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The rise of megaprojects

Counting the costs

Marion Terrill, Owain Emslie, and Greg Moran

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Overview

Australian governments are fast-tracking their transport projects, hoping for an infrastructure-led recovery from the pandemic-induced recession. But those 'infrastructure pipelines' are constipated by megaprojects that are too slow to be effective stimulus and prone to mammoth cost overruns. Governments should act now to set current projects on a sounder basis, and take steps to avoid ending up here again.

The era of megaprojects has arrived. It's 10 years since Australia's first transport infrastructure project worth at least $5 billion; now there are nine such projects under construction. Before the pandemic, the value of transport infrastructure under construction for Australian governments reached $125 billion for the first time, and two thirds of that work was on projects worth $5 billion or more. Billion-dollar projects are no longer unusual. The 2020 Commonwealth Budget upped the transport spend to one-and-a-half times the usual level.

Megaprojects are already breaking records for cost overruns. There's an overrun so far of $24 billion on just six current projects. Inland Rail was costed at $4.4 billion in 2010; it's now estimated to cost $9.9 billion. Melbourne's North East Link was costed at $6 billion in 2008; it's now expected to cost $15.8 billion, even though the Victorian Government selected the cheapest route. The Sydney Metro City & Southwest was costed at $11 billion in 2015; this year the NSW Government announced the latest estimate was $15.5 billion.

Even before the megaprojects era, cost overruns were a megaproblem. Over the past two decades, Australian governments spent $34 billion more on transport infrastructure than they first told us they would. Grattan Institute's analysis of all projects valued at $20 million or more and built over the past 20 years shows that the actual costs exceeded the promised costs by 21 per cent.

Big projects are particularly risky. More than one third of overruns since 2001 came from just seven big projects. Eighty per cent of the cost overruns came from just 14 per cent of projects; that 14 per cent exceeded their originally promised cost by more than half. Some overruns are the size of a megaproject themselves: for $1 billion-plus projects with an overrun, that overrun averaged more than $1 billion.

Projects announced before governments are prepared to formally commit are also particularly risky. Only one third of projects are announced prematurely, but they account for more than three quarters of the cost overruns. Premature announcements would be no problem if Australia had a robust process for cancelling the duds, but most projects, once announced, are seen through to completion.

Right now, governments are focused on creating jobs and stimulating the economy by spending money quickly. But spending big on transport projects makes little sense, because even before the pandemic, the Prime Minister, Treasurer, and state infrastructure ministers were worried that there weren't enough workers, materials, and machinery for the massive construction workload. When there are already bottlenecks, racing to build projects dreamt up before the pandemic just pushes up prices. Governments would get bigger bang for taxpayer buck by instead spending more on upgrading existing infrastructure, and on social infrastructure such as aged care and mental health care.

Governments should rethink major projects that have been promised or are under construction, particularly those announced without a business case. Governments should continuously disclose to Parliament material changes to expected costs and benefits, as listed companies do to the stock exchange. To avoid ending up here again in future, governments should collect data on and learn lessons from past projects. Megaprojects should be a last, not a first resort.

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1 Building infrastructure like there's no tomorrow

Before the pandemic, public infrastructure was booming in Australia. In March 2020, the value of the road and rail projects being built across the country exceeded $120 billion for the first time.[1]

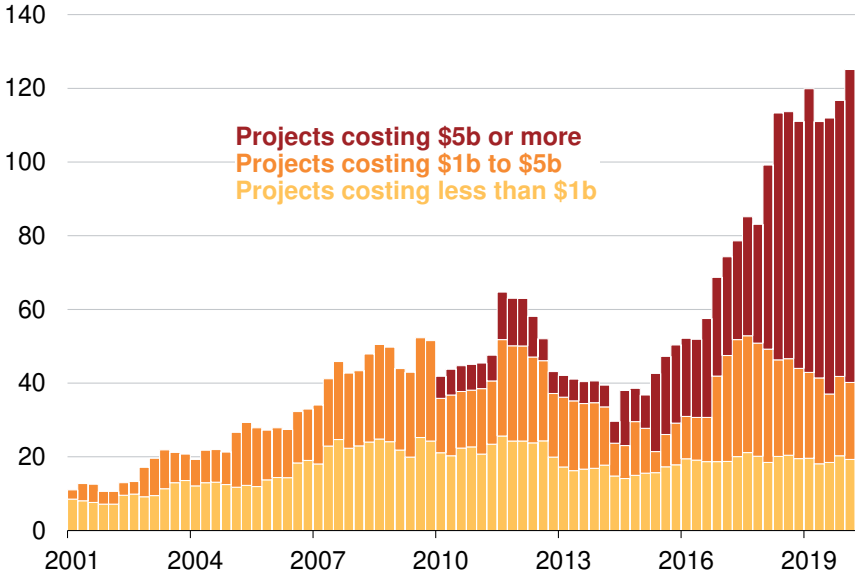
Not only was the amount of work at an all-time high, so was the size of projects being built. It is no longer true that only a couple of very large projects are being built at any one time; now, most of the work being done is on 'megaprojects' – commonly defined as projects costing $1 billion or more (Figure 1.1). In fact, we have entered an era of *mega* megaprojects, with most work being done on projects with an expected cost of more than $5 billion. During the past five years, the value of an average road or rail project being built more than doubled, from $430 million to $1.1 billion (Figure 1.2 on the next page).

That was before the pandemic. Now, there are calls for even more public infrastructure. The Governor of the Reserve Bank has called for Australian governments to increase public investment to create jobs through infrastructure.[2] The Prime Minister has called for the states to spend more on 'good projects'.[3] The transport and infrastructure ministers of all jurisdictions say they are 'clearing the way for an infrastructure-led recovery'.[4]

Given that Australia was already in new territory before the pandemic, there is a big question mark over the wisdom of this path. The risk of rushing yet more projects into a construction sector that's already building more and larger projects is that the projects may end up costing more or providing fewer benefits than anticipated – or both. In other words, even that minority of projects that have been through a

Figure 1.1: All the growth in public road and rail infrastructure work is in megaprojects

Expected cost of projects under construction, $2020 billion



Note: Includes all public road and rail projects costing more than $20 million.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

1. Includes all projects costing more than $20 million.
2. Lowe (2020, p. 5).
3. Coorey and Cranston (2020).
4. Transport and Infrastructure Council (2020, p. 1).

reasonable assessment process before the decision to build may turn out not to have been worth building at all.

1.1 Cost overruns are more likely and larger when projects are bigger

Larger projects are more likely to have cost blowouts. This is unsurprising, because larger projects have more interdependent elements, any one of which could suffer a setback that flows through to other elements.

Not only are bigger projects more likely to have a cost blowout, but when it happens, that blowout is likely to be larger, both in dollar terms and as a proportion of the project's cost. More than one third of transport overruns since 2001 came from just seven of the largest projects. And there are more and more large projects: 10 years ago the work on hand included four projects valued at $2 billion or more in today's dollars; by the start of 2020, this number had increased to 14.

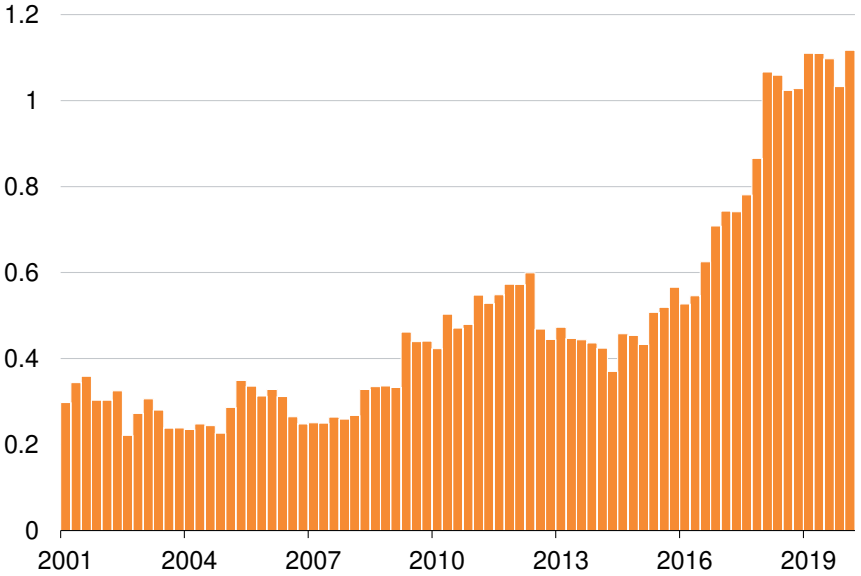
1.1.1 Even before COVID, many projects weren't going well

Even before the pandemic, there was disquiet about the scale of the public infrastructure being built. In 2019, Infrastructure Australia warned that 'while large-scale projects are becoming common place, they are also stretching the capacity of industry and government'.[5]

The Prime Minister said: 'We are really starting to hit our head on the ceiling in terms of how much infrastructure work you can get under way at any one time. And that's actually putting some cost pressures into the system.'[6]

Figure 1.2: The average project under construction now is worth more than $1 billion

Average expected cost of projects under construction, $2020 billion



Note: Includes all public road and rail projects costing more than $20 million.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

5. Infrastructure Australia (2019, p. 208).
6. Coorey (2019).

The federal Treasurer noted there were 'capacity constraints . . . related to skills, to materials, whether that be bitumen, cement, diesel, our boring equipment, and the like'.[7]

In March 2020, the Council of Australian Governments decided that it needed to start monitoring infrastructure market conditions and capacity.[8]

It is not hard to see cause for disquiet. The average size of completed transport projects had been relatively steady over recent years – until 2019. But the average value of projects completed in 2019 was twice that of projects completed over the previous five years (Figure 1.3).

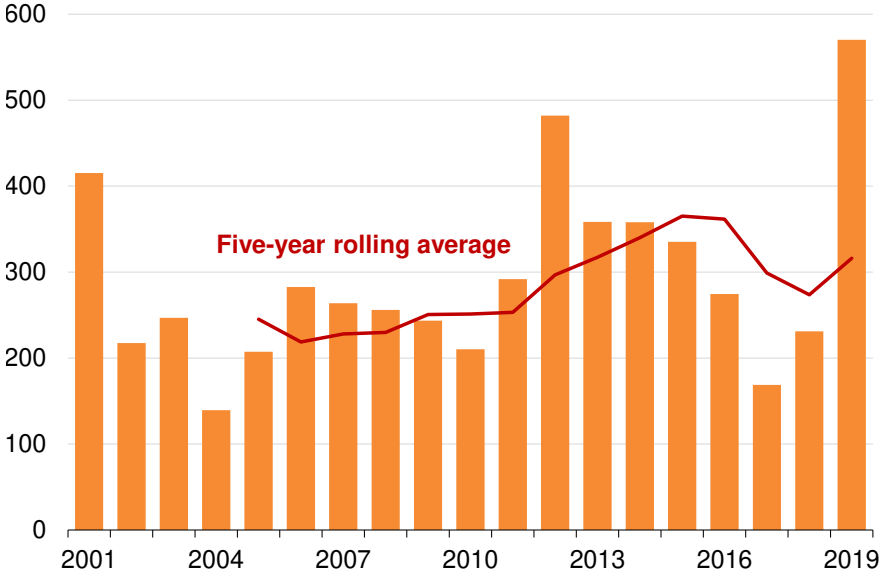
Some high-profile problems give further cause for concern. Sydney's CBD and South East Light Rail, and Melbourne's West Gate Tunnel have been particularly troubled. The following sections tell their stories.

Case study 1: Sydney's CBD and South East Light Rail

The NSW Government first allocated significant funds to the CBD and South East Light Rail project in the June 2013 state Budget. The expected cost then was $1.6 billion.[9] The plan was to run a new light rail line from Circular Quay through George Street to Central Station and to the University of NSW via Anzac Parade and Alison Road. Later that year, the Government said the benefits would be worth $4 billion, and the benefit cost ratio would be 2.5.[10]

Seven years on, it's a very different story. Services began operating along the full length of the line in April 2020, at an eventual cost of about $3.1 billion.[11] The latest published benefit estimate is $3 billion,[12]

Figure 1.3: The average cost of completed projects leapt in 2019
Average final cost of completed projects, $2020 million



Note: Includes all public road and rail projects costing more than $20 million.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

7. Caisley (2019).
8. Council of Australian Governments (2020).
9. NSW Government (2013, Section 4, p. 46).
10. Audit Office of New South Wales (2016, p. 7).
11. Audit Office of New South Wales (2020, pp. 1–2).
12. Audit Office of New South Wales (2016, p. 4).

but that hasn't been updated since 2015,[13] and therefore does not include a reduction in the benefits that were initially estimated from changes to bus services.[14] Nor does it include a benefit reduction that arose because the construction was more distressing to residents and businesses than had been anticipated[15] – so much so that they have filed a class action.[16]

What happened in those seven years? A damaging dispute with the contractor was part of the story, and so was a series of governance shortcomings.

A damaging dispute with the contractor

The Government signed a contract in December 2014 with ALTRAC Light Rail, a consortium comprising Acciona Infrastructure Australia, Alstom, Capella Capital, and Transdev.[17] The estimated cost had already gone up by this time, to $2.1 billion, due mostly to mispricing and omissions in the business case.[18]

Further overruns were caused by the unexpectedly high cost of digging up and replacing powerlines on George Street. In April 2018, the consortium filed a lawsuit in the NSW Supreme Court, alleging that the NSW Government had engaged in misleading or deceptive conduct when providing information regarding Ausgrid powerlines.[19]

The NSW Government reached a settlement with the contractors. The cost to Government for the settlement was $576 million, which included incentive payments ($44 million) and a two-year extension to ALTRAC's licence to operate the light rail (worth $221 million).[20]

A series of governance shortcomings

Poor management between 2011 and 2014 increased the project's complexity and risk and reduced the value for money, according to a 2016 Auditor-General's report.[21]

To begin with, Transport for NSW, rather than an independent body, did the assurance reviews of the project. This approach 'did not provide the independent assurance required for such a major infrastructure project'.[22]

Management of the project also departed from the planning process in the state's Major Projects Assurance Framework. Transport for NSW 'skipped two mandatory gateway reviews that could have forced it to resolve deficiencies in the project's governance arrangements and economic appraisal'.[23] For example, in June 2013 the project team identified significant design issues. Yet Transport for NSW did not recognise or resolve these issues in the business case, or accurately estimate the related costs.[24]

Case study 2: Melbourne's West Gate Tunnel

In April 2016, the Victorian Government signed an in-principle agreement with Transurban to build the West Gate Tunnel, at an expected cost of $5.5 billion. The expected benefit cost ratio was 1.1.[25]

13. Audit Office of New South Wales (2020, p. 1).
14. Ibid (p. 3).
15. Legislative Council Public Accountability Committee (2019, p. ix).
16. Supreme Court of New South Wales (2020); and Parkes-Hupton (2019).
17. Audit Office of New South Wales (2016, p. 26).
18. Ibid (p. 4).
19. Audit Office of New South Wales (2020, p. 6).
20. Ibid (p. 6).
21. Audit Office of New South Wales (2016, p. 9).
22. Ibid (p. 9).
23. Ibid (p. 9).
24. Ibid (p. 15).
25. VAGO (2019a, p. 43). The business case for the project included a headline benefit cost ratio of 1.3, but this number referred to a combined 'project' which

The plan was to build a 5km toll road linking the West Gate Freeway at Yarraville with the Port of Melbourne and CityLink at Docklands, including twin tunnels beneath Yarraville, a bridge over the Maribyrnong River, and a road above Footscray Road. Transurban had put the plan to the Government as a market-led proposal.

