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Enhancing productivity in infrastructure delivery

Policy directions paper

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Enhancing productivity in infrastructure delivery: Policy directions paper

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Executive Summary

Adequate infrastructure is essential to support a sustainable, liveable, and productive Australia. As part of the economic recovery response to COVID-19, governments have committed to a significant number of infrastructure projects at various stages of development, and to fast-tracking shovel-ready projects. Despite this, longstanding flaws in project planning, procurement and capability, and barriers to the uptake of innovative design and new technologies, will impede productivity and delivery.

This infrastructure policy directions paper provides recommendations from Engineers Australia on the measures required to enhance economic productivity in Australian infrastructure delivery. These recommendations will assist to increase productivity in the infrastructure sector, and determine how engineers can best contribute to meaningful, evidence-based development of policy in support of these aspirations.

Efficient and effective infrastructure is vital to our country's economic prosperity. Federal, state and territory governments must commit to a coordinated project pipeline through collaboration, thorough application of risk-management practices, a mature approach to project governance and procurement, and funding for infrastructure investments.

Industry also has a crucial role to play in building a healthy and progressive infrastructure sector in Australia. There is an opportunity for government and industry to consider how we collaborate and compete while working towards a prosperous and secure future for our communities and businesses in a post-COVID-19 world. Governments at all levels must work collaboratively to implement the recommendations contained in Infrastructure Australia's *Australian Infrastructure Plan 2021*.

Pipelines need to reflect priorities, based on risk and value, but flexibility is essential as priorities change. All political parties should commit to risk- and value-based prioritisation, derived from a risk assessment process, to provide a more objective list of project requirements and outcomes.

Infrastructure projects are mostly medium-to-long-term endeavours, taking many years to reach completion. Procurement processes are often unreasonably complex, with tendering and contracting issues regularly preventing small-to-medium-sized enterprises (SMEs) from equitable participation. Improving management and project procurement practices is essential as we move toward a more sustainable, productive, and resilient future.

Access to lessons learned is also necessary to drive desired behaviours in infrastructure project management, delivery, and operations. Greater collaboration is needed on this issue between government, contractors, and industry, but ensuring in-house technical capability is also vital.

Engineers Australia believes new models for infrastructure planning, funding and delivery are critical. A firm pipeline provides continuity, which is imperative to long-term planning. The infrastructure schedule of works should have committed project funding for at least the first five years of work, with additional prioritised projects for the following five years.

There also needs to be clarity on the applicability of the 'common design' approach and more scope for customised solutions. Engineers Australia recommends balancing a focus on national design standards, guidelines, and specifications, which would drive efficiency and control cost, with innovation.

Broad uptake and use of digital technologies at all phases of asset lifecycles will enhance productivity in infrastructure delivery and operation. Governments must allocate funding for training and upskilling the labour force and subsidise programs to promote collaboration between industry and academia to encourage greater integration of current and emerging technologies. In addition, people from a range of socioeconomic and sociocultural backgrounds, with different genders, abilities, and experiences, must be included in the planning and design of infrastructure assets. Homogeneity in teams limits innovation and leaves blind spots in planning and riskmanagement practices.

Infrastructure is the basis of civilisation, and longstanding challenges can be addressed through the recommendations contained in this paper. There are significant opportunities for reform to enhance productivity at all stages of infrastructure project lifecycles.



1. Introduction

Infrastructure is the cornerstone of civilisation. Adequate infrastructure is essential to support a sustainable, liveable, and productive Australia.

As part of the response to economic recovery in the wake of COVID-19 and associated restrictions, governments have committed to streamlining the infrastructure development process, and to fast-tracking shovel-ready projects. Despite this, longstanding flaws in project planning, procurement and capability, and barriers to the uptake of innovative design and new technologies, will impede productivity. There are significant opportunities for reform to enhance productivity at all stages of infrastructure project lifecycles.

This infrastructure policy directions paper provides recommendations from Engineers Australia on the measures required to enhance economic productivity in Australian infrastructure delivery.

In this document, the term *infrastructure* refers to the classes of economic infrastructure for which the Australian Bureau of Statistics provides data. These include: roads; highways and subdivisions; bridges; railways; harbours; water storage and supply; sewerage and drainage; electricity generation, transmission and distribution; pipelines; telecommunications; recreation assets; and assets related to oil, gas, coal, and other minerals.

Engineers Australia is the peak body for the engineering profession in Australia. With more than 105,000 members, we represent individuals from a wide range of engineering disciplines and branches. Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community. This policy directions paper is guided by our Royal Charter and Code of Ethics, which state that engineers act in the interests of the community, ahead of sectional or personal interests, working towards a sustainable future.

