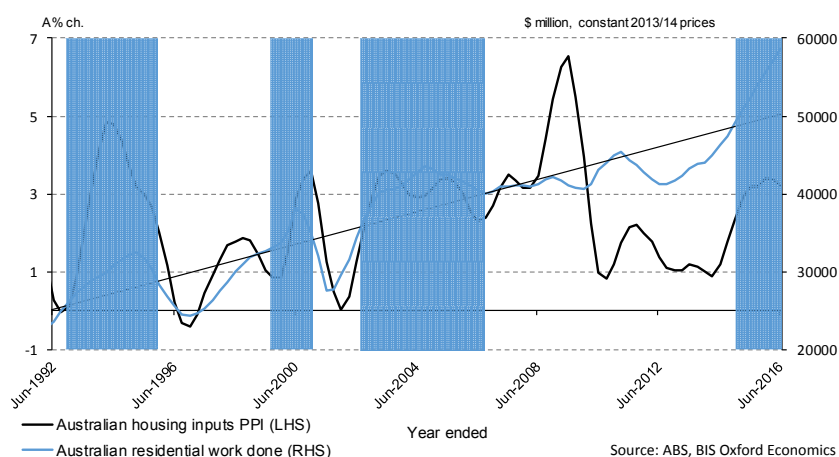
Construction Input Prices, Annual Percent Change, New South Wales



Year ended June

Source: ABS, Producer Price Index, AIP, World Trade Atlas

Residential Building Price Index versus Work Done, New South Wales



Despite booming residential building work done activity over 2015/16, house building cost growth (as captured by the ABS Housing PPI) has, perhaps surprisingly, remained contained. There are a number of factors at play that could provide a possible explanation for this, including:

- **Intense competition** – from recent industry interviews, participants stressed the growing level of competition in the residential building sector. This is consistent with the tight margins the construction industry is facing.
- **Shift in the type of housing built** – the current boom has seen the mix of residential activity change from detached houses to apartments. With apartments playing a more crucial role, the mix of materials too has subsequently changed, with a likely greater intensity of steel use (which has been subject to falling prices since the GFC). Apartment construction is potentially also more amenable to productivity improvements through prefabrication and modularization, as well as economies of scale, compared to detached house construction.
- **Other building and construction segments in New South Wales have not boomed (yet)** – the materials used in apartment construction are similar to those utilised in the non-residential sector as well as parts of the engineering construction market. While higher than in recent years, non-residential building activity is more or less similar to levels experienced in 2009/10 and the early 1990s. Engineering construction, meanwhile is only just starting to recover from a three-year decline in construction activity.
- **The end of the mining investment boom** – with the mining boom waning, this has potentially freed up capability and capacity in the market to deliver.
- **Low inflation environment** – the Australian economy has been in a low demand / low inflationary environment for several years, including record low wage growth in the construction sector.

For engineering construction (including infrastructure and mining-related construction), cost escalation as captured by movements in the engineering construction implicit price deflator (IPD) shows a similar pattern to building prices, albeit with much stronger growth in the mid to late 2000s. These very strong rates of growth were well above that observed during much of the 1990s and were driven by several synchronized factors including (i) high and rising levels of construction activity, both nationally and in New South Wales, driven by both the private and public sectors, impacting on local materials prices and labour costs; (ii) sharp increases in prices for key globally-sourced commodities such as steel and oil products and global demand boomed; and (iii) increasing construction margins.

The onset of the GFC drove a sharp correction in Australian dollar prices for steel and oil products (such as bitumen and diesel fuel) and, even accounting for the depreciation in the Australian dollar, this was a key factor driving the sharp deceleration in growth in the engineering construction IPD through 2009/10. While engineering construction activity picked up again nationally and in New South Wales between 2009 and 2013, the combination of stagnating steel prices and higher competition for work amongst contractors (impacting on margins) has helped keep cost growth in check. Over the past two years, growth in the NSW engineering construction IPD has tracked around 1% per annum, driven by falling levels of construction activity (nationally and in New South Wales) as the mining investment boom has unwound alongside public infrastructure investment, another downward correction in oil prices, and a highly competitive contractor market.

The ABS also publish an output price index for Road and Bridge Construction in its Producer Price Index series. As road and bridge construction is typically the largest component of engineering construction (typically accounting for 20-30 per cent) it should be expected that movements in this price index should be similar to the engineering construction IPD, and this is indeed the case. The key difference is that road construction is more oil products intensive than the broader engineering construction market – with BIS Oxford Economics analysis indicating that up to 20 per cent of the cost of major road projects over \$100 million in value is driven by bitumen and diesel fuel – and also much less steel intensive. This input mix kept road and bridge cost escalation generally more stable during the period of volatile steel prices just before and after the GFC, although a near doubling in road construction activity in New South Wales between 2010 and 2013, along with rising oil prices, also contributed to a reacceleration in construction costs during this time. More recently, however, road and bridge cost escalation in New South Wales (as well as nation ally) has slowed to near zero growth given sharp declines in oil product prices and lower levels of road construction activity, and falling contractor margins amidst very strong competition for work.

Risks of higher construction cost escalation in NSW

While construction cost escalation in New South Wales has been contained in recent years, an examination of the key drivers of cost growth indicates that escalation has significant upside risks going forward, with implications for the cost and potential timing of the infrastructure investment program roll out in New South Wales.

Emerging domestic input price pressures

Rising total construction activity in New South Wales will likely place additional demand pressures on locally-sourced inputs to the construction process – particularly labour, plant and equipment hire, and locally sourced materials such as concrete and quarry products. While industry interviews indicate that New South Wales has benefitted from the downturn in national construction activity (mainly as a result of the contraction in mining investment) in sourcing local inputs, they have also pointed to tightening market conditions ahead:

- Generally, while pre-construction labour (such as engineering and design skills) has been relatively mobile interstate and internationally (and can be performed remotely), construction labour is typically less mobile and needs to be performed on site. Consequently, as more major projects move into the construction phase in New South Wales, the demand for construction labour rises, and so too may construction industry wages as contractors and subcontractors compete for scarcer local skills. The looming downturn in residential building may provide some relief but, in general, many of the skills utilised during the housing boom (carpenters, joiners, tilers, bricklayers etc) are not as transferable to the engineering construction / infrastructure market. Meanwhile, rising infrastructure investment globally is also providing new competition for internationally-mobile skills such as engineering, design and project controls. Capability may be at risk through demographic effects as the current skilled workforce ages and retires.