Today, the story is very different. The expected cost has increased to $6.7 billion.[26] The latest publicly available estimate of the benefit cost ratio, in 2018, put it at 1.0.[27]

The increase in costs has been attributed primarily to the discovery of soil contamination. Other problems include the need to relocate utility pipes, and shortcomings in governance.

A three-way dispute over soil contamination

The discovery of Per and Polyfluoroalkyl Substances (PFAS) in soil on the site of the West Gate Tunnel has led to significant delays and costs.[28] The project will now be delivered at least one year later than originally planned, in 2023 at the earliest.[29] Delays in work have also led to many lay-offs.[30]

At issue is who is responsible for dealing with the contamination. Under the contracts, Transurban generally carries the risk of dealing with any existing contamination it disturbs during construction.[31] Transurban also carries the risks of complying with planning approvals, of construction and design, and of 'a general change in law'. The Government carries the risk of a 'project specific change in law or change in policy', and the two parties share the risk for unforeseeable or 'force majeure' events.[32]

Proceedings have commenced between Transurban and the building consortium of CPB and John Holland over the additional costs incurred as a result of PFAS contamination, estimated at $1 billion.[33] The building consortium has claimed the soil issue is an unforeseeable circumstance that makes it impossible to fulfil the terms of a contract. If this claim is found valid, it would enable the termination of its contract with Transurban. Transurban has indicated it may seek to terminate its contract with the Government on the same grounds of force majeure.[34]

In September 2020, the Environmental Protection Authority approved Environment Management Plans for two landfill sites in outer Melbourne to receive soil from the West Gate Tunnel Project.[35]

Relocation of utility pipes has caused additional cost

Under Victoria's Major Transport Projects Facilitation Act, gas, water, and sewerage pipes, and electricity cables, must be moved to make way for major projects within 30 days.[36] It has been reported that the Government failed to notify utility companies about the West Gate Tunnel project's special status under the act.[37] This has led to significant delays and increases in cost, which in turn has led to further arbitration between the Government, Transurban, and the building consortium.[38]

included the Monash Freeway Upgrade. The Victorian Auditor-General's Office (VAGO) noted that the inclusion of the Monash Freeway Upgrade in the calculation was inconsistent with the state Department of Treasury and Finance guidelines on separate business cases: VAGO (2019a, p. 43).

26. Ibid (p. 52).
27. Ibid (p. 53).
28. Johnston et al (2019).
29. Rooney (2020a).
30. Rooney (2020b).
31. Treasurer of Victoria and Transurban (2017, Clause 7.2).
32. Victorian Government (2017, pp. 19–22).
33. Wiggins (2020a).
34. Jacks and Lucas (2020).
35. Terzon (2020).
36. Jacks (2020).
37. Ibid.
38. Ibid.

Governance shortcomings

The West Gate Tunnel is an unusual megaproject in that it was a market-led proposal. According to advice from the Department of Treasury and Finance to the Government in December 2017,[39] the usual tender process was bypassed, and a contract signed with Transurban, on the grounds that the company's offer was 'unique'.

The uniqueness related solely to Transurban's ability to get funding for the project via increased and/or extended tolls on its existing CityLink concession. An Auditor-General's report quite reasonably questioned whether funding should have been considered the defining 'unique' characteristic to exclude a competitive procurement process, since the community will pay for the project whichever funding source is adopted.[40]

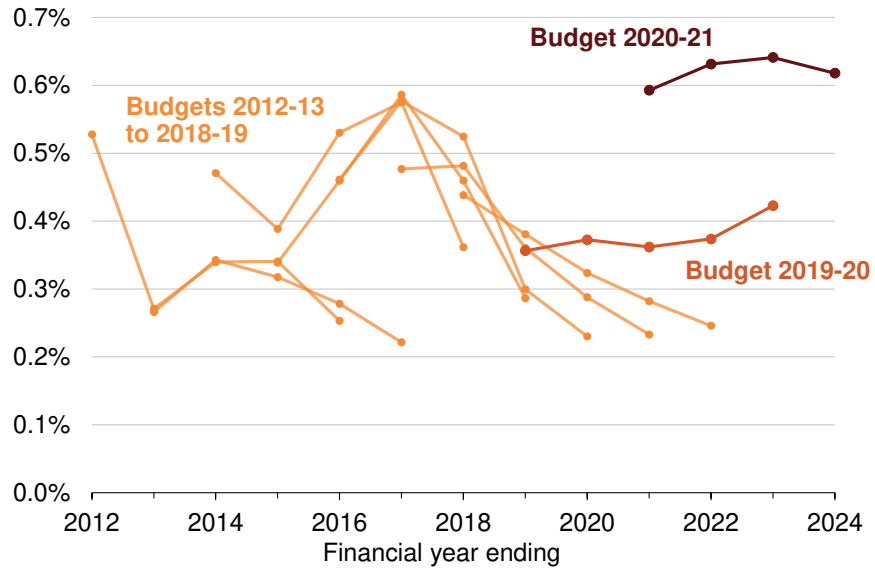
1.1.2 The infrastructure surge is risky

One of the many responses to the pandemic has been the call for more infrastructure as stimulus.[41] Public infrastructure spending is a traditional recourse when the economy tanks, for several reasons. One is the idea that construction not only props up employment, but in so doing it creates useful assets; road and rail upgrades facilitate the efficient movement of people and goods, leading to greater tax revenues down the track that help to pay for the infrastructure. A second reason is that stimulus-oriented construction can be wound back more easily once the economy is on a better footing,[42] unlike, for instance, an increase to unemployment payments.

The Federal Government has responded to calls for infrastructure as stimulus. In its 2020 Budget, it steps up funding for transport to $11.5 billion in 2020-21, $12.7 billion the following year, then about $13.5 billion in each of the following two years.[43] This is about one-and-a-half times the usual levels of funding from the Commonwealth (Figure 1.4). The Budget includes $750 million for Queensland's Coomera Connector Stage 1, and about $600 million each for upgrades to the New England and Newell Highways in NSW.[44]

Will this uptick in funding be an effective form of stimulus? There are three reasons for scepticism.

Figure 1.4: Budgeted Commonwealth spending on transport is higher than ever
Estimated transport infrastructure spend, per cent of GDP



Source: Commonwealth budget papers.

39. VAGO (2019a, p. 35).
40. Ibid (p. 36).
41. For example: Kehoe (2020), Wright and Crowe (2020) and Albanese (2020).
42. IMF (2020, p. 32).
43. Commonwealth of Australia (2020a, Section 6, p. 37).
44. Commonwealth of Australia (2020b, pp. 131–132).

First, it's not a foregone conclusion that a public infrastructure project will be effective as stimulus. As leading fiscal policy expert Valerie Ramey puts it, 'details really matter'.[45] In a comprehensive review of the fiscal responses since the Global Financial Crisis, she concludes that government infrastructure projects are not the best form of stimulus because they take a long time to get going.[46] (That's not to say they couldn't be worthwhile in the longer run, provided the benefits outweighed the costs.)

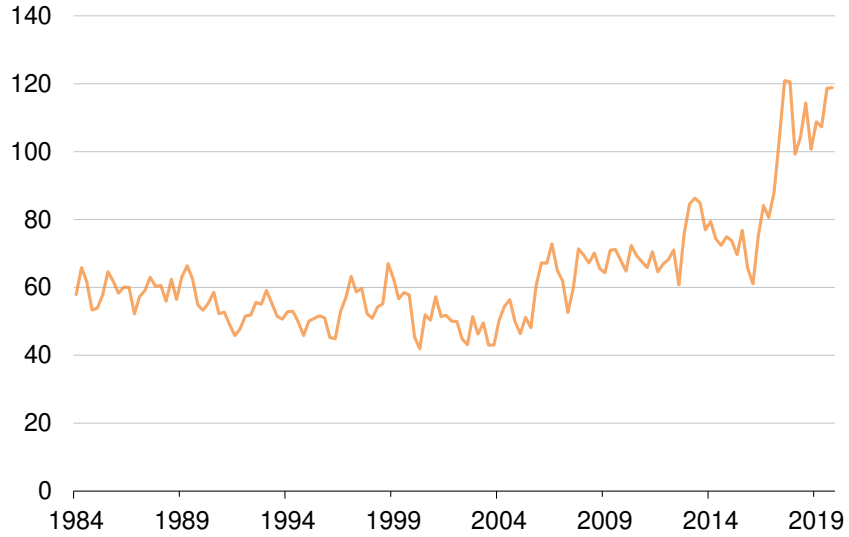
A second reason for scepticism about infrastructure as stimulus is the capacity of the construction industry. Even before the pandemic, governments were worried about the industry's capacity to take on more work on top of the record quantity of works in general and megaprojects in particular that were under construction. According to the International Monetary Fund, 'project delays are longer if projects are approved and undertaken when public investment is significantly scaled up'.[47]

The number of people working in engineering construction surged by 50 per cent in the three years before the pandemic (Figure 1.5). The image people may have of construction work as unskilled is out of date; as leading urban economist Ed Glaeser puts it, 'big infrastructure requires fancy equipment and skilled engineers, who aren't likely to be unemployed'.[48] During the mining boom, skilled labour and machinery were imported. But with national borders closed, this option is not available now or for the foreseeable future.

A third reason for scepticism about transport infrastructure as stimulus is that even before the pandemic, governments were already struggling to spend their budget allocations. Commonwealth allocations to the

Figure 1.5: More people are employed in engineering construction than ever

People employed in heavy and civil engineering construction, thousands



Source: ABS (2020a, Table EQ06).

45. Smith (2020).
46. Ramey (2019).
47. IMF (2020, p. 37).
48. Glaeser (2016).

states for transport infrastructure were underspent by $1.7 billion in 2019-20.[49] The Federal Government attributed this underspend to COVID-19 and the bushfires, yet it also underspent on transport infrastructure by about $2 billion over the preceding two years.[50]

In a recession, a sound micro-economic framework is one of the best protections we have. As the Productivity Commission has observed: 'If you build things solely for demand-side stimulus, you run the risk of wasteful spending. If you do careful project assessment, you can boost productive capacity and aggregate demand.'[51]

1.2 Projects conceived pre-pandemic are likely to suffer benefit underruns

A benefit underrun is just as serious as a cost overrun. Either shortcoming can render a project not worth building.

Information about benefits of a project is harder to come by than information about costs. Business cases often contain very little information about the expected traffic volumes underlying the benefits counted in a road project. Expected traffic volumes for toll roads have occasionally come to light after the road is completed, often as part of a court hearing that has arisen through actual patronage being much lower than expected.[52]

For rail projects, it can be even harder to assess benefits. Tasked with assessing benefits from the Regional Rail Link Project, the Victorian Auditor-General's Office noted: 'Poor benefit management practices by DOT [the Department of Transport] made it very challenging, if not impossible, to measure today whether the project has delivered all its expected benefits, and thus the level of value for money achieved.'[53]

This report is not about benefits, because the data is so scanty, but benefits should still be borne in mind when considering the merits of infrastructure proposals. The problem with projects conceived before the pandemic is that they are likely to under-achieve their benefits, for two reasons.

1.2.1 Population growth has fallen off a cliff

Population growth underpins the business cases of most if not all the transport infrastructure projects to which governments have committed. The Council of Australian Governments acknowledged this, discussing in early 2020 'the market's capacity to deliver Australia's record pipeline of infrastructure investment to support the country's growing population'.[54] Population growth exacerbates urban congestion, and creates pressure to upgrade ports, airports, and other facilities.

But the COVID crisis has caused population growth to fall off a cliff. Net overseas migration fell from 239,600 in 2018-19 to minus 72,000 in 2020-21.[55] We should not assume a return to the high-immigration policies that Australia had for many years before COVID.

Natural increase is well down too. Australia's fertility rate, currently at 1.69 babies per woman,[56] is expected to fall to 1.62 by early next decade.[57] The Australian Government expects the rate of population

49. Commonwealth of Australia (2020c, p. 7).
50. Commonwealth of Australia (2019, p. 80); and Commonwealth of Australia (2018, p. 80).
51. Brennan (2020).
52. See Black (2014). This report relies on newspaper reports for data on expected and actual traffic volumes of road projects, because no relevant official publications were made public.
53. VAGO (2018).
54. Council of Australian Governments (2020).
55. ABS (2020b); and Commonwealth of Australia (2020a, Section 2, p. 34).
56. Commonwealth of Australia (2020a, Section 2, p. 34).
57. McDonald (2020, pp. 2–4).

growth to be permanently lower than the rates assumed before COVID-19.[58]

Of course, infrastructure is a long-term investment, and Infrastructure Australia is continuing to take a 30-year view of projects, even in the midst of COVID-19. But we don't yet know whether Australia will resume its old path in a couple of years. Fertility rates in the rest of the rich world, and China, are already consistent with long-run population decline. India and the world as a whole are not yet in this territory, but total fertility rates are declining steadily.[59]

1.2.2 Work and travel patterns are likely to be different post-pandemic

Before the pandemic, few Australians worked from home. In Sydney, Melbourne, and Brisbane, about 5 per cent did, and in Perth and Adelaide it was about 4 per cent.[60] The numbers were small, but the trend was up: the rate of working from home increased by about half a percentage point between 2011 and 2016 in each of Australia's five largest cities.[61]

That changed, of course, with the pandemic. People who could work from home did so; an estimated 40 per cent of jobs can be done from home in Australia.[62]

Some people love the flexibility and comfort of working at home, and enjoy the time that used to be swallowed up with commuting. Others miss the social side of work, and find it difficult to work while their children are at home. Some businesses look forward to saving on office rental costs; others are concerned about doing new business in a world where people don't often meet face to face. Future work patterns and preferences are unclear.[63]

Likewise, future demand for public transport is unclear. No one knows how effective a future COVID-19 vaccine may be, or what kinds of social distancing requirements may be required long term. If social distancing is sustained, public transport projects – premised on the idea of carrying large numbers of people in close proximity – will need to be rethought.

In a time of high uncertainty, the best strategy is to keep options open. Major commitments to new transport infrastructure conceived for very different times make little sense right now. The mantra of stimulus does not mean that every project is a good one.

1.3 The structure of the remainder of this report

Chapter 2 shows that big projects are particularly risky, and that megaprojects often lead to mega overruns.

Chapter 3 establishes that premature announcements are a major risk factor in cost overruns.

Chapter 4 demonstrates that projects now being built have *already* had big cost overruns, and there are more to come.

Chapter 5 identifies what governments should do right now to minimise the likelihood and extent of current projects costing more than expected.

Chapter 6 nominates what governments should do to ensure they don't end up in this situation again in future.

58. Commonwealth of Australia (2020a, Section 2, p. 34).
59. C. I. Jones (2020).
60. Terrill et al (2018, Chapter 4).
61. Ibid (Chapter 4).
62. Ulubasoglu and Onder (2020).
63. Beck et al (2020) found that 71 per cent of people who'd worked from home during the pandemic say they would like to work from home more often in the future. But how frequently people will actually work from home after the pandemic remains very uncertain.

2 Bigger projects are riskier projects

Taxpayers spent $34 billion more on transport infrastructure projects between 2001 and 2020 than they had been first told they would spend.[64] These additional costs amount to more than one fifth of the initially expected costs.