1.1 Consultation process

This policy directions paper is based on a series of roundtable discussions with Engineers Australia members, and broad consultation with internal and external members of the engineering profession, members of peer peak bodies, engineering industry professionals and representatives, specialists from academia and government, and other relevant stakeholders. These discussions constituted the initial consultation phase.

In late 2020, three roundtable briefings were held with Engineers Australia members. These were facilitated by the Infrastructure, Industry and Productivity chapter lead for Infrastructure Australia's *Australian Infrastructure Plan 2021* and chaired by Engineers Australia members. The *Engineers Australia infrastructure series discussion paper Enhancing productivity in infrastructure delivery (the discussion paper)* was developed based on feedback from these consultations.¹

The discussion paper was reviewed by Engineers Australia members and formed the basis of a roundtable discussion with executive-level representatives from across infrastructure-interested sectors. Feedback on the discussion paper, roundtables, and subsequent consultations have informed the recommendations contained in this policy directions paper.

¹ Engineers Australia, *Enhancing productivity in infrastructure delivery: Infrastructure series discussion paper*, March 2021, accessed February 2022 <https://www.engineersaustralia.org.au/government-and-policy/external-voice-project>

1.2 Overview

The extensive consultation process outlined in section 1.1 identified 20 recommendations for reform to support greater productivity and industry in the nine areas:

1. Project governance and planning
2. Collaboration
3. Risk management
4. Procurement
5. Lessons learned
6. Whole-of-life investment
7. Capability and diversity
8. Common design and industrialised construction
9. Digital infrastructure and innovation

This document provides recommendations for implementation by Australian governments, in collaboration with industry and academia, to increase productivity in the infrastructure sector and to determine how engineers can best contribute to these aspirations.

1.3 Next steps

This policy directions paper will provide the basis for further consultation to inform the initiatives and advocacy campaigns Engineers Australia will undertake, including in collaboration with others in the infrastructure sector, to contribute to a more productive, innovative, and resilient Australian infrastructure industry.

Engineers Australia's infrastructure workstream includes work on important future topics that will complement this paper. These topics include sustainability and resilience in infrastructure, cities, regions and remote communities, water, the future of transport, social infrastructure, telecommunications and digital and waste and the circular economy.

Engineers Australia welcomes the opportunity to discuss the content of this paper with interested parties. If you would like to engage with the work being undertaken, please contact policy@engineersaustralia.org.au

2. Recommendations

2.1 Project governance and planning

Recommendation 1: Governments must commit to long-term collaborative planning to mitigate the negative effects of short-term electoral cycles on infrastructure planning and delivery.

Recommendation 2: The House of Representatives Standing Committee on Infrastructure, Transport and Cities should consider establishing an advisory group, comprised of representatives from across infrastructure industry, associations, and academia, to advise on best practice in planning, delivery, and maintenance of Australian infrastructure.

Recommendation 3: The Standing Committee, working with the advisory group, should engage a broad range of stakeholders to develop an infrastructure industry playbook. This would be a best-practice guide mandating key policies to optimise benefits and minimise risk in infrastructure project management, delivery, and operations.

Recommendation 4: The sector must better communicate the desired outcomes of projects and embed sustainability, resilience and circular economy principles at all stages of the asset lifecycle.

2.2 Collaboration

Recommendation 5: Governments at all levels must work collaboratively to implement the recommendations contained in Infrastructure Australia's *Australian Infrastructure Plan 2021* particularly the sustainability and resilience recommendations outlined in Section 2.

2.3 Risk management

Recommendation 6: Best-practice risk management processes must be embedded into business-case planning and project lifecycle processes. They should include all stakeholders to identify, control, mitigate and report on risks at each critical project stage.

Recommendation 7: Risk-informed management practices require frameworks to manage risk across the value chain and to ensure appropriate allocation, reporting and discipline, and proactive management of risk and return at all stages of the project lifecycle.

2.4 Best-practice procurement

Recommendation 8: Essential reform of tendering processes should be considered. This would include: providing visibility of cost to tender bidders; early engagement of potential bidders before the request for tender stage; acceleration of the shortlisting and awarding processes, and of common projects that have been successfully delivered previously; and consideration of stage-based tender processes and in-house design teams to allow equitable participation of a broader bidder market.

Recommendation 9: Engineers Australia recommends governments implement a consistent procurement framework across all levels and between all departments associated with interrelated infrastructure, applying the ISO 55000 series of standards for asset management for consistency across states and territories.

Recommendation 10: Governments should avoid using non-standard contracts and provide visibility of contracts before tender, allowing sufficient time for review. Any required amendments to standard contracts must be subject to collaborative negotiation with industry stakeholders.