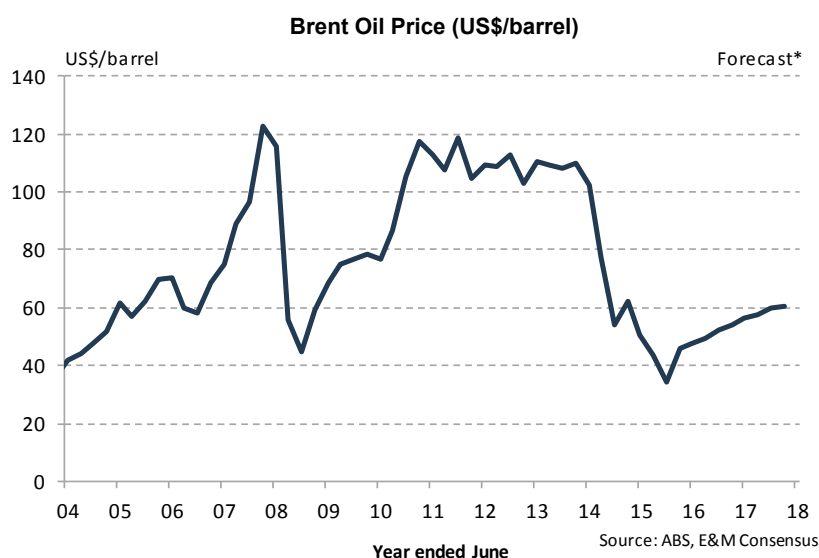
'The combination of stagnating steel prices and higher competition has helped keep cost growth in check'

- Plant and equipment hire costs have generally weakened with the lower national profile for construction work. Hire companies in Australia have responded by selling excess stock overseas and rebalancing fleets from regions of weak demand (such as Queensland and Western Australia) to stronger demand (New South Wales and Victoria). Industry interviews suggest that this process is moderating, with stock levels in most Australian jurisdictions moving closer to balance. Consequently, growth in domestic construction activity may provide upward pricing pressure in this market.
- Concrete and quarry product prices tend to move in a highly pro-cyclical manner to total building and construction activity, and recent price movements published by suppliers show stronger price increases for Sydney and other New South Wales regions than for other jurisdictions.² Prices are likely to rise significantly in the Sydney market as rising demand combines with recent closures in supply (particularly the exhaustion of the Penrith Lakes Scheme and Kurnell sand quarry), requiring more materials to be sourced outside of the Sydney region, increasing transport costs. Increasing road congestion in the Sydney region during the rollout of the construction program, and the lack of alternative transport strategies, is also likely to increase transport times, requiring additional labour and trucks to meet demand.

Emerging oil product price pressures

In recent years, the Australian construction industry has benefitted from a sharply lower global oil price, feeding through into lower prices for bitumen (a key input for road construction) as well as diesel fuel (a key input for all building and construction projects). Between March 2012 and March 2016, quarterly average Brent oil prices fell from a peak of US\$118 per barrel to US\$34 per barrel, a decline of 71 per cent. Even accounting for the depreciation in the Australian dollar, this still equated to a fall of over 50 per cent in Australian dollar Brent oil prices.

However, since March 2016, Brent oil prices have started to rise again, drifting towards US\$50 per barrel, an increase of 45 per cent, and Consensus forecasts expect further price increases for oil in coming years – with a 20 per cent increase expected in 2016/17 alone.³ Recently developed shale oil reserves in the United States and elsewhere will likely provide a cap on the overall increase in global oil prices, and so it is unlikely that oil prices will reach previous peaks. Yet even so, Australian dollar oil prices (including exchange rate effects) are likely to increase by a factor of 80-90 per cent overall over the next few years from the March quarter 2012 trough, with significant implications for bitumen and diesel fuel prices.

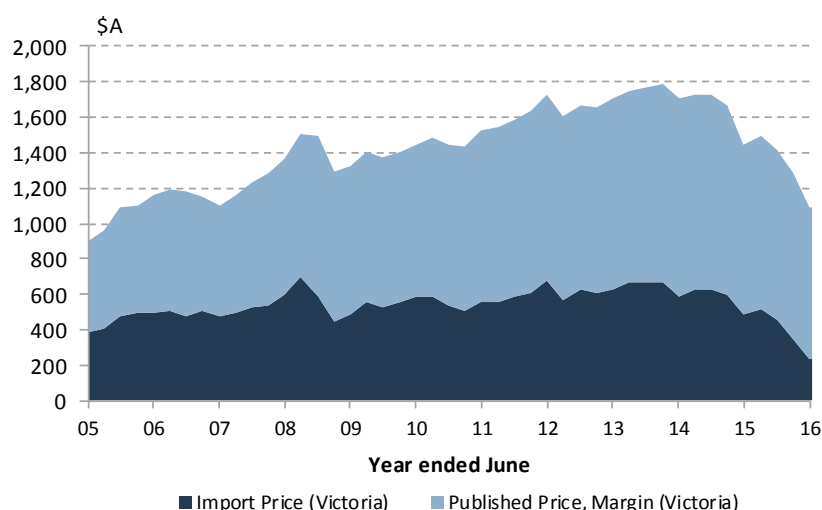


²<http://www.hanson.com.au/Portals/1/Documents/News%20-%20Media/2016%20Hanson%20Price%20Increase%20Announcement.pdf>
³Consensus Economics (2016) Energy and Metals Consensus Forecasts, November 2016, p4.

*Forecast provided by Energy & Metals Consensus Forecasts, November 2016 edition

Regarding bitumen pricing, BIS Oxford Economics notes that there is a significant (and growing) difference between the imported price of bitumen as measured by ABS Customs data (which moves closely with international oil prices) and bitumen supply prices published by state road authorities. While further analysis is warranted, recent analysis of Victorian data suggests that only a relatively small fraction of the fall in imported bitumen prices is being passed on by local suppliers, entailing a correspondingly large increase in margins. If correct, this suggests that cost escalation for road construction projects could have been even lower in recent years if the full impact of falling oil prices on imported bitumen costs were passed on through local supply chains. Conversely, there may be risks to the cost escalation of road projects in New South Wales if estimated margins on bitumen supply are maintained at high levels or increased further as international bitumen prices rise in line with the price of oil.