It would seem that nothing has been learnt in the past four years. In 2016, Grattan Institute found that taxpayers had paid $28 billion more on transport infrastructure over the previous 15 years than they had been told they would pay.[65] Our 2016 report, *Cost overruns in transport infrastructure*, was the most comprehensive study of Australian projects ever conducted, covering every transport infrastructure project that governments had planned or built since 2001.[66]

In that report, and this one, we compared the cost of projects at first announcement to the cost at completion. Some people argue that cost overruns should only be measured from the point that a formal cost benefit analysis is completed or a funding commitment made.[67] But we think that measuring from first cost announcement is necessary if we are to explore the realpolitik of infrastructure funding. Politicians often promise to build infrastructure without a cost benefit analysis or a funding commitment, and most of these projects go on to be built. Politicians and the public take these promises seriously, and so do we (see Box 1 for the example of Sydney Metro North West).

64. The 'aggregate cost overrun' of $34 billion is equal to 'total cost overruns' of $38 billion minus 'total cost underruns' of $4 billion.
65. In 2016 dollars: Terrill and Danks (2016).
66. The 2016 report and this one use data on project costs from the Deloitte Access Economics *Investment Monitor*. See Appendix A for details of the *Investment Monitor*, as well as our analysis methodology.
67. Love et al (2015, pp. 493–494); Love et al (2016, p. 185); and Seimiatycki (2009, pp. 144–145).

Box 1: Overs or unders? The case of Sydney Metro Northwest

In February 2010, the NSW Labor Government released a Metropolitan Transport Plan which included a new rail connection to Rouse Hill from the existing network at Epping. It was then called the North West Rail Link,[a] and the stated expected cost was $6.7 billion.[b]

The Coalition, on winning government in March 2011, called the project its 'first order of business'.[c] In June 2012 the Government announced that the line would form part of a new 'metro-style' system that would accommodate high-frequency trains, requiring additional upgrades between Epping and Chatswood.[d] The 2013 state Budget included an estimated cost of $8.3 billion.[e]

The project – subsequently renamed Sydney Metro Northwest – was completed in 2019 for a total cost of $7.3 billion, and was lauded as having come in under budget, despite the fact that the eventual cost was $600 million higher than the initially publicised cost.[f]

a. NSW Government (2010, p. 34).
b. West (2010); and Parliament of NSW General Purpose Standing Committee Number 4 (2010).
c. ABC News (2011).
d. Saulwick (2012); and Transport for NSW (2012).
e. NSW Government (2013, section 5, p. 3).
f. NSW Government (2019); Collins (2019); and A. Jones (2019).

Section 2.2 shows that larger projects are more likely to have a cost overrun, and a larger one. Section 2.3 shows that a minority of larger projects cause much of the problem. But first, Section 2.1 explains what's wrong with promising to build infrastructure for less than it really costs.

2.1 Unrealistic cost estimates distort investment and mislead the public

Unrealistic cost estimates for transport infrastructure distort investment planning in three ways.

First, if governments systematically understate project cost estimates, then benefit cost ratios will be systematically overstated. This leads governments to over-invest in transport infrastructure.

Second, if governments misunderstand the uncertainty in a project's cost at the time they make a commitment, their decision to invest in that project was made on an incorrect basis. Inaccurate cost estimates distort the decision to invest, and which projects to select. The design and scope of a project can change over its life, but this rarely justifies not holding governments to account for the initial cost estimates (Box 2).

Third, because unrealistic cost estimates are more prevalent for larger projects, governments are more likely to over-invest in larger projects. The clearest example of this is multi-billion dollar projects, which have historically had more frequent and larger cost overruns.

As well as distorting investment decisions, unrealistic cost estimates mislead the public. We are led to believe that a particular project is available to us for less than it really is. Yet governments almost never go back and discover how actual costs and benefits compare to the costs and benefits that were promised. If they do go back, they do not share their findings with the public.

Box 2: Our approach to scope changes

We think it's usually reasonable to hold governments to account for initial cost estimates on projects.

Take Melbourne's North East Link. In 2008 the state government said the link would 'connect the Eastern Freeway and the Metropolitan Ring Road to complete Melbourne's orbital freeway network'.[a] Several different routes have been considered, each with different costs.[b] Although the project now involves features that were not reflected in the initial cost estimate, the project's fundamental purpose – to complete the orbital network – remains unchanged.[c] In examples like this, we think it is appropriate to compare final costs to initial estimates.

By contrast, consider Sydney's CBD and South East Light Rail. This began life as a proposal for light rail between Circular Quay and Central Station.[d] But over time it became a proposal for light rail all the way to Kingsford and Randwick in the city's south-east. As a fundamentally different project, it does not make sense to compare the final cost to the estimated cost when it was proposed to extend only as far south as Central Station.

In this report, we calculate the cost overrun (or underrun, as the case may be) from the earliest cost estimate where the project had the same fundamental purpose. Appendix A explains our methodology in more detail.

a. Victorian Government (2008, p. 12); and Pallas (2008).
b. Lucas and Carey (2017).
c. North East Link Project (2020).
d. Chesterton (2008).

2.2 Big projects overrun more often and by more

Bigger projects tend to be more complex, so it's not surprising that they are more prone to cost overruns. They also tend to overrun by more, in dollar terms, and often in percentage terms as well (Figure 2.1).

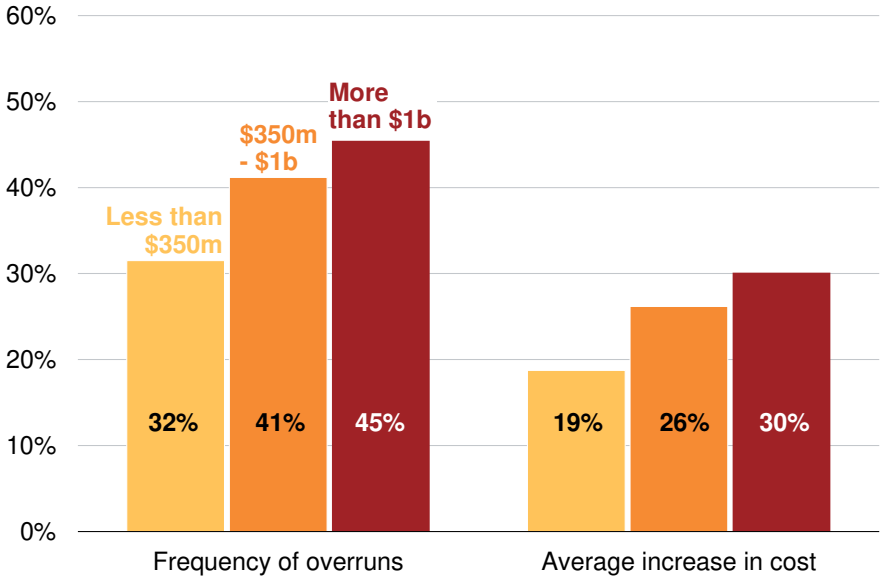
The relationship between project size and overruns is not new. In 2014 Danish economic geographer Bent Flyvbjerg coined 'the iron law of megaprojects: over budget, over time, over and over again'.[68] Our 2016 report found that a 10 per cent increase in project size (measured by cost estimate when first under construction) was associated with a 6 per cent higher chance of a cost overrun.[69]

2.3 A few projects cause a lot of trouble

The problem of cost overruns is concentrated. It's not a case of small amounts adding up across the 33 per cent of projects that have an overrun. Instead, more than 80 per cent of total cost overruns were caused by the 14 per cent of projects that exceeded their initial cost by more than 50 per cent (Figure 2.2 on the following page).[70]

More than one third of the aggregate cost overrun since 2001 came from just seven of the projects with the highest final costs (Table 2.1 on the next page).

Figure 2.1: Bigger projects overrun more often and by more
Frequency of overruns and average increase in cost as a percentage of initial project costs by level of initial cost



Note: Includes all public road and rail projects costing more than $20 million that were completed between Q1 2001 and Q1 2020.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

68. Flyvbjerg (2014, pp. 9–11).
69. Terrill and Danks (2016, p. 31).
70. These projects resulted in a total of $31 billion in overruns. This is about 82 per cent of the $38 billion of total cost overruns. (The aggregate cost overrun of $34 billion is total cost overruns minus total cost underruns.)

Table 2.1: Seven of the largest projects completed in the past two decades accounted for more than one third of overruns

Project	Year completed	Final cost ($2020b)	Overrun ($2020b)
Sydney Metro Northwest	2019	7.9	0.7
Clem Jones Tunnel (Brisbane)	2010	4.2	3.1
Airport Link (Brisbane)	2012	4.2	2.7
Eastlink (Melbourne)	2008	3.6	1.7
Epping to Chatswood Rail Link (Sydney)	2008	3.6	2.0
CBD and South East Light Rail (Sydney)	2019	3.3	1.6
New MetroRail (Perth)	2007	2.7	0.8

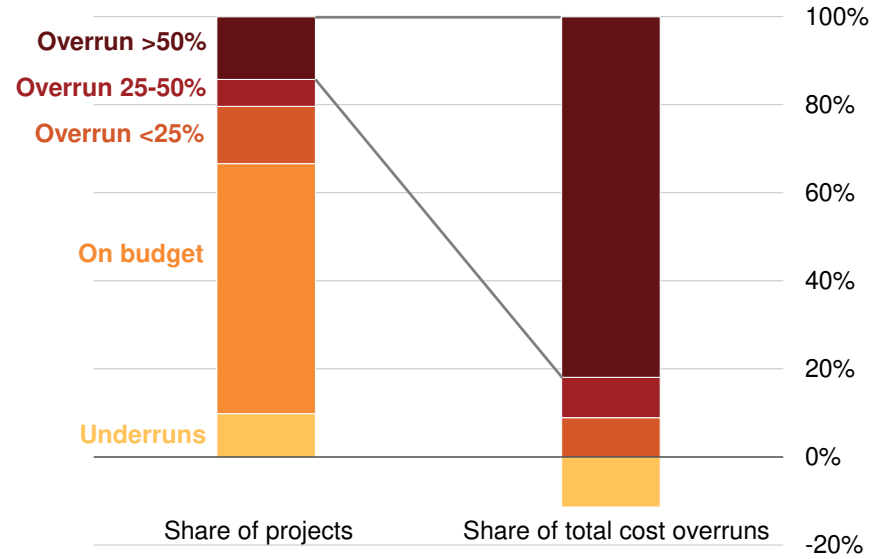
Note: Costs inflated to Q1 2020 from the mid-point of each project's construction period using ABS producer price index for road and bridge construction.

Sources: Grattan analysis of Deloitte Access Economics Investment Monitor, AECOM (2020), Brisbane City Council (2004, p. 2), SGS Economics & Planning (2019, p. 35), Queensland Government and Brisbane City Council (2005, p. 2), Bligh (2008), Audit Office of New South Wales (2020, p. 1), WA Government (2001, p. 917), and WA Government (2002, p. 892).

The overruns on the largest projects are often the size of a large project. For the $1 billion-plus projects that had an overrun, the average increase in cost was more than $1 billion (Figure 2.3 on the following page). Almost half of the projects with an initial price tag of more than $1 billion in today's money had an overrun (Figure 2.1 on the previous page).

The portfolio now under construction includes many mega megaprojects, valued at more than $5 billion, and the recent history of high overruns on the largest projects suggests there are storms ahead. The next chapter focuses on the other key predictor of cost overruns – premature announcements.

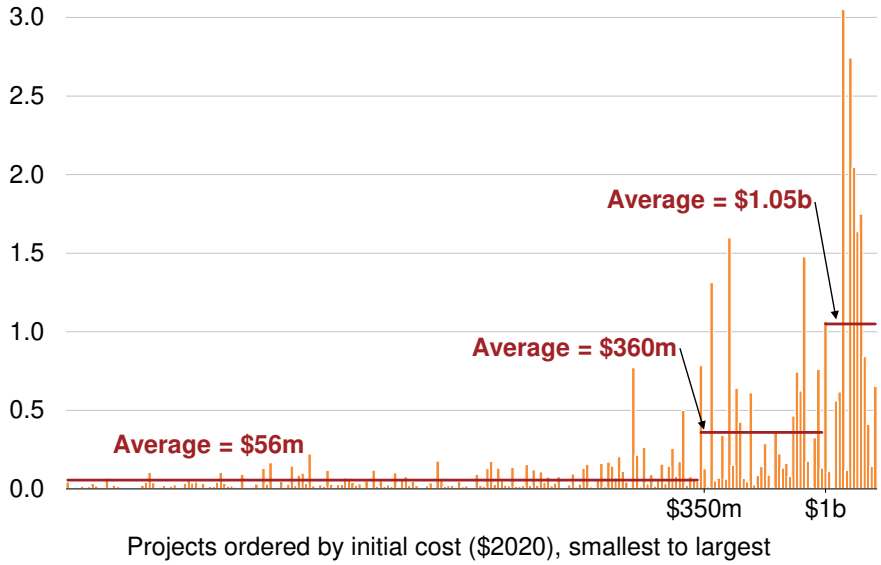
Figure 2.2: Large cost overruns are infrequent, but expensive



Note: Includes all public road and rail projects costing more than $20 million that were completed between Q1 2001 and Q1 2020.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

Figure 2.3: When a large project has an overrun, it's likely to be large
Cost overrun, for projects that had an overrun, $2020 billion



Note: Includes public road and rail projects costing more than $20 million that were completed between Q1 2001 and Q1 2020 and that had an overrun.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

3 Prematurely announced projects are riskier

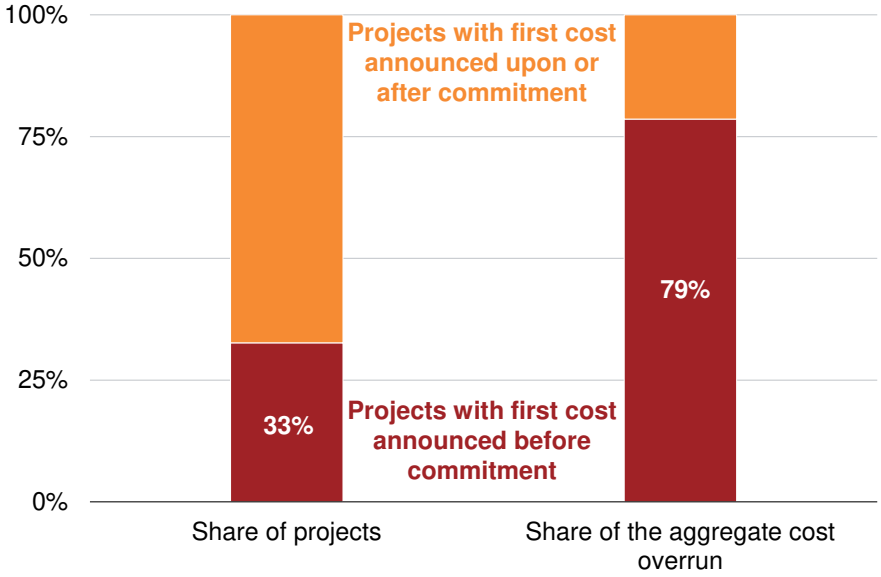
As a project evolves, the cost estimates evolve too. The cost estimates of big projects, in particular, change from first announcement to strategic business case to final business case to planning application, procurement, awarding of the contract, and finally to the ultimate cost of the completed project.

When a project is announced early, before a formal commitment such as a funding allocation, this usually means its cost estimate is a preliminary one, and does not incorporate a detailed engineering design or feasibility assessment.