Recommendation 11: In addition to independent statutory infrastructure bodies (iBodies) providing training to decision-makers, relevant technical experts must be incorporated into all project planning, procurement, and decision-making processes at all stages of the project lifecycle.

2.5 Lessons learned

Recommendation 12: Engineers Australia recommends the Australian Government consider use of funding and payment withholding mechanisms to incentivise knowledge capture and sharing at project kick-off and completion.

Recommendation 13: Engineers Australia recommends that the Australian Government develop and implement a widely accessible, centralised database for lessons learned, with limited intellectual property controls.

2.6 Depoliticised whole-of-life investment

Recommendation 14: State and territory treasuries should develop a whole-of-life infrastructure benchmarking tool and mandate its use on projects of national significance.

2.7 Capability and diversity

Recommendation 15: Engineers Australia supports a halt on tenders between 18 December and 4 January to allow for holiday leave, recognising that the wellbeing of project teams is essential to innovation, quality, and good project outcomes.

Recommendation 16: State and territory governments should provide specialist programs to support skilled migrants to transition into occupations that align with their skills and qualifications, and should provide greater opportunities for them to engage in leadership roles across the sector. Where such programs exist, they should be subject to regular review to determine efficacy and allow for continuous improvement.

Recommendation 17: People from various socioeconomic and sociocultural backgrounds, with different genders, abilities, and experiences, must be included in the planning and design of infrastructure assets to maximise accessibility for all users.

2.8 Common design and industrialised construction

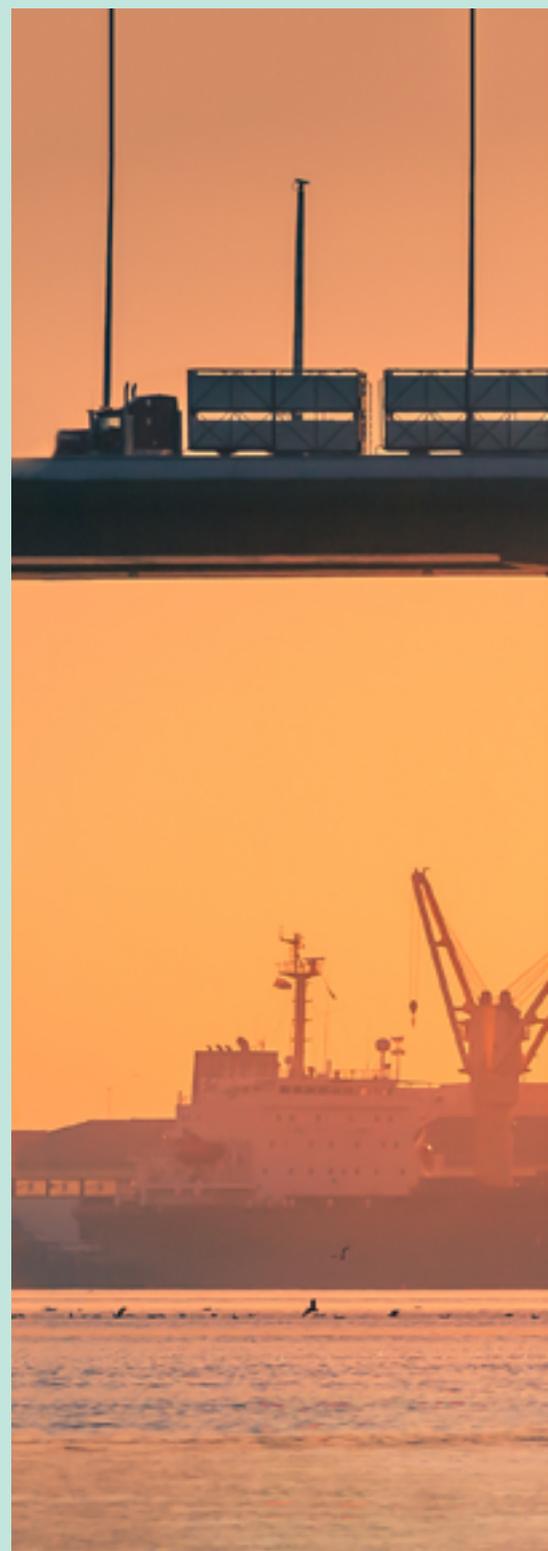
Recommendation 18: Engineers Australia recommends government and industry collaborate to nominate specific processes or products to be purchased across the project pipeline, while providing mechanisms for implementing customised solutions as required.

Recommendation 19: Engineers Australia recommends government and industry collaborate to ensure consistent national design standards, guidelines, and specifications, which would drive efficiency and control cost.