Bitumen price: Import price vs published price (Victoria)



Source: ABS, Global Trade Atlas

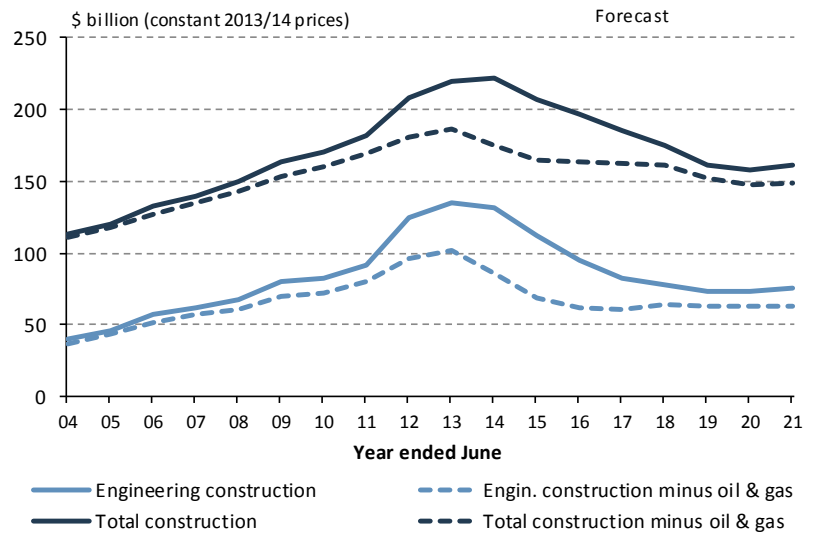
'Falling contractor margins has also been a key element constraining growth in construction costs'

Contractor margins

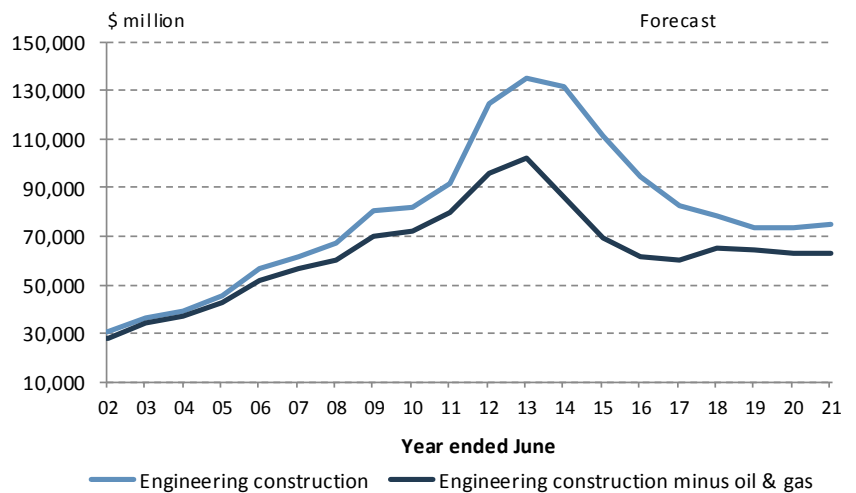
Along with lower oil prices, falling contractor margins has also been a key element constraining growth in construction costs in recent years. Lower margins have been likely driven by a mixture of factors, most notably falling levels of national construction work, increasing competition for the work available and, finally, changes in the mix of construction work. However, all three of these drivers are at risk of reversal in coming years, with implications for margins going forward:

- Firstly, total construction activity in Australia has fallen in recent years, but it is important to note that much of the decline now (and predicted over the next 1-2 years) is due to the completion of a \$200 billion construction phase of LNG production facilities in Queensland, Western Australia and the Northern Territory. A large share of this work was undertaken offshore – in particular the fabrication and modularization of very large LNG components which were imported to Australia and installed onsite using relatively little resources from the local construction industry. While the ABS construction statistics include the full value of offshored fabrication of LNG modules, in reality, the local construction demands for the LNG program likely come through earlier than recognised in the ABS oil and gas construction statistics (mainly site preparation and related infrastructure) and also retreated earlier. This experience is borne out in recent industry interviews.

Construction activity, less oil and gas - Australia



Engineering construction activity, less oil and gas - Australia

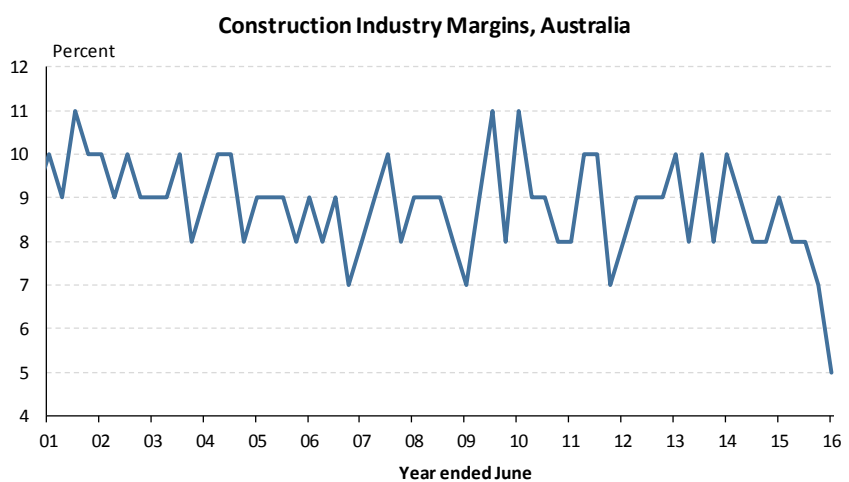


Source: ABS, BIS Oxford Economics

'For the first time since 2012/13, the engineering construction pie will be growing'

- Excluding oil and gas construction, total building and construction activity in Australia is unlikely to fall heavily from here, and is likely to oscillate in the \$150-160 billion per annum range with falling residential building offset by rising public infrastructure investment. In the infrastructure-heavy engineering construction market, BIS Oxford Economics is forecasting activity excluding oil and gas construction to trough nationally in 2016/17 before rising in subsequent years. For the first time since 2012/13, the engineering construction pie will be growing, with particularly strong growth expected in New South Wales and Victoria. In turn, this may provide an opportunity for contractors to restore margins from current (potentially unsustainable) levels.

- The ability for contractors to raise margins also depends on the degree of competition (supply of contractors) for available work. Here, procurers have benefited from very strong competition in recent years as (i) new overseas players have entered the Australian market, (ii) the local contractor market has become less concentrated with the breakup and sale of parts of the former Leighton group and (iii) the previous construction boom allowed existing contractors to increase size and capability as well as encouraging new local players to develop. However, recent industry soundings indicate these competitive benefits are likely to abate in coming years as (i) relatively few new entrants appear in the local market, with overseas-based firms looking to capitalize on new infrastructure growth hotspots in the United Kingdom and Ireland, the United States and Asia; (ii) a “re-concentration” in the local industry bidding for work given recent merger and acquisition activity⁴ as well as the potential financial failure of some players given very low industry margins and increasing risk associated with very large infrastructure projects.
- Finally, changes in the construction mix from building towards more complex and large engineering construction projects are likely to see some upward correction in margins going forward. In general, margins on building projects tend to be very low given the depth of competition in the market and low barriers to entry. Margins on engineering projects are slightly higher, particularly for more complex projects which have higher barriers to entry and greater risk.