There would be no problem with such early announcements if Australia had a robust process for cancelling those projects that, on closer examination, turned out not to be worth building, or not the best option available. But we don't have such a process; once a project is announced, it usually ends up being built. More than 80 per cent of projects that had an initial cost estimate of at least $20 million announced since 2001 were seen through to completion.[71]

An announcement is premature when a government or opposition announces it will build a project for a particular cost, but the project does not yet have the regulatory and/or financial approvals that constitute a technical commitment, and which are needed before it can actually proceed. Premature announcements of this kind are not the norm.[72] They occur about one third of the time, but they have been responsible for more than three quarters of the cost overruns over the past two decades (Figure 3.1).

Figure 3.1: Prematurely announced projects account for most of the value of cost overruns



Note: Includes all public road and rail projects costing more than $20 million that were completed between Q1 2001 and Q1 2020.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

71. Based on the shares of projects listed as 'Completed' versus 'Deleted' in the *Investment Monitor* historical record. The share of projects 'Completed' may be an underestimate of the actual share of projects that get completed because the *Investment Monitor* wraps some 'Deleted' projects into broader projects. On the other hand, it's possible that a higher proportion of the 'ongoing' projects will end up being deleted. If this is the case, the share of projects 'Completed' may be an overestimate of the actual share of projects that get completed.

72. For the analysis in this chapter we have defined a first cost announcement as 'premature' if the accompanying status in the *Investment Monitor* is 'Possible' or 'Under consideration' (and not 'Committed' or 'Under construction'). Once projects reach the 'Committed' status they 'have received the necessary regulatory and financial approval' according to the definitions and classifications document that accompanies the *Investment Monitor*.

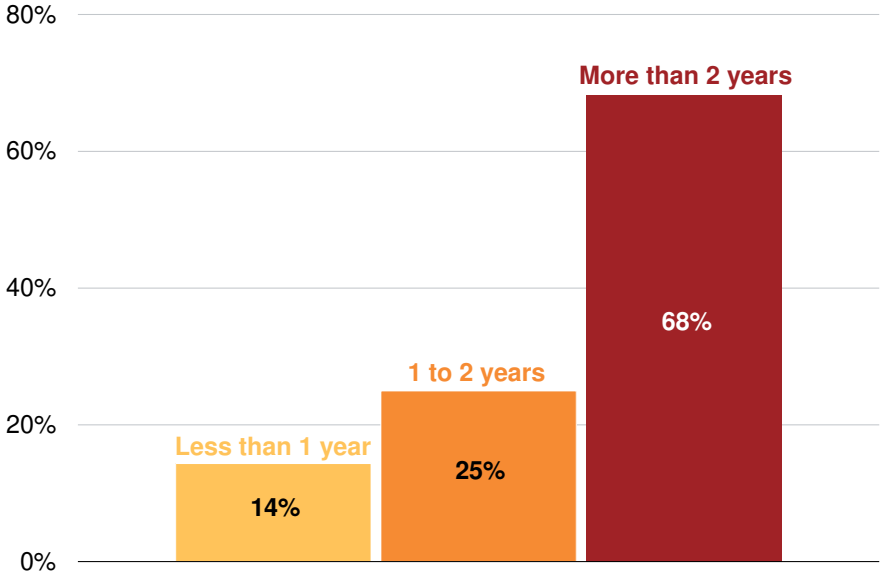
Projects with premature cost announcements exceed their promised cost by an average of 35 per cent; this is more than twice the percentage overrun (13 per cent) for projects that had their first cost announced upon or after commitment. And the more premature the announcement, the larger the overrun (Figure 3.2).

It might be hoped that floating a cost estimate early in the process would trigger the necessary refinements to the expected cost in the lead-up to commitment, so that the cost estimate at the time of commitment would be more accurate than for other projects. Unfortunately this is not the case. While the cost estimate for a prematurely announced project increases by an average of 18 per cent by the time it is formally committed, it doesn't end there; the cost estimate then increases again by a further 16 per cent on average by the time the project is completed – slightly higher than the 13 per cent average overrun for projects that have their first cost announced upon or after commitment.

Premature announcements often go hand in hand with larger projects.[73] Almost half of the projects initially expected to cost $500 million or more in today's dollars had a premature cost announcement. Figure 3.3 on the following page shows that prematurely announced projects are haunted by cost overruns throughout their life, and that these projects started out substantially bigger, on average, than those projects announced in a more orthodox way.

Figure 3.2: The earlier the first cost announcement, the larger the overrun

Average change in cost as a percentage of initial project costs, by length of time between first cost announcement and commencement of construction



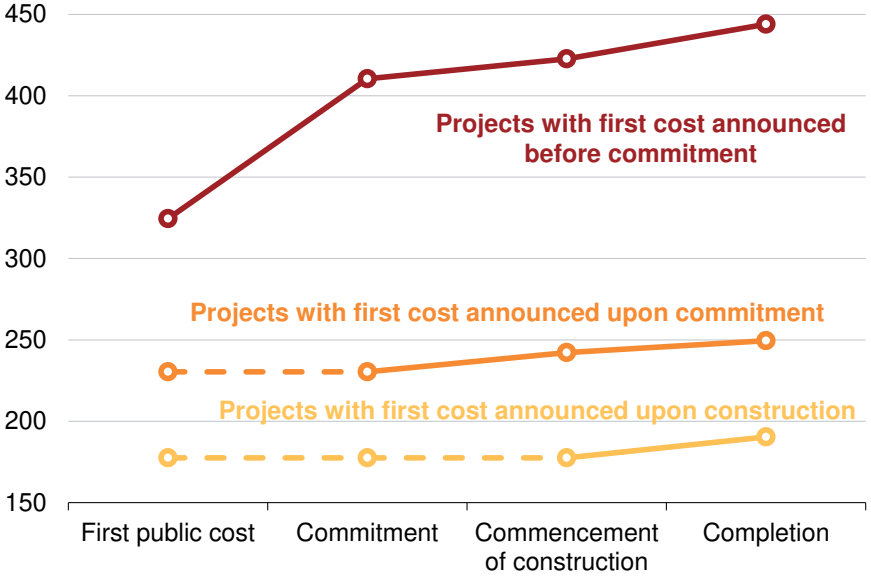
Note: Includes all public road and rail projects costing more than $20 million that were completed between Q1 2001 and Q1 2020.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

73. Despite projects with premature cost announcements being larger *on average*, there are still poor cost outcomes among smaller projects with premature cost announcements. For projects with an initial cost of up to $100 million, the average cost outcome for projects with a premature cost announcement was a 33 per cent overrun, compared to a 17 per cent overrun on projects without a premature cost announcement.

Figure 3.3: Projects with premature cost announcements are haunted throughout their lives

Average project size by project stage, $2020 million



Note: Includes all public road and rail projects costing more than $20 million that were completed between Q1 2001 and Q1 2020.

Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

4 The current crop of projects is already breaking records for cost overruns

In the past two decades, Australian governments have spent $34 billion more than they initially said they'd spend on transport infrastructure projects. But that sum is being dwarfed by what's now unfolding.

So far, Australian governments will spend at least $24 billion more than they said they would on just six extremely large, or 'mega' megaprojects.

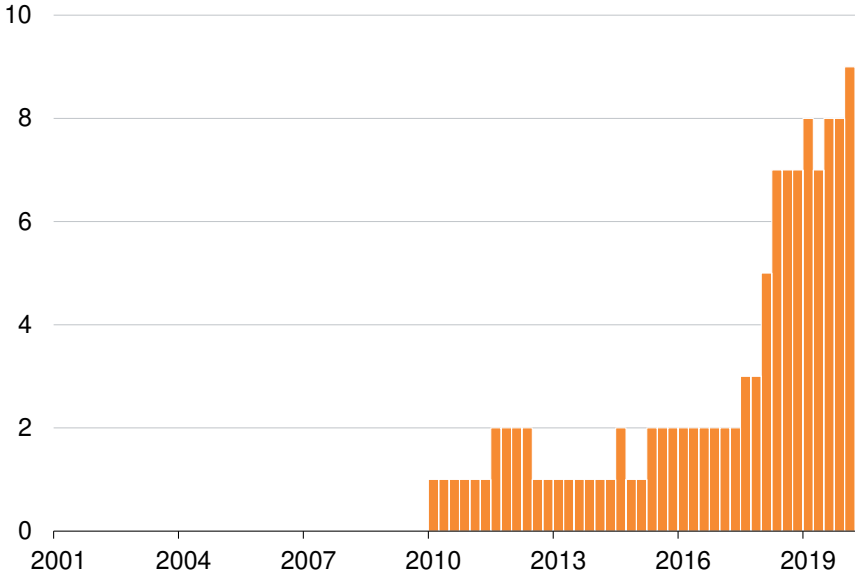
Previous chapters established that large projects are at greater risk of cost overruns (Chapter 2), as are prematurely announced projects (Chapter 3). This chapter shows that the current crop of projects is breaking records in two ways: the number of extremely large projects currently being built (Section 4.1), and the size of the cost overrun that has already been confirmed on these extremely large projects (Section 4.2). And Section 4.3 suggests further records may yet be broken.

4.1 A record number of mega megaprojects are being built

Ten years ago, Australia had just one mega megaproject valued at $5 billion or more in today's dollars under construction: the Airport Link M7 and Northern Busway in Brisbane (Figure 4.1). At the time it was considered 'the most complex road and tunnel engineering feat in Queensland's history',[74] and it made use of Australia's two largest tunnel boring machines as well as 17 road header machines – the most on any Australian construction project to that time.[75]

Figure 4.1: The number of projects expected to cost $5 billion or more has grown dramatically in just a few years

Number of projects under construction with an expected cost of at least $5 billion ($2020)



Source: Grattan analysis of Deloitte Access Economics Investment Monitor.

74. Bligh (2008).
75. John Holland (2020).

Now Australia has nine projects of this size or larger under construction:[76]

- WestConnex (Sydney)
- Sydney Metro City & Southwest
- Metro Tunnel (Melbourne)
- Inland Rail (Melbourne to Brisbane)
- Cross River Rail (Brisbane)
- West Gate Tunnel (Melbourne)
- Removal of an additional 25 level crossings (Melbourne)
- METRONET (Perth)
- Pacific Highway Upgrade – Woolgoolga to Ballina (NSW)

The capacity of the engineering construction sector to manage so many projects on such an enormous scale has been called into question.[77]

Projects worth more than a couple of hundred million dollars can only be taken on by Tier 1 contractors, of which there are three in Australia: CPB, John Holland, and Acciona.

Industry players, large and small, are calling for large and megaprojects to be split into smaller packages of works, so that mid-tier firms can tender for them.[78]

But even if this happens in future, it won't change what's already in train.

76. This does not include the North East Link project in Melbourne (discussed further in Section 4.2.2 on page 25), for which major works are yet to commence.
77. For example: Coorey (2019), Caisley (2019) and Infrastructure Australia (2019, p. 208).
78. For example: Croagh (2020) and Hayford (2020a, p. 7).

4.2 Cost overruns on a handful of mega megaprojects are breaking records

The West Gate Tunnel project in Melbourne has already exceeded its initial cost estimate by more than $1 billion,[79] and there are reports that costs could further blow out.[80] But the West Gate Tunnel is not the project with the largest cost overrun of recent times. It is one of six mega megaprojects that are being built and have generated $24 billion worth of cost increases, confirmed as at late 2020 (Figure 4.2 on the next page). There is no guarantee that there won't be further overruns in future.

Chapter 1 told the story of the West Gate Tunnel. The following sections tell the story of each of the other five current mega megaprojects that already has a substantial overrun.

4.2.1 WestConnex

WestConnex is a 33km tolled motorway that will link the west and south-west of Sydney with Sydney Airport and Port Botany. It includes about 19km of tunnels. The project is being completed in stages, with two major sections already open: WestConnex M4 between Parramatta and Haberfield, and WestConnex M8 between Kingsgrove and St Peters. Two 7.5km tunnels to link these sections (the 'M4-M5 Link') are due to be completed in 2023.[81]

While the fundamental purpose of the project has remained unchanged, scope changes have seen its estimated cost rise by about $2 billion. And because of uncertainty about the basis of early cost estimates, many people expect an overrun closer to $7 billion.[82]

79. Edwards (2017).
80. Jacks (2020).
81. Transurban (n.d.).
82. For example: O'Sullivan (2016), Australian Associated Press (2016) and Sanda (2017).

WestConnex was first proposed by Infrastructure NSW, and adopted by the NSW Government, in October 2012.[83] The initial proposal differed to the final plans in a number of respects, but the essential nature of the project was the same: a 33km motorway to connect a widened and extended M4 to the M5 East corridor, providing better access to the airport and the port.[84] While the original plan was to connect to a widened M5 East, the final plan involved connecting to a 'New M5', later renamed the WestConnex M8.

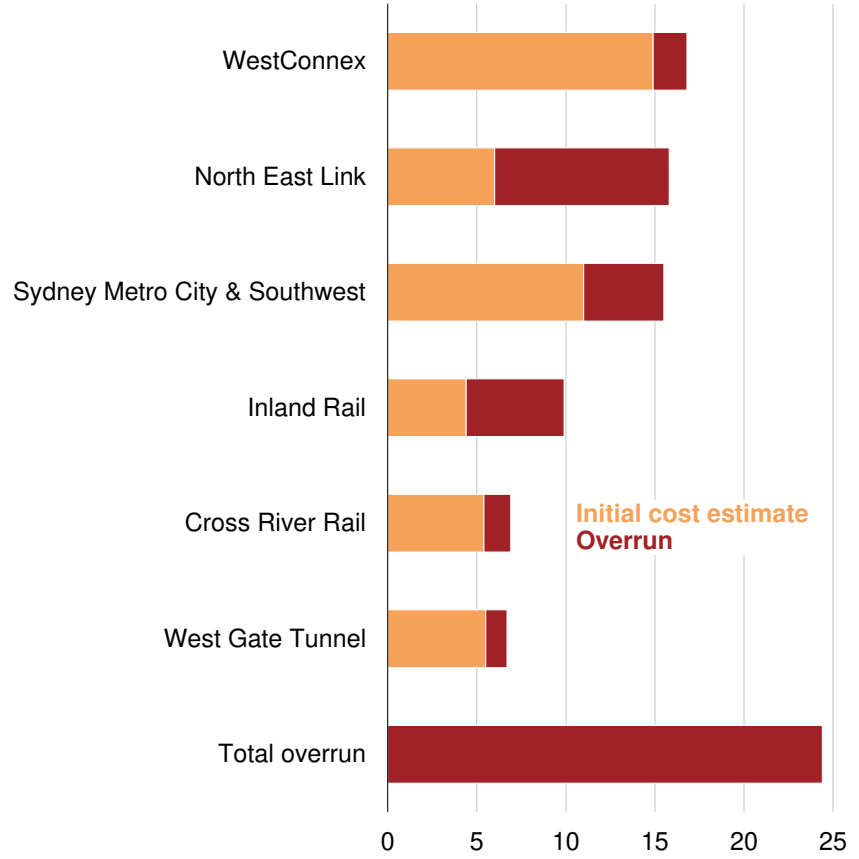
The initial cost estimate for the project that grabbed the headlines was $10 billion.[85] However, a joint study by Infrastructure NSW and the NSW Government published at the time of the original announcement noted that the cost could be as high as $13 billion.[86] That study also indicated that the estimate had been discounted to 2012 dollars, meaning the 'outturn' cost – the nominal amount that would be spent in total over the project's expected 10-year life – would be a lot higher.

The 2013 NSW Budget referred to the $10-to-$13 billion range as the 'Estimated Total Cost'.[87] This caused confusion because 'Total estimated cost' is usually reported on a nominal outturn basis in budget infrastructure statements.