2.9 Digital infrastructure and innovation

Recommendation 20: Governments must allocate funding for training and upskilling of the labour force, and subsidise programs to promote collaboration between industry and academia to encourage greater integration of current and emerging technologies. This will be essential to designing a better future for Australian infrastructure.

Recommendation 21: Governments must provide a streamlined grants process and additional funding for start-ups and scale-ups to support innovation (for more information, refer to Engineers Australia's *Commercialisation of engineering innovation discussion paper*).





3. Project governance and planning

Australia is relying on governments to improve the management of project pipelines to boost our economy in the wake of the COVID-19 pandemic and to ensure we are future-ready. Collaborative, cross-sectoral, long-term planning of infrastructure is critical to sustainable economic prosperity.

The Australian Government must work with governments at all levels to commit to continuous improvement through best-practice project governance, planning, procurement, and delivery. Federal, state and territory governments must also commit to a coordinated project pipeline through collaboration, thorough application of risk-management practices, a mature approach to project governance and procurement, and funding for infrastructure investments.

Best practice requires that governments at all levels, and across all parties, work together to ensure a reliable and productive pipeline. Intergovernmental forums have been subject to several reviews, which have highlighted limited success in improving productivity. With the dissolution of the Council of Australian Governments (COAG) and the formation of the National Cabinet in March 2020, there is an opportunity for bipartisan, intergovernmental commitment to long-term planning. However, it is not enough for governments to simply talk to each other about the issues impacting the stability and productivity of our infrastructure project future. Engineers Australia recommends the establishment of an advisory group of relevant and diverse stakeholders to provide expert guidance to the House of Representatives Standing Committee on Infrastructure, Transport and Cities on specific issues in infrastructure industry.

An opportunity identified by Engineers Australia members and other key stakeholders is for the Australian Government to develop a blueprint for best practice in infrastructure construction.

The United Kingdom released the Construction Playbook to set out key policies and guidance for how public works projects and programs are assessed, procured, and delivered.² Whether a playbook or a blueprint, Australian infrastructure industry requires clear guidance on how to implement the existing Infrastructure Investment Program and the recommendations contained in the *Australian Infrastructure Plan 2021 to enable successful delivery*.

While not covered in detail in this paper, sustainability and resilience of infrastructure is an important overarching topic that requires consideration at every stage of an assets lifecycle. More severe and frequent extreme weather events – in the form of bushfires, flood and drought – disruptions due to the COVID-19 pandemic and geopolitical conflicts have exposed Australian infrastructure to heightened and more complex risks in recent years. These ongoing, and in many cases escalating issues, should inform every facet of the infrastructure conversation. The importance of this topic is highlighted in Infrastructure Australia's *Australian Infrastructure Plan 2021* with reforms concerning sustainability and resilience being considered in every chapter of the plan.³

An interdependent relationship exists between productivity and resilience as it relates to infrastructure. Investment, both monetary and time, in rebuilding and repairing damaged or offline infrastructure prevents the development of new capabilities and hinders growing demand by delaying other projects.

² Cabinet Office, *The Construction Playbook: Government guidance on sourcing and contracting public works projects and programmes*, Version 1.0, Cabinet Office, HM Government, December 2020, accessed February 2022 <https://www.gov.uk/government/publications/the-construction-playbook>

³ Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021 accessed 15 March 2022 <https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan>

Productivity within the sector is likely to decrease without a concerted effort to improve the resilience of current and future infrastructure.

Resilience goes further than just extreme weather events, and also includes supply chains, skills and cyber threats. To assist in responding to this issue the *Australian Infrastructure Plan 2021* proposes taking a systems approach to resilience, starting with developing a nationwide understanding of the risks being faced, and sharing accountability across all partaking organisations.⁴

Likewise, reforms are needed to enhance sustainability within the sector. Infrastructure Australia's *Delivering Outcomes: A roadmap to improve infrastructure industry productivity and innovation*⁵ calls for the sector to improve conveying desired sustainability outcomes to better facilitate the development of solutions, by focusing on the needs of people and place. Change is required to focus on longer-term decision making processes which are clear and comprehensive and recognise the future value derived by focusing on sustainability and resilience.

Due to the magnitude and complexity of this topic, Engineers Australia proposes to explore infrastructure sustainability and resilience in dedicated discussion papers and directions papers.

Recommendation 1: Governments must commit to long-term collaborative planning to mitigate the negative effects of short-term electoral cycles on infrastructure planning and delivery.

Recommendation 2: The House of Representatives Standing Committee on Infrastructure, Transport and Cities should consider establishing an advisory group, comprised of representatives from across infrastructure industry, associations, and academia, to advise on best practice in planning, delivery, and maintenance of Australian infrastructure.