The prospect of rising contractor margins, while a risk to cost escalation in the near term, need not be considered a threat to construction industry capacity and capability in the long term. To the contrary, evidence from recent industry soundings indicate that the current low margins and profitability are discouraging industry participation and investment to boost capacity and capability. As one contractor noted in a recent interview:

“One of the really important decisions about creating capacity is the willingness or otherwise to gear up and build your business. From our point of view, we are not willing to do that, which is probably something that governments don’t want to hear. And the reason is simply the risks and poor return which don’t justify it. Our industry is littered with carcasses. It is a shocking industry in terms of financial failure. Why would you invest in our industry? You can’t sell a construction business – no one would ever buy it. You can’t list them because no one would ever invest in them. If you want to grow capacity, you need to be careful and cautious about it. You need to have a balance sheet to grow capacity if you are sensible.”

⁴Such as Ferrovial’s acquisition of Broadspectrum in June 2016, and CIMIC’s takeover of UGL in December 2016.

Worse, the combination of lower margins and higher risk being borne by contractors via the contracting method increases the likelihood of (potentially high profile) financial failures in the industry as the New South Wales infrastructure investment program is rolled out, which would have even larger long term capability and capacity implications – as well as higher long term costs – through litigation and re-contracting. Consequently, a return to higher margins in the industry may be considered desirable from an industry sustainability (and investment in own capacity and capability) viewpoint.

Implications and Recommendations

Overall, while escalation in construction costs has been more or less contained in New South Wales in recent years, there are reasonable grounds to suggest from the analysis undertaken in this report that escalation will accelerate in coming years. To a significant degree, increasing cost escalation is likely to emerge from international factors which are beyond the immediate control of local industry and government – such as rising commodity prices and increasing infrastructure activity overseas. However, cost escalation driven by rising local input prices indicates that pressure is being brought to bear on (potentially constrained) local supplies, which could represent a threat to construction industry capacity or capability.

The timeframe when costs start to escalate in New South Wales may not be too far away. Industry soundings have indicated that contractors are already starting to feel the pressure from rising input prices, and while these have been absorbed to date through lower industry margins, these costs will eventually be passed on in the form of higher construction prices. Says one contractor:

“We have been bringing people from Brisbane, bringing people from Perth. It’s only been recently the cost pressures have started. I was in Melbourne five months ago and I mentioned that I haven’t seen any price pressures coming through the tender box yet. But it’s now starting to happen. There’s always this lag between absorbing the increases before they can get them back from the market”

“In New South Wales, it’s not just infrastructure booming, but building is also very strong. Our biggest issue is not the ‘working it out and doing it’, it’s the cost, and us predicting escalation and what things are going to cost in the future... Yes, we are feeling [cost increases]. But it hasn’t hit us fully just yet. Because what we will be whining about is in two years when we ...haven’t got the escalation right. I was in Queensland for that boom and there were things that caught us out. We tried to predict the future as best we could but we still got caught out.”

Overall, recent soundings suggest that industry has been absorbing emerging price pressures through competitive tendering for projects that has resulted in a sharp weakening in industry margins. This has offered cost benefits for government procurement in recent years, but may yet have longer term consequences if industry forecasts for cost escalation turn out to be too conservative. While it is ultimately industry’s responsibility to get their pricing and escalation forecasts right, history suggests that mistakes have been made in the past – and could be made again. Consequently, governments and planning agencies should have appropriate strategies in place to minimise the risks and potential negative impacts. These include:

➤ **Developing quantitative analyses and forecasts for demand and supply for key “at risk” local construction inputs to identify potential gaps and to develop appropriate planning strategies.**

This report has, for instance, highlighted the risks surrounding quarry products and on-site labour skills. Further analysis should be undertaken to map demand and supply for quarry products in regional construction hotspots that could be used to identify and fast-track the development of new supply sources. Further analysis should also be undertaken to quantify the supply and demand for key construction and professional skills, particularly those used on-site during the construction process. This should make use of latest Census data when it is released during 2017 which will likely indicate the extent to which skills have moved into New South Wales since the end of the resources investment boom.

➤ **Provide a clear and coherent “whole of government” pipeline so that industry can plan effectively to meet demand.** Recent industry soundings confirmed that the visibility of the pipeline was a core factor driving capacity and capability outcomes, with industry relatively confident that shortfalls could be overcome given a long enough lead time. Flexibility in the pipeline could also help mitigate the risk of excessive construction cost escalation.

➤ **Develop a formal construction transport and logistics plan** to reduce the risk of bottlenecks, delays and rising costs for the delivery of construction materials and the disposal of waste. Such a plan could make use of alternative transport corridors – such as waterways and coastal shipping as well as rail – whilst also improving the efficiency of road networks.

➤ **Enhance the pool of workforce skills available to the New South Wales construction industry** through expanding the coverage of the Infrastructure Skills Legacy Program and removing constraints to workforce development initiatives – as well as skills mobility and transferability – at the procurement phase.

➤ **Monitor supply chains for internationally-sourced inputs** to ensure that global prices for foreign-sourced inputs are being passed on for construction projects in New South Wales.

➤ **Develop policies that promote industry participation and investment in capacity** through the construction cycle. This may include fostering the spectrum of construction contractors, small and large, through the provision of a range of project types and sizes (e.g. de-bundling packages of work where possible), using licensing (as in Queensland) to ensure that contractors have financial capability to undertake work and pay subcontractors, “.... contractors have financial capability to undertake work and pay subcontractors, and utilising procurement strategies which maximise long term value rather than focusing on lowest price.”

➤ **Document and record prices paid for inputs and construction services on major infrastructure projects for benchmarking purposes** which can improve future cost estimation efforts and reduce the risk of underestimating project costs.

‘There may be longer term consequences if industry forecasts for cost escalation turn out to be too conservative’

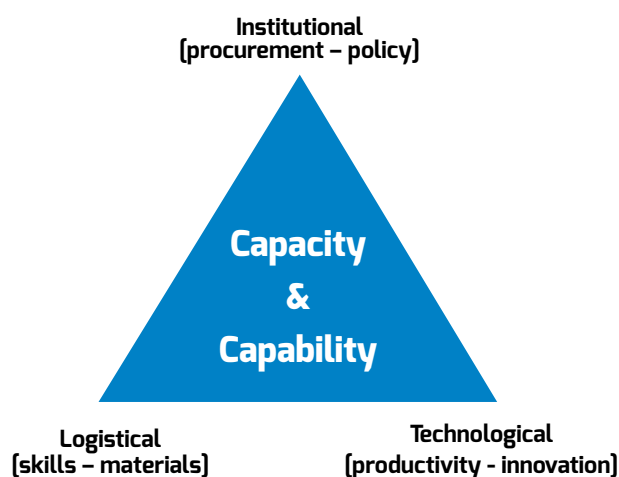


6

MAXIMISING THE LEGACY FOR NSW

Maximising the legacy for NSW

The principal aim of the research program supporting this report has been to identify capability and capacity issues in the NSW construction sector that could potentially impact the timely and value for money delivery of the NSW Government's infrastructure program in the short and medium term.