The business case was completed later in 2013, and contained a refined estimate of $11-to-$11.5 billion ($2012).[88] The $11.5 billion estimate was then reported in the 2014 NSW Budget, where an outturn cost of $14.9 billion was also reported.

The estimated outturn cost was half-a-billion dollars higher in the 2015 Budget, with the increase attributed to the addition of tunnels for a

Figure 4.2: Just six mega megaprojects have caused $24 billion in cost overruns so far
$ billion



Sources: As referenced throughout Section 4.2.

83. Trembath (2012).
84. SGS Economics & Planning (2015).
85. For example: Budd (2013).
86. Infrastructure NSW, TfNSW, and RMS (2012, p. 26).
87. NSW Government (2013, Section 3, Page 4).
88. WestConnex (2013, p. 15).

future southern extension and additional scoping works around the St Peters interchange.[89] The estimate jumped a further $1.4 billion to $16.8 billion in the 2016 Budget after an updated business case in late 2015. This remains the current estimate. The updated business case attributed the almost-$2 billion increase since the first business case estimate of $14.9 billion to:[90]

- extension of the M4-M5 Link to the Anzac Bridge, Victoria Road, and the future Western Harbour Tunnel and Beaches Link ($1.2 billion); and
- provision for an 'enhanced' connection to the terminals of Sydney Airport (the 'Sydney Gateway') ($402 million); and
- 'acceleration costs and associated delivery costs for scope enhancements' ($322 million).

4.2.2 North East Link

The cost of the North East Link, a toll road in Melbourne which will join the M80 Ring Road to the Eastern Freeway, has leapt since an estimated cost was first announced in 2008.

The North East Link was included in the Victorian Government's Victorian Transport Plan in 2008, with a cost of 'more than $6 billion'.[91]

Two changes of government later, the Andrews Government announced its intention to proceed with the project in December 2016, then with an expected cost of $10 billion.[92] At this point, a route for the road was yet to be determined.

Costings for four potential routes were released in August 2017, ranging from $7 billion to $23 billion.[93]

In November 2017, the Government announced that the cheapest of the four routes had been selected, though the expected cost was now $16.5 billion.[94] Part of the extra cost related to widening of the Eastern Freeway, necessary to accommodate extra traffic coming off the North East Link.[95] However, the project's fundamental purpose remained unchanged: connecting the M80 Ring Road to the Eastern Freeway. In May 2018, a business case was completed, which revised the expected cost down slightly to $15.8 billion.[96]

4.2.3 Sydney Metro City & Southwest

The City & Southwest section is the second stage of the Sydney Metro system, following the Northwest section, which was opened in May 2019. The main feature of the system is high-frequency, driverless trains operating on mostly underground lines.

The Sydney Metro City & Southwest project will extend the Northwest line by 30km, from Chatswood in the north to Bankstown in the south-west, via the CBD. The project involves twin tunnels under Sydney Harbour, from Chatswood to Sydenham in the inner west.

Cost estimates for the project crept up in the early years of planning, before an overrun of $3 billion was announced because construction was proving more expensive than expected. An internal review has also suggested that costs could increase by a further $1 billion.

89. Saulwick (2015).
90. WestConnex (2015, Table E2, p. 24).
91. Victorian Government (2008, p. 12). See also Pallas (2008) and Parliament of Victoria (2020, p. 3).
92. Galloway (2016).
93. Lucas and Carey (2017).
94. Andrews (2017).
95. Lucas and Jacks (2017); and Victorian Government (2018a, p. 4).
96. Victorian Government (2018a, p. 7).

Media reporting in 2015 had early cost estimates for the project of up to $11 billion.[97] A year later, the expected cost was between $11.5 billion and $12.5 billion.[98]

In February this year the NSW Government announced an overrun of $3 billion on the project, with the current estimate now sitting at $15.5 billion. NSW Transport Minister Andrew Constance attributed the overrun to higher costs because of higher demand in the market:[99]

> I am sorry it happened this way but it is very much market forces at play in terms of the build. We are not denying there hasn't been significant cost pressures on the project... If you go back five years ago, I think it's fair to say that not even Treasury could predict the escalation increases in the infrastructure market. And it's not just in Sydney.

The Minister's comments reflect the story being told in Figure 6.3 on page 43. Transport construction costs were flat between late 2013 and late 2016, but grew strongly thereafter.

Regardless of the market movements, however, there are questions over the early cost estimates. Former WestConnex and Transfield chair Tony Shepherd has suggested the $12.5 billion figure was 'probably an early estimate before the facts were in'.[100] More generally, he also recommended governments be 'very careful on making the point that estimates in the early days are just preliminary estimates because no one has done the work yet'.

The Sydney Metro City & Southwest project may face further overruns. An internal budget review is reported to have forecasted a final cost of $16.8 billion – $1.3 billion higher than the current $15.5 billion estimate.[101]

97. Beech (2015); and Kembrey (2015).
98. NSW Government (2016).
99. O'Sullivan (2020a).
100. Rabe and O'Sullivan (2020).
101. O'Sullivan (2020b).

4.2.4 Inland Rail

Inland Rail is a 1,700km freight railway line connecting the ports of Melbourne and Brisbane. Its ultimate cost is expected to far exceed the initial estimate.

The current route was first specified in a 2010 report by the Australian Rail Track Corporation, which estimated the cost at $4.4 billion.[102]

In 2015, a full business case was completed, with the likely, or median, cost estimate now $9.9 billion.[103] Based on this business case, Infrastructure Australia assessed the benefit cost ratio (BCR) at 1.1 and noted: 'Given the marginal nature of the BCR, an increase in project cost could have a significant impact on the final BCR.'[104] The 2017 Commonwealth Budget noted that 'the project is sensitive to increases in project cost'.[105]

National Trunk Rail, proponents of a rival plan to build an inland rail, have suggested the costs of the project will blow out further, to $16 billion, because the project involved upgrading existing lines and connecting them.[106]

The Millmerran Rail Group of farmers from the Darling Downs has claimed that the project is open to cost blowouts because the chosen route is through a floodplain.[107]

4.2.5 Cross River Rail

The 2017 Queensland Budget estimated the cost of the Cross River Rail project, which includes a new line under the Brisbane River, at

102. P50 or median cost: ARTC (2010, p. 14). The P90 cost was estimated at $4.7 billion.
103. ARTC (2015, p. 166).
104. Infrastructure Australia (2016, p. 6).
105. Commonwealth of Australia (2017, Section 9, p. 11).
106. Wiggins (2017).
107. Ludlow (2019).

$5.4 billion.[108] The 2019 Budget included an additional $1.48 billion of 'private finance contributions', bringing the total project cost to $6.9 billion.[109]

Despite this change in budgeted cost, it continues to be referred to as a $5.4 billion project,[110] and the Queensland Government insists the project is still on budget.[111]

Technical issues related to the Boggo Road station including problems with the track alignment could cause a cost overrun, though the Government has not adjusted the official expected cost.[112]

In April 2020, the independent board overseeing the project was removed.[113] The Cross River Rail Authority now reports directly to Cross River Rail Minister Kate Jones. She said this change was made to improve oversight of the project in an attempt to avoid cost overruns:[114]

> [I want] a direct line of sight on how we build the Cross River Rail project. It's my job to hold [contractor CPB] to that contract... You need to be hands-on to keep the contractor accountable. They need to know we are breathing down their neck.

In July 2020, the Shadow Transport Minister wrote to the Auditor-General suggesting the actual cost may be as high as $12 billion.[115]

108. Queensland Government (2017, p. 74).
109. Queensland Government (2019, pp. 103–104). See also Adept Economics (n.d.).
110. For example: Elks and Williams (2020); Elks (2020); Knowles (2020) and Gordon (2020).
111. Marszalek (2020).
112. McCutcheon (2020).
113. Crockford and Lynch (2020).
114. Elks and Williams (2020).
115. Minnikin (2020).

The project did not receive approval from Infrastructure Australia

In July 2017, Infrastructure Australia reviewed the project's business case, and decided not to award the proposal the status of 'Project' on the Infrastructure Priority List. Infrastructure Australia considered that the benefits in the business case were significantly overstated, and that the costs of the project were likely to exceed its benefits.[116]

Infrastructure Australia continued to list the project as an 'Initiative', suggesting further business case development as a next step, until it was removed from the priority list in 2019, because construction had commenced.[117]

The Queensland Deputy Premier questioned the independence of Infrastructure Australia in light of its rejection of the Cross River Rail business case.[118]

4.3 Other records may yet be broken

Large projects come with cost risk, as do prematurely announced projects. Either of these characteristics on its own should prompt caution. A combination of the two should mean red flags.

For example, in March 2019 the Commonwealth Government announced an initial cost estimate of $4 billion for Geelong Fast Rail when announcing $2 billion of federal funding for the project.[119] However, on the same day as the Commonwealth's announcement, the Victorian Transport Minister, Jacinta Allan, cast doubt over the estimate, and was reported as saying the project would cost up to three times as much.[120]

116. Infrastructure Australia (2017).
117. Infrastructure Australia (2020, p. 12).
118. Caldwell (2018).
119. Harris and Galloway (2019).
120. Jacks et al (2019).

4.3.1 Melbourne's Metro Tunnel is at risk of a large overrun

Construction of the Metro Tunnel commenced in 2018.[121] The project is expected to be completed in 2025,[122] and remains officially on budget, at a cost of $11 billion.[123] However, it was reported in October 2020 that the Victorian Government had agreed to pay an extra amount to cover a share of cost overruns incurred by the contractors.[124]

The Auditor-General has noted that early construction works cost $150 million (or 30 per cent) more than anticipated, funded from the budget for the main works phase.[125] The Auditor-General noted that 'the heavy use of project-wide contingency funds is an early warning flag for the project, particularly because there are at least five more years of complex and risky construction works ahead'.[126]

It has also been reported that unexpected problems, including geological problems, have created additional costs.[127] The consortium building the Metro Tunnel project, Cross Yarra Partnership (CYP), has sought additional Government funding.[128] In 2019, a mediator was appointed to negotiate between the CYP and the Victorian Government.[129]

The consortium ceased tunnelling work for a period in December 2019 and has reportedly threatened to quit the project entirely unless the Government agrees to contribute to the increased costs, reported to be about $3 billion.[130]

121. Victorian Department of Treasury and Finance (2019).
122. Metro Tunnel (n.d.).
123. Ibid.
124. Jacks and Towell (2020).
125. VAGO (2019b, p. 9).
126. Ibid (p. 8).
127. Jacks and Danckert (2019).
128. Willingham (2019); and Baxendale (2020).
129. Willingham (2019).
130. Jacks and Danckert (2019).

5 What governments should do immediately

This report has quantified how common cost overruns are, and how costly. It has also quantified the cost overrun risks of large projects and prematurely announced projects. These facts should come as no surprise to politicians, bureaucrats, or the industry.

Grattan Institute's 2016 report, *Cost overruns in transport infrastructure*, made recommendations that, had they been taken up, would have significantly ameliorated the problem Australia now faces. But with little having changed in the way projects have been selected, costed, and initiated, the most pressing challenge for state governments now is to deal with those projects that are already being built or about to begin.

This chapter recommends some immediate measures. Section 5.1 is about how to deal with projects that are currently under construction, and Section 5.2 is about how to deal with the suite of projects that governments have committed to building but have not yet commenced.

5.1 Establish the state of projects currently under construction

Australia has a record program of transport infrastructure projects in progress, yet Australians have only limited information about the status of these projects. It seems that even governments sometimes have only limited oversight, because some projects are managed by private entities under Public Private Partnerships.

Historically it has suited governments to run their infrastructure programs this way. A politician can expect to enjoy an electoral benefit from announcing a new project, particularly in the lead up to an election. If the project ends up costing more than was promised, there is every chance the original proponent will no longer be in the same role. And even if they are, there is a good chance the public will have forgotten the original cost promise that justified the investment.

Of 32 projects larger than $500 million committed to since 2016, only eight had a business case either published, or assessed by a relevant infrastructure body at the time of commitment (Figure 5.1 on page 31 and Table 5.1 on the following page).[131] This means politicians are committing to projects without knowing whether they are in the community's interest to build, let alone whether they are the best choice for the money.

And governance has been no better for those projects which have received Commonwealth Government support. Of 22 large projects to which the Commonwealth Government has committed a contribution since 2016, only six had a business case published or assessed by Infrastructure Australia at the time of commitment. A further 14 were listed as 'initiatives' on IA's Priority List, indicating they 'have the potential to address a nationally significant problem or opportunity' but that their assessment had not yet been completed. The remaining two had not appeared on any Infrastructure Australia priority list at the time a state government committed to them.

As Infrastructure Australia put it:[132]

> Too often we see projects being committed to before a business case has been prepared, a full set of options have been considered, and rigorous analysis of a potential project's benefits and costs has been undertaken.

Box 3 on page 32 details the particularly egregious example of Melbourne's suburban rail loop.

131. 'Committed' here refers to a budget allocation being made for construction of the project in a state or territory budget.
132. Infrastructure Australia (2018a, p. 1).

Table 5.1: Most large projects are still committed to without an approved business case

Project	State	C'wealth contribution	IA status at commitment	Business case timing	Business case distribution
Inland Rail	National	Y	Project	At time of commitment	Published.
Northern Road Upgrade	NSW	Y	Project	At time of commitment	Assessed by IA
M80 Upgrade (Northern & Western sections)	VIC	Y	Project	At time of commitment	Assessed by IA
North East Link	VIC	Y	Project	At time of commitment	Assessed by IA and published
West Gate Tunnel	VIC	N	None	At time of commitment	Published
Beerburrum to Nambour Rail	QLD	Y	Project	At time of commitment	Assessed by IA; summary released
Bruce Highway (Bribie Island Road to Steve Irwin Way)	QLD	Y	Initiative	At time of commitment	Summary published by BQ
Bruce Highway (Caloundra Road to Sunshine Motorway)	QLD	Y	Project	At time of commitment	Assessed by IA
F6 (Stage 1)	NSW	N	None	Assessed later	Summary published by INSW
M12 Motorway	NSW	Y	Initiative	Assessed later	Assessed by IA
Sydney Gateway	NSW	N	Initiative	Assessed later	Summary published by INSW
Sydney Metro West	NSW	N	Initiative	Assessed later	Summary published by INSW
Monash Freeway Upgrade (Stage 2)	VIC	Y	None	Assessed later	Assessed by IA
Bruce Highway (Woondum to Curra)	QLD	Y	Initiative	Assessed later	Assessed by IA
M1 Pacific Motorway – Eight Mile Plains to Daisy Hill	QLD	Y	Initiative	Assessed later	Assessed by IA; summary released
M1 Pacific Motorway – Varsity Lakes to Tugun	QLD	Y	Initiative	Assessed later	Assessed by IA; summary released
Thornlie Line Extension	WA	Y	Initiative	Assessed later	Assessed by IA
Yanchep Rail Extension	WA	Y	Initiative	Assessed later	Assessed by IA
New Bridgewater Bridge	TAS	Y	Initiative	Assessed later	Assessed by IA; didn't pass
Central Walk	NSW	N	Initiative	None assessed or published	
North South Metro Rail Link	NSW	Y	Initiative	None assessed or published	
Princes Highway Upgrade (Albion Park Rail Bypass)	NSW	Y	None	None assessed or published	
Cranbourne Line Duplication	VIC	N	Initiative	None assessed or published	
Hurstbridge Line Upgrade Stage 2	VIC	N	Initiative	None assessed or published	
Melbourne Airport Rail	VIC	Y	Initiative	None assessed or published	
Suburban Rail Loop	VIC	N	None	None assessed or published	
Sunbury Line Upgrade	VIC	N	None	None assessed or published	
Bruce Highway (Haughton River floodplain)	QLD	Y	Initiative	None assessed or published	
Rockhampton Ring Road	QLD	N	None	None assessed or published	
Bunbury Outer Ring Road (Stages 2 & 3)	WA	Y	Initiative	None assessed or published	
North-South Corridor (Torrens River to Darlington)	SA	Y	Initiative	None assessed or published	
Tonkin Highway Corridor Upgrades	WA	Y	Initiative	None assessed or published	

Notes: IA = Infrastructure Australia. INSW = Infrastructure NSW. BQ = Building Queensland. Includes all fixed infrastructure projects with expected total cost greater than $500 million, committed to since December 2016. Does not include budget items referring to a program of smaller works. 'Committed' here refers to a budget allocation being made for construction in a state or territory budget, or the Commonwealth budget in the case of Inland Rail. A business case for Bruce Highway (Haughton River floodplain) was unsuccessfully assessed by IA..