Recommendation 3: The Standing Committee, working with the advisory group, should engage a broad range of stakeholders to develop an infrastructure industry playbook. This would be a best-practice guide mandating key policies to optimise benefits and minimise risk in infrastructure project management, delivery, and operations.

Recommendation 4: The sector must better communicate the desired outcomes of projects and embed sustainability, resilience and circular economy principles at all stages of the asset lifecycle.

4 Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021 accessed 15 March 2022 <https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan>

5 Infrastructure Australia, *Delivering Outcomes: A roadmap to improve infrastructure industry productivity and innovation*, 2022 accessed 21 March 2022 <https://www.infrastructureaustralia.gov.au/publications/delivering-outcomes>

4. Collaboration

Industry also has a crucial role to play in building a healthy and progressive infrastructure sector in Australia. The swift transitions required in response to COVID-19 pandemic restrictions have highlighted the need to reassess our infrastructure requirements for the future.

There is an opportunity for government and industry to consider how we collaborate and compete while working towards a prosperous and secure future for our communities and businesses in a post-COVID-19 world.

Engineers Australia supports the work of independent statutory infrastructure bodies (iBodies) and their assessments of long-term infrastructure needs. However, meaningful integration requires cross-party and multi-departmental commitment to using iBody recommendations for priority projects.

In the United Kingdom, Project 13 is an industry-led response to infrastructure delivery models that have failed clients, suppliers, operators and users of infrastructure systems and networks.⁶ The platform seeks to shift infrastructure delivery from a transactional model to an enterprising one. Its potential lies in promoting supply chain integration, enabling smart, collaborative working practices, and aligning commercial arrangements and incentives with customer and end-user outcomes. It emphasises the need to recognise infrastructure as an information-based industry. The benefits of Project 13 are greater certainty, productivity, performance and value in delivery and operation, and a more sustainable, innovative, and highly skilled industry. At its core, Project 13 relies on collaboration between owners, partners, advisers and suppliers through direct exchange, knowledge sharing and long-term alliances.⁷

Engineers Australia had the opportunity to provide engineering expertise to inform development of Infrastructure Australia's *Australian Infrastructure Plan 2021*⁸. *The recommendations contained in the Plan should be implemented according to the suggested sponsors and timelines.*

Recommendation 5: Governments at all levels must work collaboratively to implement the recommendations contained in Infrastructure Australia's Australian Infrastructure Plan 2021 particularly the sustainability and resilience recommendations outlined in Section 2.⁹

⁶ Project 13, *Project 13* [website], n.d., accessed 14 February 2022 <https://www.project13.info/>

⁷ Project 13, *About Project 13* [website], n.d., accessed 14 February 2022 <https://www.project13.info/about-project13/>

⁸ Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021 accessed 15 March 2022 <https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan>

⁹ Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021, p199, accessed 15 March 2022 <https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan>

5. Risk management

Pipelines need to reflect priorities, based on risk and value. However, as new information, technologies and risks develop or are identified, priorities may need to change. Such flexibility needs to account for works completed, costs incurred, and other commitments already applied. All political parties should commit to risk- and value-based prioritisation, derived from a risk assessment process, to provide a more objective list of project requirements and outcomes.

Major infrastructure projects are complex, lengthy and involve many diverse stakeholders at various stages throughout project lifecycles. These projects are regularly plagued by significant time delays, cost overruns, failed procurement, or funding difficulties. Many of these issues are avoidable, and result in significant losses to GDP and quality of life.

While some appetite for risk is necessary to encourage innovation, risk analysis is often undermanaged at various stages of the project lifecycle and value chain.

Thorough risk assessment in the initial project phase is critical to limiting risk in the next phase. Implementing continuous risk-management practices to monitor and control at each critical stage mitigates against realisation of identified risks at later project stages.

Proper consideration of appropriate risk allocation must consider the appetite and capability of potential owners to absorb risk. Those stakeholders should be engaged early and often to ensure responsibility and accountability throughout the project lifecycle. Inappropriate allocation of risk undermines the professional indemnity insurance market, breeding instability and contributing to a continuation of the boom-bust cycle. Risk management practices must be embedded into business-case planning and project lifecycle processes, and should include all stakeholders to monitor, control, mitigate and report on risks at each critical project stage.

Recommendation 6: Best-practice risk management processes must be embedded into business-case planning and project lifecycle processes. They should include all stakeholders to identify, control, mitigate and report on risks at each critical project stage.

Recommendation 7: Risk-informed management practices require frameworks to manage risk across the value chain and to ensure appropriate allocation, reporting and discipline, and proactive management of risk and return at all stages of the project lifecycle.