In this report, capacity refers to the availability and quantum of inputs to the construction industry, while capability refers to the quality of these inputs and their ability to be combined to produce best value outcomes.

Further, construction industry capacity and capability can be presented as the combination of logistical, technological and institutional factors:

- ❶ **Logistical** – reliable access to essential inputs (skills and materials) by producers
- ❷ **Technological** – optimal combination (of inputs to produce outputs) by producers
- ❸ **Institutional** – full participation (in tenders and legacy programs) by producers

In approaching the issue of capacity and capability, BIS Oxford Economics has undertaken an extensive survey and soundings (interviews) of the broader construction industry in New South Wales – including contractors, suppliers, developers, procuring NSW Government agencies and industry associations and stakeholders – capturing a significant slice of the market. Insights have also been drawn from contractors based in Queensland and Western Australia who, apart from also tendering for work in New South Wales, have provided insights into the mistakes industry made during the resources investment and construction boom in their home states, and their learnings from this.

It should be noted that in the surveys and soundings, industry had both positive and negative feedback regarding the state of the market in New South Wales, the outlook and opportunities for activity, and the way the infrastructure program in New South Wales is being managed, procured and delivered. Given the nature of the task at hand, however, much of the material in this report tends to focus on areas for improvement, so that capability and capacity risks are appropriately highlighted. But this should not distract from the fact that many industry participants also expressed positives about the opportunity for work in New South Wales and the ways in which NSW Government agencies had, in many cases, improved their engagement with industry.

Through this approach, key “pinch points” in the construction industry supply chain in New South Wales have been identified which could come under pressure as the infrastructure program continues to be rolled out in New South Wales. Where this is dealing with potential gaps in the supply of certain construction materials or key skills, further analysis can and should be undertaken to more precisely quantify the extent of the gap, and the most likely timing of constraints to capacity and capability relative to the demands placed by the construction program.

In this respect the release of new, detailed Census data during 2017 should provide an ideal base to undertake quantification of capability gaps for the most ‘at risk’ skills categories. Meanwhile, further quantification analysis should also be undertaken on the materials side where risks are greatest.

This task is made more difficult by the falling quality and coverage of manufacturing production data (which is used as inputs by the domestic construction industry) produced by the Australian Bureau of Statistics in recent years. Consequently, one of the themes emerging from this research, mirroring similar concerns expressed by the Productivity Commission's 2014 inquiry into *Public Infrastructure*, is the need for better data (across not just manufacturing, but also construction, costs and productivity) to assist strategy and decision-making.¹

Meeting the challenge

This report shows that the construction industry in New South Wales faces significant capacity and capability challenges over the next five years – as well as the long term – to meeting projected demand. However, a major theme emerging from the research is industry's high confidence in ‘getting the job done’, particularly if they are given long lead times to address these challenges in the form of a clear, industry-wide long term project pipeline.

In most interviews with construction contractors and suppliers, the main challenge was seen as not an inability to deliver, but rather whether delivery could be achieved in a timely and ‘value for money’ way. Here, industry noted the way the pressures of the recent resources construction boom introduced ‘transformational’ thinking and solutions to meet extremely tight development and construction timeframes, including the increased use of Fly In Fly Out (FIFO) workforces and construction camps, regional development initiatives to service key construction hotspots, the offshoring of significant volumes of engineering, design and fabrication work, and the intensive use of prefabrication and modularisation particularly in the LNG construction market. Having been trialled during the resources boom, these approaches are expected to remain a part of the construction industry's ‘response kit’ to future investment and construction cycles.



¹Productivity Commission (2014), pp47-49.

However, while these solutions enabled a lot of construction activity to be delivered in a short space of time (and, likely, contributed to stronger productivity growth during the early 2010s) they did not prevent significant increases in construction costs. In part, this was because the resources boom coincided with a tremendous investment cycle globally, affecting prices for key imported inputs such as steel and oil products. However, much was also self-inflicted with strong demand pressure also brought to bear on scarce local supplies of skills and materials. According to the industry soundings, the Queensland and Western Australia governments made a fundamental mistake in pursuing an aggressive increase in public infrastructure investment (following many years of weakness) to coincide with the demands of the resources investment boom, which affected the timeliness and value for money delivery of state infrastructure projects. The lessons from the resources boom for New South Wales and other state jurisdictions are clear:

- Develop a clear and credible long term pipeline of projects so that industry can transform and invest in capacity and skills
- Provide room for the construction industry to use their knowledge and skills to come up with innovative solutions
- Be aware of other demands on the industry, whether in the private sector, regionally, interstate or across different levels of government – and be prepared to retain flexibility in the pipeline to avoid excessive pressures on key materials and labour inputs.

Overall, while industry expressed confidence in getting New South Wales to its construction destination, the route will still likely present risks and challenges along the way. As one construction industry supplier mentioned during recent interviews: “It’s like the old joke, if you want to get over there, well, this is a hell of a place to start”. Yet these challenges are by no means unsurmountable. As in previous construction cycles in other states, New South Wales is building a strong profile in construction work over the next few years and, in the case of infrastructure activity, is rising from a low base. Growing the capability of industry, sustainably, within this envelope is a challenge, but a manageable one. While projected growth in infrastructure construction is significant, the overall size of the current wave of work is significantly less than that faced by Queensland or Western Australia during the resources boom. The key challenges involve:

- Managing the regional nature of the work, with the heavy concentration of activity in Sydney likely to create multiple logistical capacity and capability challenges (whilst also threatening to drain skills and materials from regional areas)
- In the longer term (over the next 5-15 years), continuing to build construction industry capacity – through innovation and institutional policies – to handle a higher ‘baseload’ of construction activity in the state in the face of demographic shifts (including ageing of the population and the location of work) and changing long run materials and resources supply