Source: Grattan analysis.

5.1.1 Conduct an immediate stocktake

What has changed is the scale of the transport infrastructure construction agenda, and the advent of the pandemic-induced recession. These two factors make more urgent the need to review and potentially re-prioritise projects. The International Monetary Fund argues that such a review and re-prioritisation should include revisiting benefit cost analyses in light of the social changes caused by the COVID-19 crisis. It also argues for a well-coordinated system for actively monitoring projects, differentiated by project size, complexity, and stage.[133]

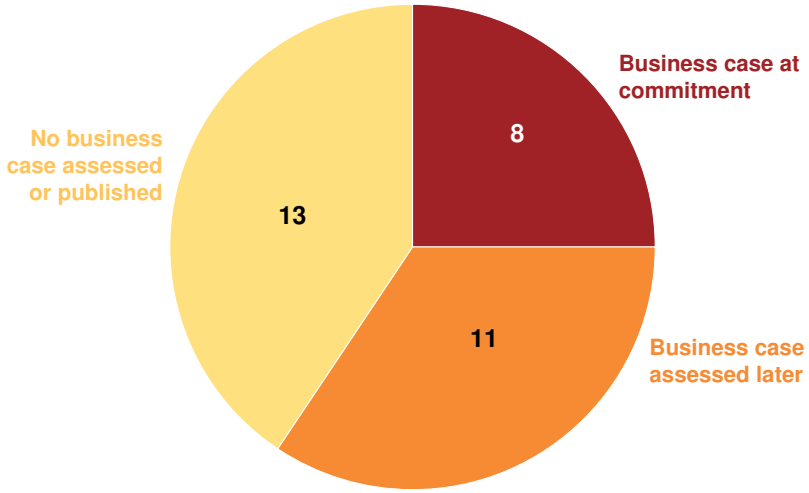
Recommendation 1

The Auditor-General of each state, and where relevant, the Commonwealth, should conduct an immediate stocktake of the transport infrastructure projects in progress, and for each one valued at $100 million or more report on:

- the announced cost at close of contract
- the expected total cost and the reason for any change from the announced cost
- the announced date at close of contract of coming into operation
- the expected date of coming into operation, and the reason for any change from the announced date
- the announced scope at close of contract
- any changes to scope and the reasons.

Figure 5.1: Most large projects are still committed to without an approved business case

Proportion of projects costing more than $500m, committed to in 2017-2020, with business case published or assessed by a relevant infrastructure body



Notes: Includes all fixed infrastructure projects with expected total cost greater than $500 million, committed to since December 2016. Does not include budget items referring to a program of smaller works. 'Committed' here refers to a budget allocation being made for construction of the project in a state or territory budget, or the Commonwealth budget in the case of Inland Rail.

Source: Grattan analysis.

133. IMF (2020, p. 35).

5.1.2 Require continuous disclosure of material changes in costs and benefits

If companies rather than governments were making large investments in public infrastructure, those companies would have reporting obligations under the *Corporations Act 2001 (Cth)*. Listed companies are required to report a change in their financial forecast or expectation, or that their earnings will be markedly different to market expectations.

If an equivalent regime applied to governments in respect of their investments in public infrastructure, governments would be required to report to the electorate through Parliament any material changes to expected costs, expected benefits, or expected timing of infrastructure projects, during the construction phase and on completion.[134]

Taxpayers are investors in public infrastructure. Governments should be legally obliged to reveal to taxpayers what they are funding.

Governments should also be transparent when they settle claims for extra funding. Even if governments view the settlement amount as confidential, they should issue an opinion from the government lawyers that the settlement amount constituted a fair and reasonable outcome for taxpayers.

Such arrangements could also improve real-time monitoring. It is well understood in other industries that close monitoring enables a project owner to nip problems in the bud. Timely information on divergences from expectations, or major and unforeseen incidents, can prevent problems in settings ranging from mine safety[135] to industrial megaprojects.[136]

134. The Australian Government has noted that private owners of infrastructure would be required to develop and monitor these requirements as part of their obligations to their shareholders: DIRD (2016, p. 66).
135. Brady (2019).
136. Merrow (2011).

Box 3: Melbourne's suburban rail loop was promised without appropriate scrutiny

Melbourne's suburban rail loop is a particularly egregious example of a large project being announced without appropriate scrutiny. It is expected to be the most expensive transport infrastructure project announced in Australia.[a] Yet, before the Victorian Government announced it, the project had been subjected to far less scrutiny than most large projects.

In August 2018, three months before a state election, the Victorian Government promised to build the 90km loop connecting Cheltenham in the south-east with Werribee in the south-west. It would be built over 30 years, starting in 2022.[b]

The project did not appear on Infrastructure Australia's priority list. Infrastructure Victoria did not recommend the project, and was not consulted before the Government's announcement.[c] Neither was Cabinet, nor the Department of Economic Development, Jobs, Transport, and Resources.[d] Instead the project had been worked on by Development Victoria, reportedly with the knowledge of only four ministers.[e]

a. No official cost estimate has been announced to date, though an initial figure of $50 billion was widely reported: for example Jacks and Preiss (2018), Hosking (2020), McGinn (2019) and Fox and King (2018). The 2019 Budget included only $300 million for a business case, design, and pre-construction works. The Budget did not specify an estimated total investment: Victorian Government (2019, p. 157). The strategic assessment published by the Victorian Government mentions an expected cost 'in the order of $30-50 billion': Victorian Government (2018b, p. 28).
b. Andrews (2018); and Jacks and Preiss (2018).
c. Carey (2018); and Lucas and Jacks (2018).
d. Lucas and Jacks (2018).
e. Ibid.

Recommendation 2

For projects with an expected cost greater than $500 million, the relevant state minister should be required to report to Parliament on a continuous disclosure basis where there is material change to the expected costs, benefits, and/or completion date of the project.

5.2 Establish the incoming batch of projects on a sounder basis

The Commonwealth Government has increased its transport infrastructure allocation to the states, and state governments are also planning further infrastructure construction as an aid to economic recovery.

Ministers appear to be planning to further relax their already-lax standards. Their communiqué after the Transport and Infrastructure Council meeting in June 2020 illustrates their intention to over-ride infrastructure bodies or water down their role where possible:

> Ministers... [discussed] their commitment to delivering their existing infrastructure pipelines... ensuring sufficient resources are deployed to move projects through assessment processes and into construction faster by targeting administrative bottlenecks. Ministers further agreed to work together to harmonise and streamline processes to clear the way for an infrastructure-led recovery to Australia's current economic condition, including consideration of infrastructure bodies' processes and environmental approvals.[137]

While ministers have the responsibility and the power to make investment decisions, they should make them with due care and diligence. They should not mislead people about what is really being promised.

5.2.1 Specify the range and status of cost estimates

Infrastructure is popular electorally, and it's not surprising that politicians are tempted to make premature promises.

But they are unwise to specify solutions, let alone scope, cost, or timing, without a realistic idea of what is involved. In the sober assessment of Infrastructure NSW, doing so prematurely may lead to 'disappointment in the community and counterproductive pressure on project delivery teams'.[138]

Recommendation 3

Ministers and government agencies should disclose the status of cost estimates for infrastructure proposals valued at $100 million or more, including

- quoting the wide range of possible values when the proposal is at the concept or indicative-estimate stage,
- for more advanced estimates, quoting a range and specifying whether they are preliminary business case estimates or final business case estimates,
- specifying what the accepted tender and state costs are, and
- reporting the outturn cost.

State revenue offices should report these estimates or budgets, and reconcile between them as projects develop and costs become more certain.

137. Transport and Infrastructure Council (2020).

138. Infrastructure NSW (2020).

5.2.2 Require independent assessment of infrastructure decisions

Governments across the country have expressed a willingness and desire to improve infrastructure decision-making, with infrastructure bodies now established in all states and within the Commonwealth (Box 4 on the following page).

Even though infrastructure advisory bodies have a variety of functions, all have the potential to assist governments improve the way they handle the risks of infrastructure projects, particularly the risks associated with size and premature announcement.

As outlined in Section 5.1, politicians have little incentive for good practice in cost estimation and project announcement. If state infrastructure bodies were required to publish independent assessments of projects before money could be committed, the scrutiny on cost management and infrastructure investment decisions would be increased. This scrutiny would serve to better align politicians' incentives to the public interest.

The additional transparency would not prevent elected representatives from doing their jobs, but would make it more costly for them to do so recklessly and without proper care for committing public money.

Recommendation 4

Governments should refine the legislated role of their infrastructure advisory bodies so that, before funds are committed to a project valued at $100 million or more, the infrastructure body

- assesses the quality of the business case, including the robustness of the assumptions underpinning it, and
- publishes the assessment on its website.

Box 4: Each state's infrastructure body has slightly different legislated responsibilities

Between 2011 and 2019, each Australian state established an infrastructure body to advise the state government on infrastructure, with varying degrees of independence.[a] These organisations are the state complements to Infrastructure Australia, which was established in 2008 and overhauled in 2014.

For most state bodies, the major focus is project assessment and long-term strategy:

- All states empower their agencies to assess major infrastructure proposals.[b]
- All states except Queensland empower their agencies to prepare a state infrastructure strategy over a 20-to-30-year horizon.[c]

Building Queensland is the only state body tasked with leading business case development for large projects. It leads the preparation of the business case for projects costing $100 million or more ($500 million or more for non-toll road projects), and assists in the preparation of the business case for projects costing $50-to-$100 million.[d]

Building Queensland also produces an infrastructure pipeline document, which identifies all major infrastructure proposals Building Queensland considers priorities.[e]

Similarly, Infrastructure SA produces a Statement of Capital Intentions, identifying the major infrastructure projects to be pursued in the state as a priority within the next five years.[f]

Infrastructure Victoria has a wider role in publishing research on infrastructure matters.[g]

Infrastructure NSW is the only state infrastructure body which is heavily involved in delivery of major projects. It is charged with preparing project implementation plans for major projects, and also overseeing and monitoring the delivery of major projects.[h]

a. Infrastructure NSW was the first established, in July 2011: *Infrastructure NSW Act 2011*. Infrastructure WA was the last established, in July 2019: *Infrastructure Western Australia Act 2019*.
b. Infrastructure Victoria does so only at the request of the Government and there is no mandatory requirement that it do so: *Infrastructure Victoria Act 2015*, Section 44.
c. *Infrastructure NSW Act 2011*, Sections 16-18; *Infrastructure Victoria Act 2015*, Sections 32-36; *Infrastructure Western Australia Act 2019*, Sections 13-17; *Infrastructure SA Act 2018*, Sections 20-22; and Infrastructure Tasmania (2019).
d. *Building Queensland Act 2015*, Section 14.
e. *Building Queensland Act 2015*, Section 15.
f. *Infrastructure SA Act 2018*, Sections 23-25.
g. *Infrastructure Victoria Act 2015*, Section 8.
h. *Infrastructure NSW Act 2011*, Sections 28-36.

6 How to avoid ending up here again

If there is no change in the way infrastructure is conceived and delivered in Australia, there's no reason to expect any different outcome in future. Australians can expect a steady stream of cost overruns, especially on larger projects and projects that are announced before a formal commitment.

A better approach is entirely achievable, with three strategies. First, megaprojects should be the last, not the first resort. Second, the tools for estimating costs could be much better, as they are in many countries. And third, learning the lessons from completed projects would enable successful strategies to be repeated and less successful ones avoided. The following sections explain.

6.1 Megaprojects should be the last, not the first resort

Projects worth $1 billion were a rarity two decades ago. In 2001, there were just two such projects under construction; by 2020, there were 18.

Megaprojects have become more prevalent, at the same time as there has been a push to greater national integration,[139] and more active Commonwealth involvement in transport infrastructure. Bodies such as the Australian Rail Track Corporation, the National Transport Commission, and Infrastructure Australia have been created to deal with this greater focus on national planning and coordination.

The Commonwealth has not restricted itself to planning and coordination, however. Every federal budget and every federal election includes announcements of big, iconic, 'nation-building' infrastructure.

Megaprojects have become normal. They have often been justified on the grounds of strong population growth. What is less often stated but just as important are exceptionally low real interest rates since the Global Financial Crisis, which have resulted in very strong land price increases. Land acquisition has become more important because planning authorities no longer assume large cities will keep expanding outwards.

Governments have choices about how to respond to these pressures.

The first resort should be efficient usage of the infrastructure we already have. If there is excessive road congestion in peak periods, the most efficient remedy is congestion pricing.[140] Public transport fares should also be higher in peak periods.[141]

Efficient use of existing infrastructure requires dealing with the mounting maintenance backlog. An historical underspend on preventative maintenance, a lack of data, and inadequate reporting requirements have contributed to a maintenance backlog across all infrastructure sectors. This will erode the quality and reliability of many assets and cause higher costs for future asset maintenance and renewal, according to Infrastructure Australia. 'Unless addressed, maintenance of our transport networks will become increasingly unsustainable,' it said in 2019.[142]

Governments should also modestly upgrade existing infrastructure, such as widening or upgrading key arterial roads, improving surfaces, upgrading railway stations, and improving key road intersections. For instance, if dilapidated wooden bridges were replaced with steel

139. Arising from the National Competition Policy of the 1990s and the National Reform Agenda of the first decade of this century: PC (2006, Chapters 6 and 7).

140. Terrill et al (2019).
141. Infrastructure Victoria (2020).
142. Infrastructure Australia (2019, p. 50).

bridges, they would be able to handle B-double semi-trailers which currently have to take circuitous routes instead.[143] NSW's pinch point program aims to unclog traffic bottlenecks by improving the capacity of the road network without needing to build new roads.[144]

Smaller projects generally have higher benefit cost ratios.[145] They are more robust to a range of future scenarios, such as the fall in population growth caused by the pandemic response (Section 1.2.1). Keeping options open, particularly in a time of high uncertainty, is a smart strategy.

It is a long way from these infrastructure projects to the $1 billion-plus megaprojects, let alone the $5 billion-plus mega megaprojects. Rather than reaching for the heroic and the iconic megaproject, governments should focus on upgrading and improving existing infrastructure.

Recommendation 5

State departments of transport and infrastructure should devote more resources to identifying modest-sized transport infrastructure proposals with higher net benefits than very large projects. Megaprojects should be proposed as the last, not the first resort.

6.2 Use better tools for estimating costs

Cost estimates made early in the life of a project are necessarily less precise than later ones.