6. Best-practice procurement

Infrastructure projects are mostly medium-to-long-term endeavours, taking many years to reach completion. Procurement processes are often unreasonably complex, with tendering and contracting issues regularly preventing small-to-medium-sized enterprises (SMEs) from equitable participation.

Improving management and project procurement practices is essential as we move toward a more sustainable, productive, and resilient future.

Reform of tendering processes will be critical to providing SMEs with a chance to compete. Participation of SMEs is good for projects and good for the economy, but lengthy and costly processes have largely excluded such players from competing for large contracts. The cost to businesses of submitting a tender can sometimes outweigh the return on investment. Industry and government alike would benefit from greater visibility of how much it would cost a company to submit a tender. Early engagement with industry before tender should be encouraged to promote open dialogue between businesses and government. This would support greater transparency, knowledge capture and sharing, and equitable participation across the market. Including the estimated cost of the tender submission during pre-tender engagement processes would give the government insight into the cost barriers for some potential bidders. Solutions should then be explored to support reducing these costs, such as staged tenders or removing certain aspects from the tender and bringing those elements in-house, to allow for a healthier and more diverse market.

The procurement process sets the tone for the project. Setting the standard and behaviours of the project early, focusing on quality and safety, rather than lowest cost, is critical to developing the right project culture. Without compromising on quality and safety, the acceleration of decision-making in the awarding of tenders and commencing work is critical to hastening economic recovery in response to COVID-19. With government commitments to accelerating shovel-ready projects to stimulate the economy after restrictions ease, common projects that have been successfully delivered in the past could also be considered for acceleration. Provided that lessons learned have been captured, some cost savings could be achieved by simplifying tendering processes for such standard projects.

Ensuring that project bidders are shortlisted promptly can also assist in limiting the time and money spent by companies that are identified as unsuitable. Prequalification schemes must be reviewed to allow for greater diversity of potential bidders, and where existing bidders are prequalified, any requirements for previously provided material should be removed. Review and reform of procurement processes to improve national consistency will be essential to enhancing Australian productivity in infrastructure delivery. Stage-based tendering can and does work well in some industries. A way to encourage more diverse participation is to develop baseline infrastructure first, with a structured return on investment, before proceeding to the next level of value-adding infrastructure.

Due diligence activities must be applied in the early stages of all infrastructure projects for them to succeed. Engineers Australia supports Infrastructure Australia's recommendation to 'Uplift quality of infrastructure decision-making through development of delivery and training for key decision-makers on due diligence and de-risk, construction innovation, timing of project announcements, commercial and legal and project governance'.¹⁰ While such training would be undeniably beneficial and is considered essential, the importance of engaging broad technical expertise in these early-phase processes cannot be overstated.

¹⁰ Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021, p62, accessed February 2022 <https://www.infrastructureaustralia.gov.au/publications/2021-australian-infrastructure-plan>

It is impossible to deliver the breadth of training required for complex infrastructure projects in one program. So, while it is recommended that decision-makers are trained in the areas above, they must continue to engage and rely upon multidisciplinary infrastructure experts, including engineers, to advise on aspects where they do not possess the technical knowledge. Appropriate technical expertise in decision-making is vital to project success. Relevant expertise also assists with ensuring products sourced are fit-for-purpose and of suitable quality. Without adequate technical expertise, it will be difficult to maximise benefits and minimise risks.

The Office of Projects Victoria established the Australian Major Projects Leadership Academy to build and maintain the capability in complex infrastructure project delivery. This 12-month program has been developed and delivered in collaboration with the Oxford Saïd Business School and provides leaders of complex major projects with best-practice training. Current participants include state government and infrastructure agencies across Australia, to develop public sector capability. Similar training should be made available to private-sector clients to promote project success in both public and private infrastructure investment and planning. Ideally, the Victorian model should be emulated and accessible across all jurisdictions, and brought in-house in the various state and territory project offices and departments. Such models also provide access to a valuable network of project leaders with a platform to share insights, lessons, and case studies in a non-adversarial way.



Although states and territories have implemented asset management plans based on recommendations contained in the *Australian Infrastructure Plan 2016*, the four phases of the asset lifecycle – acquire, operate, maintain and dispose – are not embedded into planning, design, delivery, and operations. Governments need to implement a consistent framework across all levels and between all departments associated with interrelated infrastructure. Engineers Australia recommends applying the ISO 55000 series of standards for asset management to optimise management of Australian infrastructure assets, maximise value and make asset management consistent across states and territories.

Recommendation 8: Essential reform of tendering processes should be considered. This would include: providing visibility of cost to tender bidders; early engagement of potential bidders before the request for tender stage; acceleration of the shortlisting and awarding processes, and of common projects that have been successfully delivered previously; and consideration of stage-based tender processes and in-house design teams to allow equitable participation of a broader bidder market.