Capacity and capability risks

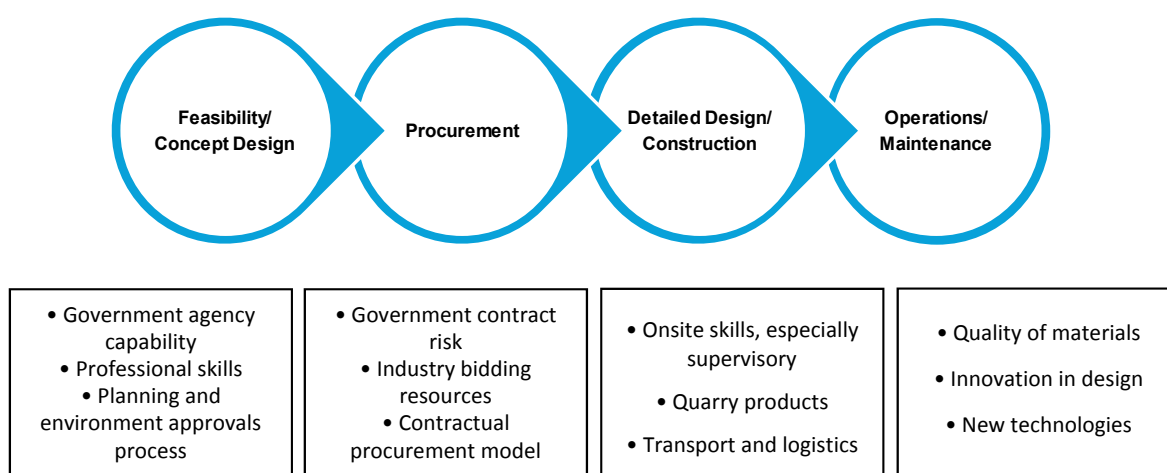
If these challenges are managed well, not only will infrastructure projects be delivered on time, but also on budget and to a high quality, providing value for money for New South Wales. Getting it wrong will likely result in project delays, potential project and business failures (including costly litigation, rectification works as well as social costs) and, overall, higher industry cost escalation.

Construction cost escalation – both nationally as well as in New South Wales – is presently weak, as evidenced by various aggregate construction cost indices such as implicit price deflators for building and construction, as well as construction output indices published by the Australian Bureau of Statistics in its producer prices series. On the surface, this suggests that, as yet, the construction industry in New South Wales is not yet experiencing critical capacity or capability constraints – and this perspective is also reflected in responses from recent industry interviews. Our research coupled with industry interviews suggests several broad reasons why cost escalation has been weak:

- **New South Wales has, indeed, been absorbing latent capability and capacity** from rest of Australia (particularly the former resources boom states of Queensland and Western Australia) as well as internationally.
- **Very strong competition for work**, particularly with international contractors also bidding on projects and willing to take on risk, resulting in very low margins for construction work.
- **The nature of procurement in New South Wales**, with some notable exceptions, is highly price-focused and rewards low price tenders. However, while this is delivering value for money in terms of project capital expenditure costs, many industry participants as well as other stakeholders questioned whether this will deliver value for money in the long run.
- **More broadly, the general deflationary economic environment**, internationally as well as in Australia. Falling commodity prices from 2011/12 peaks not only directly impacted on construction costs (particularly falling prices for key construction inputs such as steel, oil products and copper) but also freed up domestic construction industry capacity and capability as work done for the resources sector declined. This has resulted in historically weak growth in construction wages, for example, as well as falling (or weaker growth in) prices for other construction inputs such as plant and equipment hire, design and engineering, and quarry products.

However, our analysis of the drivers of construction cost escalation, coupled with industry soundings, reveals potential risks to capacity and capability, hidden underneath the generally benign state of cost escalation currently. In our view, these risks emerge across all phases of construction, as shown below.

Project Lifecycle and specific risks



These risks to capability and capacity have been outlined within this report. The **pre-construction phases**, particularly, place significant pressure on the professional capability of both the procuring agencies as well as the private sector. In order to boost their capability, agencies have been hiring aggressively from other jurisdictions as well as the private sector, presenting further industry challenges. While professional engineering skills have been stretched, evidence from industry soundings suggests that capability has been leveraged from other states as well as internationally. Surveying skills, however, remain critically stretched given the need for 'on the ground' capability during these phases. Meanwhile, the **form of procurement model and risk allocation** used (for example, 'hard' Design and Construct contracting versus Early Contractor Involvement), also has implications for the quantum of resources required in the pre-construction phases, but may also influence the degree of innovation and call on resources during the construction and maintenance/operations phases.

At the **construction** phase, it is the logistical capacity and capability risks which become heightened. Here, the specific risks for New South Wales revolve around access to onsite skills (particularly foremen and site managers as well as crucial infrastructure trades and professions ranging from onsite engineers to form workers, tunnellers and mechanical and electrical trades) as well as the availability and cost of materials, with the greatest challenge likely to be in sourcing natural sand for use in cement. Transport and logistical risks are also highly significant, with the heavy concentration of work targeted in the Sydney metropolitan region necessitating even more intensive use of the urban road network to haul construction materials from primary sources, distribution and manufacturing locations to construction sites, as well as managing the removal of spoil.

Finally, the presence of capacity and capability risks at the **post-construction** phase (operation and maintenance) depends very much on how well risks were managed at earlier stages. Here, once again, how procurement is managed may be crucial. Contracting models which provide scope for industry innovation in design, the use of high quality materials and new processes or products are likely to impact on the ultimate operations and maintenance requirements of the built asset. Ideally, the procurement model chosen incentivises both government agencies and contractors to choose approaches which minimise 'life cycle' costs of the asset (including operations and maintenance) rather than focusing just on the cost of construction itself. In other words, 'value for money' should be a long run, not a short run, concept.

Together, the existence of these risks means that there is little room for complacency. If realised, these risks to capability and capacity will likely see a re-acceleration in construction cost escalation in New South Wales. Where shortages do eventuate, it is likely to see delays in the project pipeline. Inevitably, as demonstrated during the resources boom, the overriding constraint will not be finance or willingness to invest, but rather what industry can deliver and at what cost. In particular:

- **New South Wales cannot simply rely on competition and excess industry capacity nationally to keep industry margins at current low levels.** The industry soundings, coupled with our own construction activity research and forecasts, suggest that construction activity is rebalancing nationally as the decline in resource-related construction begins to steady (following several years of decline). The infrastructure-heavy engineering construction segment of the market (excluding the import-

intensive oil and gas segment) is projected to trough in 2016/17 and start to rise again in subsequent years, not just in New South Wales, but in other states and territories. While residential building activity is projected to fall, this will not necessarily free up capacity for economic infrastructure projects (e.g. transport and utilities) given the weak transferability of skills (although it may free resources for non-complex non-residential building projects). Meanwhile, international interest in infrastructure investment is also rising, which may attract international contractors and professionals back overseas. And within the domestic market, the period of low profitability is now being followed by industry consolidation and re-concentration. In other words, a stronger phase of competition within the industry may be coming to an end.