A good estimate has four attributes: it should be close to the true value; it should be unbiased, with successive estimates not deviating consistently from the true value in a single direction; it should be well calibrated, meaning that the range of the cost estimate's uncertainty interval frequently includes the true value; and it should be reliable, in the sense that an expert's estimates can be repeated by others.[146]

For an estimate to have these attributes, the estimator needs two things: adequate data, and a clear understanding of how to use it in constructing the estimate. But, as the following sections explain, the data available in Australia is far from adequate, and there are shortcomings in the official guidance on cost estimation.

6.2.1 A fundamental gap is data on completed projects

Experts in cost estimation are calling for, and should get, better data.

Road experts from all jurisdictions are recommending a cross-jurisdictional database of final project costs and what gave rise to them.[147] It should be established. Minor variations in how state and territory governments select and procure infrastructure projects are insignificant when compared with the value of being able to learn from a large pool of projects generated by very similar processes. Such data would help specialists to develop better cost estimates at early stages of a project.

The database should contain sufficient information to enable experts to contextualise costs, such as project type, site, materials, utilities, environmental mitigation costs, and techniques. To do their job properly, experts also need:[148]

> direct costs from contractor, client-side project management/ stakeholder engagement/ environmental costs, costs arising from unforeseen risks, and contingencies . . . important categories of costs like utilities relocation that can have a significant impact on costs.

143. Potter (2020).
144. Transport for NSW (2020).
145. Infrastructure Australia (2019, p. 298).
146. DIRDC (2018, pp. 16–17).
147. Chowdhury et al (2020, p. 32).
148. Ibid (p. 32).

The Department of Infrastructure, Regional Development and Cities agrees. It has pointed to the challenges a cost estimator may face – key among them being 'not having access to historical cost databases' of the kind that are available to their US and European counterparts.[149]

This is not a new problem. In 2014, the Productivity Commission called for strategic benchmarking data, including costs per major unit, using a standard cost breakdown, and average expenditures over the construction period. The commission envisaged that this information would be required for any infrastructure project where there was a Commonwealth funding component, and that it would be independent of both government and industry influence.[150] Benchmarking data would complement the detailed data called for by cost estimation specialists, enabling a 'top down' view alongside the 'bottom up' view of detailed historical cost data.

Grattan Institute, too, has called for better data to assist cost estimation. In 2016, we recommended that the Commonwealth seek the cooperation of the states to create new benchmarking data to improve risk measurement in new project proposals.[151] We also recommended that the Commonwealth put to use the post-completion reports that states are already required to provide as a condition of their final milestone payment, by aggregating the data into a useful product.

Despite widespread understanding of the scarcity of data, it seems that almost nothing has happened since then.

The only progress has been a first step on the path towards achieving a benchmark series of construction costs per lane kilometre for roads. The Bureau of Infrastructure, Transport and Regional Economics conducted a pilot study in 2015 of 45 road projects and a 2017 update of 32.[152] This work was carried out at the request of the Transport and Infrastructure Council of the Council of Australian Governments,[153] which commissioned the work in response to recommendations of the Productivity Commission's inquiry.[154] The bureau's findings were interesting and suggestive, but limited by the small sample size and lack of detail (Figure 6.1 on the next page). The bureau recommended that the benchmarking be repeated in 2019 – which did not happen.[155]

Lack of data is showing up today in insufficient provision for 'worst case' cost outcomes

One clear manifestation of the scarcity of data is that the cost estimates of current projects continue to make insufficient provision for 'worst case' outcomes.

Business cases typically include an estimate of the the median cost, or 'P50', and the worst case, or 'P90'.[156] In business cases produced in recent years, the difference between P50 and P90 cost estimates is generally about 7 per cent (Table 6.1 on page 40). But the experience of the past two decades has shown that the difference between the P50 and P90 costs is actually 49 per cent, on average.[157]

This difference between usual cost estimation practice and observed reality would be unlikely to occur were a cross-jurisdictional database of

149. DIRD (2017, p. 8).
150. PC (2014, pp. 47–48).
151. Terrill and Danks (2016, pp. 7–8).
152. BITRE (2018).
153. Transport and Infrastructure Council (2015).
154. PC (2014, p. 47).
155. BITRE (2018, p. 21).
156. 'P50' refers to the amount which the actual project cost will exceed in 50 per cent of cases. 'P90' refers to the amount which the actual project cost will exceed in the worst 10 per cent of cases.
157. Analysis based on comparison of final project cost to the estimated cost when first committed. Ten per cent of projects overrun by more than 49 per cent after the project is committed, while the median overrun is zero: Grattan analysis of Deloitte Access Economics *Investment Monitor*.

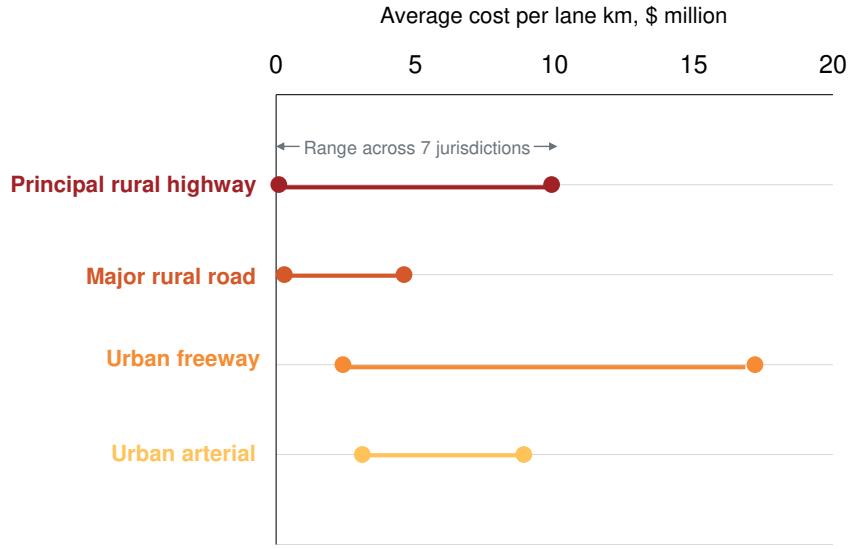
final project cost outcomes available to estimators. Such a database would indicate that large cost overruns are far more frequent than recent cost models imply.

This comparison of cost estimation practice and actual experience shows that either median cost estimates are generally too high, or – more likely – 'worst case' cost estimates are generally too low.[158] Cost estimates are making insufficient allowance for unlikely events that cause large cost overruns. Part of the reason for this is likely to be that most cost estimation methods recommended in guideline documents and handbooks do not include the costs of any unknown risks not explicitly identified by the estimator (see Appendix B).

The P90 estimate for the West Gate Tunnel in the 2015 business case was $5.548 billion, 6.2% higher than the P50 estimate. Were this P90 estimate correct, it would indicate that there is only a 10 per cent probability that the eventual project costs would exceed $5.548 billion. As shown in Section 1.1.1 on page 8, the current cost estimate is $6.7 billion, and there are reports that costs could further blow out.[159] Given this situation, it seems unlikely that the P90 estimate of $5.548 billion took sufficient account of unlikely adverse events.

There is a pressing need for better data.

Figure 6.1: Road costs vary widely across jurisdictions



Notes: Costs per lane kilometre exclude property acquisition and supplementary costs. BITRE randomly assigned responding jurisdictions a number between 1 and 7. Tasmania did not provide data in 2017.

Source: BITRE (2018, Table R.B3, p. 26).

158. In fact, it is clear that relying on median cost estimates will systematically understate the cost of the portfolio of projects. This is because the distribution of cost estimates is right-skewed, and therefore the mean, or expected value, is greater than the median cost estimate. More detail on the distribution of cost estimates is in Appendix B.
159. Jacks (2020).

Table 6.1: The difference between median and 'worst case' cost estimates is lower, on average, than experience suggests it should be

		Cost estimate (nominal, $millions)		
Project	**State**	**Median**	**'Worst case'**	**Difference**
Inland Rail	National	$9,889	$10,657	7.8%
Metro Tunnel	Vic	$10,154	$10,837	6.7%
West Gate Tunnel	Vic	$5,226	$5,548	6.2%
Canberra Light Rail	ACT	$759	$806	6.2%
Bruce Highway – Cairns Southern Access Corridor (Stage 3)	QLD	$470	$500	6.4%
Bruce Highway – Cairns Southern Access Corridor (Stage 4)	QLD	$97	$104	7.2%
M1 Pacific Motorway – Eight Mile Plains to Daisy Hill	QLD	$713	$747	4.8%
M1 Pacific Motorway – Varsity Lakes to Tugun	QLD	$960	$1,017	5.9%
Townsville Eastern Access Rail Corridor	QLD	$369	$392	6.2%
		Benefit Cost Ratio		
		Median	**'Worst case'**	**Difference**
Beerburrum to Nambour Rail Upgrade	QLD	1.48	1.35	9.6%
Bruce Highway – Deception Bay Road Interchange	QLD	3.23	3.03	6.6%
Bruce Highway – Maroochydore Interchange	QLD	3.4	3.2	6%
Bruce Highway – Bribie Island Road to Steve Irwin Way	QLD	2.02	1.91	5.8%
Centenary Bridge Upgrade	QLD	0.85	0.75	13%
Smithfield Transport Corridor Upgrade	QLD	2.9	2.6	11%
			Average difference of above estimates	7.3%
			Average actual difference across all projects completed in the past 19 years	**49%**

Notes: Public business case documents for the last six projects in the table do not explicitly include median and 'worst case' cost estimates on a comparable basis. They do, however, include benefit cost ratios estimated using median and 'worst case' cost estimates. The relevant difference between these benefit cost ratios is equal to the ratio between median and 'worst case' cost estimates, inflated and discounted, including operational costs. Operational costs are typically less than 6 per cent of capital costs for these projects.

Sources: ARTC (2015, p. 19), Victorian Department of Economic Development, Jobs, Transport and Resources (2016, p. 9), Victorian Government (2015, p. 211), Capital Metro Agency (2014, p. 86), Building Queensland (2017a, p. 4), Building Queensland (2017b, p. 3), Building Queensland (2018a, p. 3), Building Queensland (2018b, p. 3), Building Queensland (2017c, p. 131), Building Queensland (2016, pp. 12–13), Building Queensland (2018c, p. 9), Building Queensland (2018d, p. 9), Building Queensland (2018e, p. 10), Building Queensland (2019, p. 10), Building Queensland (2017d, pp. 13–14), and Grattan analysis of Deloitte Access Economics Investment Monitor*.*

Recommendation 6

The government of each state should require its infrastructure minister to provide completed project data for any infrastructure project valued at $20 million or more, to that state's infrastructure advisory body. The completed project data should include:

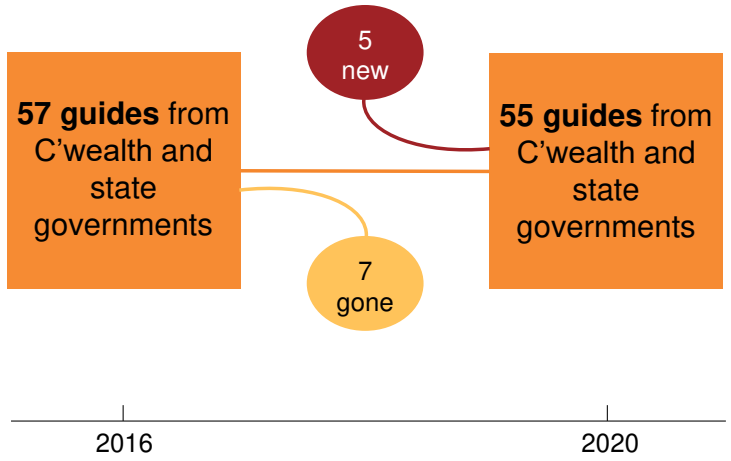
- First announced cost, contracted cost, cost estimate at the start of construction, any further significant changes to costs, and final outturn costs:
  - sub-divided into project management, preliminary design and investigation, property acquisition, and construction cost components.
- Key physical characteristics of the infrastructure, including type of road or track, number of lane or track kilometres, and length of any tunnel.
- Project location, including green- or brown-field, geology, and whether CBD, urban, or rural.
- Estimated and actual construction start and completion dates.
- Any material changes to scope, and the reasons and dates.
- Contract type and partners.

Chief Executive Officers of the state infrastructure advisory bodies should agree on the data definitions and format, to facilitate pooling of data across state lines.

6.2.2 A proliferation of cost estimation handbooks adds unnecessary complexity

In 2016, we at Grattan Institute were startled to discover there were more than 50 current guideline documents and handbooks on how to estimate project costs in Australia. Four years later, not much has changed: seven guidance documents have been retired, but another five have sprung up in their place (Figure 6.2).

Figure 6.2: There are 55 guides in Australia for estimating the cost of transport infrastructure projects



Source: Grattan analysis of Australian Commonwealth and state guidance.

Ultimately, all cost estimates use some combination of four tools: expected value, sensitivity analysis, probability pricing, and reference class forecasting, often referred to as benchmarking or validation (see Appendix B). But the handbooks that are current today present these same basic tools in a wide variety of ways, and they are inconsistent in terms of which tools they recommend, and in how they guide the user through the relationships among the various tools.

It is not obvious why Australian jurisdictions need different approaches to the same basic tools. Not only are the core tools presented in inconsistent ways, but the data that would be required to use the tools properly is not available to cost estimators. In particular, probability pricing and reference class forecasting rely on historical cost outcomes.

It would be prudent for governments embarking on megaprojects, with the associated complexity and risk, to ensure a high competency standard for those involved; for instance, registration as a cost engineer or risk engineer.

Recommendation 7

The Commonwealth Government should provide model guidelines that states and territories may adopt or adapt, that recommend a consistent approach to measuring and managing project risk, including a statement of seniority where specific guidelines would otherwise conflict with one another.

6.3 Learn from history

There is an element of chance to any individual project finishing on budget. It would therefore be fair to argue that imperfect cost estimates simply reflect the difficulty of the cost estimation task – if it were true that cost underruns were anywhere near as common or as large as cost overruns.

But overruns are much more common and much larger than underruns. The reasons are not a mystery – as this report has shown, large projects are more prone to overruns and to larger overruns; also prematurely announced projects are more prone to overruns, which are often larger too.

The following sections point to two other predictors of overruns: broader market conditions, and contract type.

6.3.1 Take advantage of cyclical conditions

While the number and size of cost overruns well and truly eclipses the number and size of cost underruns, the six largest underruns since the beginning of 2001 all occurred on projects completed since the beginning of 2015. In that period, 12 per cent of projects finished below their first announced cost, compared to 9 per cent in the 14 years before.

Similarly, cost overruns were less frequent and smaller on average in the period from 2015 to 2018 than the long-term averages – although the trend was not sustained into 2019.

This potentially promising trend to smaller overruns and more underruns appears, at least in part, to have resulted from favourable cyclical conditions. According to the International Monetary Fund, individual projects can cost 10-to-15 per cent more simply because they are built at a time of particularly high public investment.[160]

The period of fewer and smaller overruns since 2015 may have reflected an unexpected flattening in costs in the preceding years (Figure 6.3 on the next page). Initial cost estimates would have

160. IMF (2020, p. 37).

assumed that recently-observed growth in prices in the construction market would continue in the near future. If that growth did not eventuate, and prices flattened, bids for tenders may have come in lower than expected, leading to projects contracted or constructed at lower-than-expected costs between late 2013 and late 2016. And a number of these projects would have been completed from about 2015 onwards.

These market conditions probably also led to a period of more frequent and larger underruns.