Recommendation 9: Engineers Australia recommends governments implement a consistent procurement framework across all levels and between all departments associated with interrelated infrastructure, applying the ISO 55000 series of standards for asset management for consistency across states and territories.

Recommendation 10: Governments should avoid using non-standard contracts and provide visibility of contracts before tender, allowing sufficient time for review. Any required amendments to standard contracts must be subject to collaborative negotiation with industry stakeholders.

Recommendation 11: In addition to iBodies providing training to decision-makers, relevant technical experts must be incorporated into all project planning, procurement, and decision-making processes at all stages of the project lifecycle.

7. Lessons learned

An essential component of driving desired behaviours in infrastructure project management, delivery, and operations is access to lessons learned. Increasingly, technical and specialist knowledge is being subcontracted out. At the completion of the project, the contractor moves on, along with their knowledge, and without this type of feedback, critical lessons are lost and are at risk of repetition in future projects.

Having core knowledge embedded in government agencies is important for oversight across major projects, to guard against repeated mistakes and to promote replication of project successes.

Greater collaboration is needed on this issue between government, contractors, and industry if it is going to be solved, but ensuring in-house technical capability is also vital.

Best practice requires continuous improvement, with an initial and ongoing cyclical review. When partnering, consultants and contractors can showcase work during the tendering process, exploring what was done last time and how it could be improved. Sharing lessons learned should be a condition of project funding and capturing further lessons in post-completion reviews should be a condition of final payment. Reviews should also be made available as a form of knowledge that is applied to future projects. Engineers Australia advises incentivising the review of past lessons at project kick-off and in post-completion evaluations. Lessons learned must be adequately captured in the closing report to ensure transfer of knowledge across major projects. Providing a platform for lessons learned with limited intellectual property controls would promote continuous improvement and avoid repeated mistakes.¹¹

Recommendation 12: Engineers Australia recommends the Australian Government consider use of funding and payment withholding mechanisms to incentivise knowledge capture and sharing at project kick-off and completion.

Recommendation 13: Engineers Australia recommends that the Australian Government develop and implement a widely accessible, centralised database for lessons learned, with limited intellectual property controls.

¹¹ Other modes of sharing lessons learned include programs for decision-makers, such as the Australian Major Projects Leadership Academy, and industry-led programs such as Project 13, as described earlier in this document.

8. Depoliticised whole-of-life investment

Engineers Australia believes new models for infrastructure planning, funding and delivery are critical. A firm pipeline provides continuity, which is imperative to long-term planning, particularly given that projects can take 10 to 15 years from strategic planning to commencement of operations. However, politically induced changes and/or shifting project plans create ambiguity. The infrastructure schedule of works should have committed project funding for at least the first five years of work, with additional prioritised projects for the following five years.

This is a challenge under the Australian federal system of government, where funding is allocated by both the Australian Government and the states/territories, but once a project is listed in the immediate schedule or forward works program, it should be committed for completion. There is the risk of a few mega-projects consuming budgetary allocation to the detriment of broader outcomes. However, the pipeline needs to balance budgetary constraints by prioritising projects across a range of asset classes (with predetermined proportion allocations – not solely based on a benefit–cost ratio criteria) and a range of project values.

Unfortunately, during election campaigns, political parties are incentivised to promote projects that appeal to electorates, as opposed to those which have been properly tested through impartial analysis. If viewed only at the electorate level, communities can tend to prioritise initiatives that meet their local needs, rather than taking a state- or nationwide perspective.

Futureproofing infrastructure requires a whole-of-life assessment of risk, cost, and schedule to extract maximum value for money. Whole-of-life assessment must embed resilience and sustainability in infrastructure across the lifecycle and plan for more frequent and extreme weather events associated with climate change. Australia supports *Infrastructure Australia's Australian Infrastructure Plan 2021* recommendation that advises state and territory treasuries to develop a '...nationally consistent whole-of-life infrastructure cost and schedule benchmarking tool and mandate its use on projects of national significance'.¹²

Recommendation 14: State and territory treasuries should develop a whole-of-life infrastructure benchmarking tool and mandate its use on projects of national significance.

¹² Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021, p62, accessed 14 February 2022. <https://www.infrastructureaustralia.gov.au/publications/2021-australian-infrastructure-plan>

9. Capability and diversity

The lack of diversity and the strain on the capability and capacity of teams, leading to poor mental health outcomes and poor project outcomes, is highly detrimental to attracting and retaining essential expertise in the infrastructure industry. Homogeneity in teams, particularly in decision-making roles, not only demonstrates a lack of inclusivity but also limits innovation and leaves blind spots in planning and risk-management practices. People with similar skill sets are incentivised to change roles, often to assist in tenders, and can find themselves overloaded.