- **New risks to skills capability are expected to emerge.** While some gaps in skills have been chronic for some time (and managed to date through importing skills from other sectors or regions as well as, in the case of surveyors, technological advances), there is a class of onsite construction skills which is expected to experience increasing capability pressure in coming years. Shortages in quality foremen and site managers already exist and are currently being managed sub-optimally by builders and construction contractors (e.g. accepting lower quality skills outcomes, incurring extra costs in supporting site supervision). Over time, further gaps are expected to emerge in key construction trades as well as quality, experienced engineering professions (particularly as the skills base ages). Education and training policies (such as the Infrastructure Skills Legacy Program) are an important, positive step in boosting capability, albeit focusing heavily on apprentices instead of broader skills needs. Furthermore, it is being counteracted by an agency culture which precludes the hiring of professionals from the resources industry in working on transport projects, effectively ignores workforce development as a criterion in awarding projects, and does not provide the pathways from education to professional development via cadetships as it did in past decades.
- **Risks to construction material supplies are also apparent,** although here more avenues exist to take advantage of global supply chains. Even so, the currently weak growth profile for materials costs (as revealed in producer price index and customs trade data) is unlikely to be sustainable over the next few years, let alone the longer term. Rising international prices for oil since the start of 2016 are already impacting on prices for diesel fuel and bitumen, which are used particularly heavily in road construction projects. Cost growth is also accelerating for quarry products in the Sydney region, given the impending closure of key sources of supply and the need to transport replacement capacity from longer distances. In the case of natural sand – an important ingredient for cement – local supplies are expected to be exhausted within the next five years necessitating more costly imports (as well as bulk port capacity in Sydney where it can be landed). Meanwhile, although steel prices are likely to remain low because of global oversupply, this itself threatens the existence of the local, high quality, steel industry and its important input by-products such as slag.

- **Transport and logistics risks are of paramount concern** amongst materials suppliers and construction contractors. The concentration of overlapping construction projects in the Sydney region, particularly, is expected to place substantial stress on the city's (already highly congested) urban road network as materials are brought to site and as spoil and waste is removed. Apart from the potential direct impacts in terms of delays to construction projects, this is also likely to see increasing material input prices given that a large part of the cost of materials is driven by the cost of transport. Road maintenance costs are also likely to rise in catering for the increased trafficking load. Here, there is a need for expanding materials transport network capacity to cater for increasing volumes, including the increasing use of alternative (rail and water) transport solutions.

Building on the opportunities

To some degree, these risks are driven by external factors, ranging from demographic change, to the state of global demand for materials and resources. However, on the positive side, our industry soundings indicate that there is much that is within the control of government and planning agencies to minimise capacity and capability risks. The pressures which are now being brought to bear on the broader construction industry in New South Wales provide an opportunity to innovate, to come up with better ways of doing things, and in so doing, to provide a long term positive legacy for New South Wales that will assist in managing future investment cycles.

Of these, the most critical innovations may be:

- **The provision of a clear and coherent 'whole of government' long term project pipeline** to give industry the best possible chance of responding, rather than separate pipelines by separate agencies. The pipeline could also include known major projects by the private sector as well as, potentially, major competing projects in other jurisdictions, so that industry is fully aware of the likely call on resources at all stages of construction. Maintaining a sustainable, strong pipeline for work (and avoiding booms and busts where possible) will also assist in leaving a legacy for New South Wales in that it encourages the retention of skills, training of the next generation of staff, and increasing productivity.
- **Ideally, the long term project pipeline will retain flexibility to help smooth the volatility of construction cycles** with their negative impacts on capacity, capability and costs during sharp upturns, and loss of skills, unemployment and excess capacity during corresponding downturns. However, another key issue surrounding the project pipeline identified by contractors and suppliers in industry soundings was sovereign risk – that changes in government could see legally contracted projects simply cancelled by incoming administrations. Avoiding situations such as the failed East West Link in Victoria, and the risk to the Canberra Light rail project during the recent ACT election may require the development of a 'Critical Projects' list that, having met appropriate cost-benefit tests and business case hurdles, is agreed on by all major political parties.

- A long term project pipeline, incorporating large public and privately funded projects, could also assist in avoiding capability constraints in **regional areas of New South Wales**. Here, better knowledge of existing projects underway and capabilities present at the regional level could be used to improve the sequencing of regional projects. This would help optimise the use of existing, on the ground, resources and capabilities rather than requiring capability to be contested and imported from other regions or interstate.
- **Boost workforce development initiatives to meet demand for key onsite skills.** This can be achieved by expanding the coverage of the Infrastructure Skills Legacy Program to further projects and skill sets (including onsite professions), but also by removing existing constraints to workforce development initiatives at the procurement phase. Over time, it is expected that these measures will boost education and training, competencies and the number of skilled workers across a range of construction trades. In turn, this could help alleviate pressures on critical occupations such as site managers and foremen, who are primarily sourced from the more experienced trades ranks. Incentives and further training may also be considered to encourage experienced and capable trades workers to shift into supervisory roles.
- **The establishment and regular maintenance of an industry wide construction materials plan,** based on major projects from both the public and private sectors, so that the demand and supply balance for scarce quarry products can be quantified, mapped, emerging gaps identified quickly, and strategies put into place to accelerate the development of new supply sources and related logistics where appropriate. This is particularly important for quarry products given the very long lead times required to develop and approve new quarries (affecting the supply of hard rock, aggregates and sand), and limited existing sources of supply. With the addition of each project to the long term project pipeline, account should be taken of that project's call on natural material resources, how these resources are sourced and transported, and how this call could be reduced through other initiatives, such as recycling or utilising new or substitute materials (e.g. structural steel-focused engineering solutions rather than concrete) if critical input constraints emerge.
- Similarly, attention needs to be focused on the **development and maintenance of a construction transport and logistics plan** to avoid bottlenecks, delays and rising costs for construction materials as a result of congested road transport networks, particularly in the Sydney metropolitan region where construction activity will be most focused. This may include demand management tools, such as putting a price on road use in the CBD and nearby construction zones, but also taking more advantage of non-road transport such as rail and water. Here, international evidence suggests that increasing the use of barges and rail can reduce the number of truck journeys on city roads substantially. Sydney, itself, is amenable to a significant increase in barge use for moving construction materials and spoil, given the ability to load and unload materials at existing city-based ports and the

development of distribution facilities upstream. However, it will be crucial that these existing transport assets are protected and zoned for construction industry use. Residential developments are already encroaching on industrial use areas including critical loading and unloading facilities in the Bays precinct in Sydney, as well as upstream in Camellia. If these facilities were preserved, costs and delays through congestion of the urban road network could be avoided, as well as serving as the only economic landing point for future natural sand imports once existing capacity in Sydney is depleted.