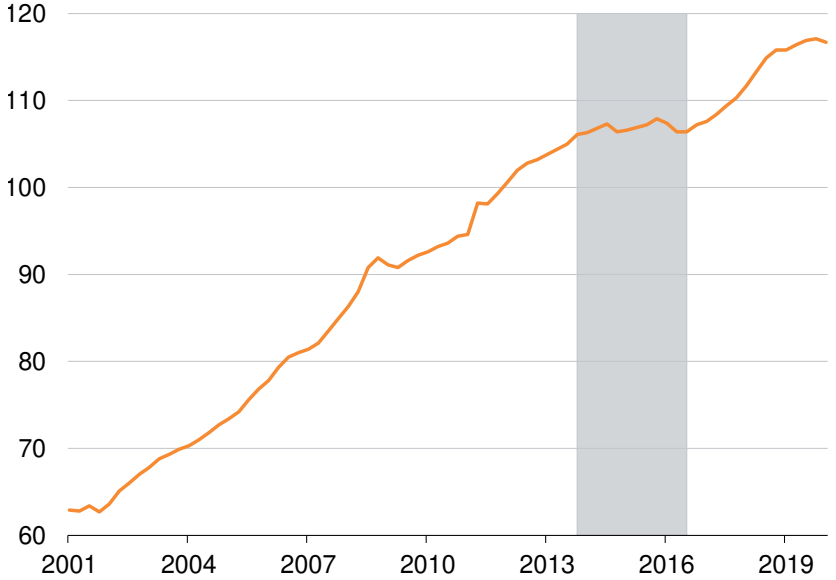
A major factor in this increase in underruns appears to have been conditions in the construction market as the mining boom wound down. In late 2014, it was reported that 'the cost of building projects has fallen by up to 50 per cent as construction firms desperately seek work after the end of the mining boom'.[161] The then Minister for Infrastructure and Regional Development, Warren Truss, was quoted as saying:[162]

> What we have found is that when we have been calling tenders for projects over the last 12 months or so, we are getting prices sometimes as low as half the cost that we were being asked to pay three or four years ago, or maybe two or three years ago... Almost universally now tenders are coming in under our estimates, and projects are being completed under our estimates.

These conditions were still prevailing almost two years later, when BIS Shrapnel reported that its monitoring of major projects was revealing 'more projects where the winning bid is much lower than what was initially budgeted (and expected) by governments'.[163] The BIS Shrapnel report noted the example of the Cooroy to Curra: Section C project on

Figure 6.3: Transport construction costs were broadly flat between late 2013 and late 2016

Producer Price Index, road and bridge construction, Australia



Source: Index Number 3101 from Table 17 of ABS (2020c).

161. Freed (2014).
162. Ibid.
163. Hart (2016).

the Bruce Highway. Originally estimated to cost $624 million, it was contracted in February 2016 for $384 million.[164]

Another Queensland project contracted around the same time, Stage 2 of the Gold Coast Light Rail, had a similar experience. The total cost of the project had been reported as $700 million in December 2015.[165] But when the contracts were awarded in March 2016, the cost had dropped to $420 million.[166]

We'd expect prices in a market to fall as demand does. But even in the specific example of the market for infrastructure construction, where prices reflect – among other things – the risk that something might be more costly to build than expected, contractors are willing to take on a given level of risk for a lower price if there is less work around.[167]

The implication of this finding on more and larger cost underruns, along with fewer and smaller cost overruns, is that there are potentially material value-for-money gains if governments take care and a medium-term view on the timing and rate at which they introduce new projects to the market. This indicative finding warrants more detailed analysis by governments.

6.3.2 Analyse the cost outcomes of different contract types

There is lively debate at present about the allocation of risk between government and the firms it contracts with to construct public infrastructure. In particular, many industry players are unhappy with the risk allocation inherent in proposals going to market: 'John Holland will no longer bid on projects where it believes the risk profile is unacceptable,' its CEO, Joe Barr, said in March 2020.[168]

Australian governments allocate risks among the parties through the choice of contract type, and the precise terms of the contract. The Public Private Partnership, or PPP, model is widely used because it allocates additional risk to the private sector.[169] The risk allocation comes at a cost, of course, the idea being that PPPs can result in lower costs than traditional delivery models if the additional commercial discipline is greater than the higher costs of private capital that PPPs incur.

We have been unable to analyse the impact of contract type on cost outcomes for this report, due to the paucity of data available. There have been very few Australian studies of this question, and those that have been published have been limited by very small sample sizes. Governments should invest more in understanding the patterns of outcomes of different contract types.

6.3.3 Publish post-completion reviews of big projects

Large public infrastructure projects are funded wholly or mostly by taxpayers. Therefore the community at large has a stake in knowing how projects turned out, whether costs were well managed, and whether the initial promises were delivered. But at present, information on project delivery is not presented in a clear way.

Post-completion reviews should be conducted on all big infrastructure projects. Infrastructure Australia requires them in its Assessment Framework,[170] and has elevated them to a principle of infrastructure decision-making.[171] The Commonwealth Department of Infrastructure, Transport, Regional Development and Cities supports the notion that funding should be contingent upon proponents agreeing to

164. Rostron (2016a).
165. ABC News (2015).
166. Rostron (2016b).
167. Battley (2020).
168. Wiggins (2020b).
169. Hayford (2020b, p. 4).
170. Infrastructure Australia (2018b, pp. 38–41).
171. Infrastructure Australia (2018a, p. 3).

post-completion reviews,[172] and has laid out how they should happen.[173] The Productivity Commission wants them too.[174]

Post-completion reviews are a matter of routine elsewhere. For instance, England's Post-Opening Project Evaluation analyses safety, cost, environmental impacts, accessibility, and integration with other local, regional, and national plans and programs. Norway's post-opening evaluation of major projects examines the monetised costs and benefits, including construction costs, levels of demand, accidents, and local air pollution.[175]

But no matter how often it's recommended in Australia that projects be evaluated post-completion, it almost never happens. Of large projects (costing more than $500 million) completed in the past four years, the only published post-completion report is for stage one of the Capital Metro light rail in Canberra.[176]

The lack of post-completion reviews reveals a desire by Australian governments to avoid accountability – and it amounts to a wasted opportunity to build internal capacity and learn from history.

Recommendation 8

State governments should be required by legislation to publish post-completion reviews of all projects costing more than $100 million. Reviews should include:

- Eventual costs.
- A rigorous estimate of eventual benefits.
- An explanation of deviations from initial estimated costs and benefits.
- Contract type.
- Scope changes.

172. DIRD (2016, p. 66).
173. DITCRD (2019, p. 20).
174. PC (2014, Recommendation 7.1).
175. Jong et al (2019, p. 77).
176. The Capital Metro Delivery Report includes a preliminary evaluation of benefits, and a revised estimate of the project benefit cost ratio: Transport Canberra (2019).

Appendix A: Methodological appendix

Many of the charts and much of the analysis in this report – in particular the analysis of cost overruns in Chapters 2 and 3 – use data on projects from the Deloitte Access Economics *Investment Monitor*. This appendix describes the *Investment Monitor* and how we prepared the data for analysis.

A.1 Deloitte Access Economics *Investment Monitor*

Since 2001, Deloitte Access Economics has routinely screened government budgets, announcements by private companies, the media, and other publicly available data sources to produce a quarterly snapshot of expected investment plans for each sector, including transport. We have linked the quarterly releases of the *Investment Monitor* from Q1 2001 to Q1 2020 to form a panel dataset that tracks the expected cost and degree of commitment to all publicly announced investment projects from first announcement through to completion.

A.2 The sample we used

Our sample consists of projects from the *Investment Monitor* that:

- are road or rail projects;
- had an initial expected cost of at least $20 million in nominal terms; and
- are 'public' projects.

We define a 'public' project as an investment by a government body in publicly accessible road or rail infrastructure. Our definition includes Public Private Partnerships (PPPs), but excludes investments by private operators of public infrastructure. The *Investment Monitor* has a variable indicating whether projects are public, private, or a PPP, but we do not rely on this variable because it is incomplete and is not consistent with our preferred definition in some cases.

For our analysis of cost overruns, we considered only projects that had been recorded as 'Completed' in the *Investment Monitor*'s historical database as at the end of March 2020. The historical database is a record of, among other things, the final cost and status of each project that leaves the *Investment Monitor*'s quarterly 'pipeline'.

For Figure 1.1 on page 5, Figure 1.2 on page 6, and Figure 4.1 on page 22, we considered only projects that had been recorded as 'Completed' or were still in the pipeline as at the end of March 2020. This removed some irregularities in the data relating to projects that do not appear to have been seen through to completion.

A.3 How we compared the costs of projects that occurred at different times

The *Investment Monitor* generally records the expected and final cost of a project in nominal, outturn dollars. To compare the costs of projects that occurred at different times, we adjusted costs for inflation using the Australian Bureau of Statistics's Producer Price Index for road and bridge construction (Index Number 3101).[177] Although this index does not include railway construction, we considered it a more appropriate index of transport construction costs than its parent indices, which include many non-transport construction activities.[178]

177. ABS (2020c, Table 17).
178. We consider our approach here to be an improvement on that in our 2016 report, *Cost overruns in transport infrastructure*, where we adjusted for inflation using Index Number 30 'Building construction'.

We assume that the distribution of project costs across time is the same for all projects, and we convert nominal outturn costs to Q1 2020 dollars from the middle year of the period during which each project was under construction. While only approximate, this approach is sufficient for controlling for the effect of inflation at the aggregate level under the assumption that the distribution of project costs over the construction period does not vary with time. Importantly, the inflation adjustment procedure does not affect the estimates of the size of cost overruns in this report, only the relative size of projects that are constructed in different periods.

A.4 How we checked 'outliers'

In the first instance, we measured cost overruns over the life of a project as the final cost in the historical database minus the first cost estimate that appeared in the quarterly pipeline (i.e. the initial cost).[179] We then verified the initial cost, first cost when committed, first cost when under construction, and final cost, of the projects with the largest changes between initial and final costs (both overruns and underruns). This was to provide assurance that the largest cost changes in our analysis were not driven by erroneous datapoints or an artefact of how a project and its costs had been recorded over time in the *Investment Monitor*.

It was beyond our resources to research the cost histories of all 683 completed, public road and rail projects in our sample. Therefore, we restricted our checking in the first instance to the 54 projects whose final cost was at least $250 million (in $2020) higher or lower than their initial cost. This threshold was chosen somewhat arbitrarily as the level at which a tractable amount of research and checking would account for the vast majority (almost 80 per cent) of the total value of cost changes.

Having done these checks and correcting costs where appropriate, we performed a second round of checks. This involved checking costs of projects for which the change in cost as a percentage of initial cost was outside the range of percentage cost changes on projects that were looked at in the first round of checking. Such 'outliers' were checked progressively until no project in the sample had a percentage change in cost that was outside the range of those checked. This process resulted in an additional 10 projects having their costs checked.[180]

Of the 64 projects we reviewed in total, we revised the initial cost of 34 and the final cost of 17. These changes resulted in a 1 per cent decrease in the total initial costs of these 64 projects, and a 4 per cent decrease in the final costs.

In many cases we needed to change cost estimates because:

- the fundamental purpose of the project changed over time (see Box 2 on page 15); or
- components of the project were added or subtracted to the project record in the *Investment Monitor* over time (e.g. a record may have begun life in the *Investment Monitor* relating to an entire project, but at some point in time changed to relating to a single stage of the project only – or vice-versa).

These issues arise because we have linked into a time series a dataset (the *Investment Monitor*) which is intended to be looked at as a quarterly snapshot.

179. 'True' overruns will be probably *underestimated* to the extent that projects had early cost estimates that were missed in the compilation of the *Investment Monitor*, including because such estimates were announced prior to commencement of the *Investment Monitor* in 2001.

180. Our treatment of outliers in this report differs to that in our 2016 report. In the 2016 report we simply excluded projects with percentage cost changes outside the range observed on a smaller sample of projects that we manually collated: Terrill and Danks (2016, pp. 64–65).

Appendix B: Risk appendix

The cost estimation handbooks that are current today generally recommend some combination of four tools: expected value, sensitivity analysis, probability pricing, and reference class forecasting, often referred to as benchmarking or validation.

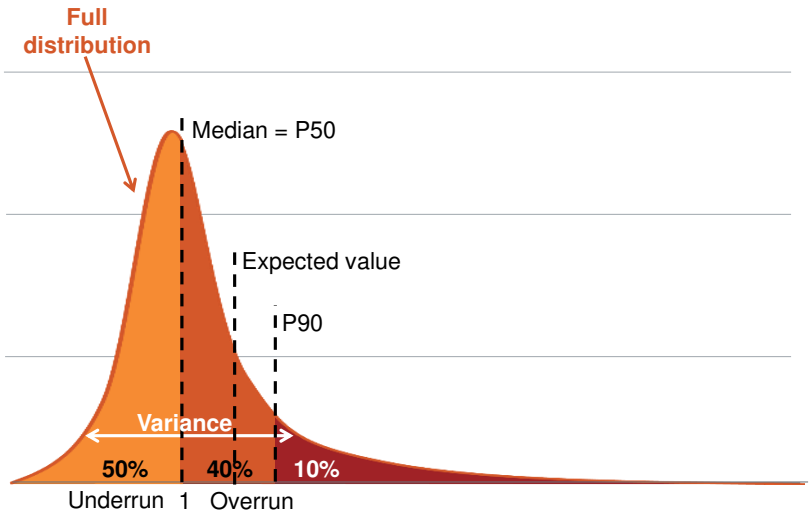
The first three tools involve the estimation of particular statistics, or characteristics of the distribution of potential costs. Reference class forecasting is a method for estimating the overall distribution.

The expected value of a project's cost is the average or mean cost of a project. It is calculated by assigning a single probability to each potential cost outcome, and multiplying this probability by the cost of that particular outcome if it did occur. This is the simplest approach to estimating the likely size of cost overruns. Its main shortcoming is that it does not include the costs of any unknown risks not explicitly identified by the estimator.

Sensitivity analysis assesses the range within which a cost estimate is likely to vary. It involves specifying the range of values that critical inputs to project cost estimates could take, and estimating how much the project would cost if the inputs were to take these values. Like the expected value methodology, it does not deal with unknown risks not explicitly identified by the estimator.

Probability pricing identifies how large a project budget needs to be to accommodate a specific probability that the project will be completed within budget. For instance, most projects have 'P50' (or median) and 'P90' (or 'worst case') cost estimates, which identify the prices for which it is expected that a project will meet or better its budget in 50 per cent or 90 per cent of cases respectively.

Figure B.1: Key risk measurement and management concepts
Illustrative probability distribution of cost outcomes on individual projects



Notes: The distribution of cost risk depicted is a stylized representation of the distribution of cost overruns. This chart illustrates the relative distances between key points of the distribution.

Reference class forecasting, often referred to as benchmarking or validation, compares cost estimates for one project to those on similar projects that have already been built. The average size of cost overruns observed across the sample can be used as an estimate of the expected value of cost overruns; the variance of the outcomes on the comparison projects can be used to understand the range within which a cost estimate is likely to vary; and the different points within the observed distribution can be used to estimate probability prices.

Reference class forecasting incorporates the likely costs of unknown risks and does not suffer from optimism bias, because it relies on objective historical information. Its main shortcoming is that it does not account for the ways in which a project's risk profile is unique.

Figure B.1 on the preceding page illustrates these tools for the costs of a group of completed projects: expected value (or mean); variance (assessed by sensitivity analysis); and probability pricing levels. The fourth tool, reference class forecasting, offers a way to improve the quality of expected value, sensitivity analysis, and probability pricing by relying on experience.

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