- **There is scope to review the procurement process for major projects in New South Wales** to ensure they are not only achieving value for money in a long term sense, but is not, by itself, contributing to capacity and capability constraints in the short or long term. Industry soundings supporting this research suggest that, while there are many good examples of procurement across most NSW government agencies, there are also issues which may need to be addressed:
 - ▷ the cost to industry of bidding
 - ▷ time taken and personnel required
 - ▷ unnecessary and repetition of information requested by government
 - ▷ risk allocation
 - ▷ government dictating the program/project timeframes slash without complete knowledge of expert engineering
 - ▷ responsibility for planning, utility and environmental approvals being shifted onto the private sector
 - ▷ discouragement of innovation
 - ▷ limits to the capability of industry and pressure on government procurement teams

Currently, according to some industry observers, there exists an unwillingness by some major players to 'gear up and build your business'. The procurement and government delivery culture in New South Wales is said to be contributing. Industry questions whether lowest price always equals best value? And industry argues that mispricing of risk occurs under the State's current procurement model. There is a lack of confidence that if industry invests in capacity, the current contracting culture in NSW will not adequately capture the risk and returns that industry needs to see on its investment. According to industry sources, this is resulting in a 'discouraged contractor effect', which is already placing a limitation on industry capacity and capability in NSW – by discouraging some from tendering and by dampening enthusiasm for investment in new plant and skills. Industry has expressed the view that across the nation industry participants are not bidding on approximately 20-30% of open tenders.² This can be because ultimately the assessment is being made that the risk and return of projects – as currently framed – does not warrant tendering.

² Dan Reeve (General Manager Transport, SMEC Australia), Procurement and cost of bidding: where can we do better?, Presentation to Roads Australia Annual Forum – Brisbane, June 2016

Fostering broader industry participation

Currently in New South Wales there is a heavy reliance on D&C (design and construct) procurement, marked by a culture where government seeks to shift risk (even approvals risk from its own instrumentalities, as well as 'unknowable unknowns' risk) onto the contractor. This can mean only big players can participate because contractors need a big balance sheet to cope with unknowable contingencies.

Fostering broader industry participation, which will benefit both government and industry, does not happen automatically. Ensuring diverse contractor involvement is especially challenging for large projects: only a handful of players are capable of taking big projects on by themselves.

Seeing more Tier 2 and especially Tier 3 players involved, to get them accredited, acclimatised, and ready to perform work, may require a more flexible delivery model. Tier 2 and Tier 3 contractors operate on skinny margins and tight overheads, but are facing rising overheads in the modern world as more and more stakeholders become involved, from safety crews to community relations to environmental considerations. This is increasing the 'soft' management requirements on small contractors. There is a 'small operator risk' around smaller contractors who may be less solvent or lack established processes.

To attract smaller operators, some NSW agencies are now using more 'Construct-only' contracts (not full D&C), in an effort to engage more Tier 2 and 3 players and increase industry participation. Getting more smaller players involved happens when agencies are proactively sponsoring discussion between contractors, exchanging methods of working, and building up a list of contractors familiar with government procedures.

Complexity of the approval process is growing over time, which works against smaller participants. For example, as many as 100 easements overlaying one title is not unusual, which adds complexity and takes time - possibly 6 to 12 months - and money to complete the validation process.

There is a potential value in **formalising entry of smaller contractors into the market in New South Wales:**

- › Transport for NSW's Asset Standards Authority (ASA)³ provides a reference point here: the ASA is responsible for assessing and authorising organisations to become Authorised Engineering Organisations (AEOs), to provide services within a defined scope linked to the stages of the asset life cycle including design, build, commissioning, maintaining, operation and decommissioning
- › the Queensland Building and Construction Board (QBCB) has formulated a policy that states the Minimum Financial Requirements for licensing under the Queensland Building and Construction Commission Act 1991.⁴

Industry tells us that liabilities are currently being taken on by small/medium sized companies that may prove too much for them, that these firms may be underpricing and not allowing sufficiently for risk, and they don't have the balance sheet (or legal resources) to handle potential liabilities. This highlights the need for proactive policy in regards to smaller players to safeguard the sector's stability.

There is a need to increase **literacy** across the construction industry spectrum in how to understand planning and environmental risk.

Constructive partnership: A model for the future

The prevailing stakeholder approach may be termed a 'transactional approach' by government and industry. Fully optimising the construction program arguably will require something more: an intentional culture of 'constructive partnership.'

Consider, for instance, knowledge retention. Intergenerational planning of essential skills requires onsite skill development and a learning legacy that will last well beyond the current infrastructure wave. Optimally, this will happen best when government and industry actively partner together, covering across all the multi-faceted and multi-cyclical aspects:

- › the need to train people for now, and then transfer them to the next program (whether it be the next building, mining, civil or transport program)
- › to include a 'workforce development component' in the project delivery model

OPTIONS TO CONSIDER

- › **Procurement** - Forms of procurement contracting that emphasise partnership, especially relationship style contracting models, may have an increasingly important role to play in New South Wales, going forward. In particular, Early Contractor Involvement (ECI) should be encouraged, especially where the client agency is still feeling its way. Risk sharing or de-risking needs consideration: for risks where a reasonable bidder couldn't have anticipated a given event, government could look at sharing risk, or contractors could receive compensation, or alternatively government can use an Early Contractor to de-risk the project.
- › **Competition** - More participation by Tier 2 and Tier 3 players should be encouraged: accreditation of smaller operators, along with more choice and flexibility of delivery models, could assist industry participation to become more diverse.
- › **Training** - Intergenerational transfer of essential construction skills, as an integral part of the delivery model, will help retain the learning benefits of the current program and ensure knowledge retention after major infrastructure programs.

- › develop mechanisms for 'skills exchange' (for example: industry partners with TAFE, workers learn onsite with formal accreditation)
- › getting people who have never been in the workforce into a job (for example, a program ensuring local people get employed on local projects)

Ideally, the cost would be shared between industry and government. **The skills legacy would become a routine component in the bid process, as a formal bid criterion.**

During the interview process for this Report, industry has signalled a willingness to partner more proactively with government, to ensure that future capacity and capability needs of the sector are met. This may require government to evolve some of its approaches, including its procurement and delivery culture.

Under the right circumstances, the procurement process can become a positive tool for growth and development of the NSW construction program. It can encourage players, both contractors and agencies, to:

- › think longer term, with a more sustainable mindset
- › maximise the social benefit to the community
- › yield the best value for the taxpayer
- › price risk appropriately
- › develop the next generation of essential skills
- › invest in new capacity for the medium term

By embedding appropriate goals in the procurement process and by selecting the right delivery model, government can enhance its partnership with the private sector and foster deeper industry participation.

In this way all three aspects of capacity and capability – logistical, technological, institutional – will be realised, in turn maximising the legacy for New South Wales.

³ <http://www.asa.transport.nsw.gov.au/ts>

⁴ The objectives of the Minimum Financial Requirements in Queensland's policy are to promote financially viable businesses and foster professional business practices in the Queensland building industry. To achieve these objectives and minimise the incidence of financial failure in the building industry, this policy requires all Applicants and Licensees to comply with the Minimum Financial Requirements. For further information: http://www.qbcc.qld.gov.au/sites/default/files/Minimum_Financial_Requirements_Policy.pdf





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