Since early 2020, bushfires, floods and the impact of the pandemic have meant the collective mental health of Australians has suffered. Some industries have found themselves more overloaded than others, and with infrastructure set to pave the way to economic recovery, many construction companies are feeling the pressure to exert resources to support these endeavours. Businesses are calling on clients to support a blackout on tenders during the holiday period to allow recuperation and reconnection with family and friends. Engineers Australia supports these recommendations to halt requests for tenders between 24 December and January 4, recognising the wellbeing of project teams is essential to innovation, quality, and good project outcomes.

The engineering capability challenge must be addressed to harness existing skills, encourage greater participation in tertiary education, and retain talent. This can include providing strategic support for engineers at all stages of their careers for development opportunities and through the creation of an attractive, safe, and inclusive culture. Without the available expertise and skills to deliver projects successfully, model planning will be insufficient in delivering inclusive infrastructure that meets the needs of diverse communities across Australia. Federal, state and territory government's forecasting of infrastructure spending and work such as Infrastructure Australia's *Infrastructure Priority List*, can assist to predict the skills needed in the future.¹³ This information can be used to lessen future skills shortages. The technical expertise necessary to deliver efficient, effective, and sustainable infrastructure is multifaceted and requires a mix of graduates, early-career, mid-career, and seasoned experts from varied backgrounds. The sector needs to look at how it can invest in the skills required for tomorrow's infrastructure. This includes investment in young people through promoting engineering early in their education, development of early career graduates and having a greater understanding of the value of migrant engineers.¹⁴ Diversity delivers. Without the inclusion of people from a range of different socioeconomic and sociocultural backgrounds, with different genders, abilities and experiences, projects risk failure to fulfil the broad needs and expectations of Australian communities in infrastructure delivery.

Federal, state and territory governments have implemented programs at various levels to support migrants and refugees to find employment. Barriers exist for skilled immigrants across the engineering sector, and particularly in senior leadership roles. Engineers Australia's *Barriers to employment for migrant engineers*¹⁵ research report has analysed these barriers and delivered recommendations to address them. However, with so many skilled migrant engineers employed in roles that do not reflect the breadth of offshore qualifications and experience, there is an opportunity for state and territory governments to provide specialist programs to connect with skilled migrants who can fulfil the skills supply needs of industry.

13 Infrastructure Australia, *Infrastructure Priority List 2021*, accessed 11 March 2022

https://www.infrastructureaustralia.gov.au/publications/Infrastructure_Priority_List_2021

14 M Bell and P Briggs, 'Engineering Skills Supply and Demand: Discussion Paper' *Engineers Australia* March 2022, Accessed 11 March 2022 <https://engineersaustralia.org.au/government-and-policy>

15 J Romanis, 'Barriers to employment for migrant engineers', *Engineers Australia*, October 2021, accessed March 2022 <https://engineersaustralia.org.au/Government-And-Policy/Policy-Reports>

The lack of gender equality in design has been well documented, with data bias and the design of seatbelts, other protective gear, and virtual reality headsets just some of the examples of products that can result in inconvenient or even fatal consequences for women. The consequences of gendered design and planning extend to infrastructure, and unintentionally impact women disproportionately. A lack of consideration of the way in which gender influences our prioritisation, use and engagement with infrastructure must be considered, and can be addressed by ensuring equitable representation in decision-making roles and at all levels and stages of project lifecycles. The Organisation for Economic Co-operation and Development (OECD) published an Issues Note in March 2019 focused on Gender Equality and Sustainable Infrastructure,¹⁶ which highlighted that infrastructure is essential in providing equal opportunity through connected, safe, and efficient structures and services. Engineers Australia supports the OECD's call for integrated policy towards quality sustainable infrastructure development with a gender lens.

Encouraging greater access to education, training, and employment for First Nations Australian engineers will provide an essential cultural perspective to major infrastructure. The relationship of First Nations Australians to land and country will assist in bringing cultural protections and environmental management principles to major infrastructure projects.

Grant Maher, Chair of the Engineers Australia's Indigenous Engineering Group, believes that incorporating Indigenous perspectives in project planning will help to **'reduce our consumption and waste and come back to that original thinking where you are at one with the lands'**.¹⁷

Yuin man, Michael Hromek, the technical executive of Indigenous architecture at international professional services firm WSP, advises that 'avoiding building on cultural sites is important, but rather than Aboriginal knowledge being something that shouldn't be disturbed, we should think about how to tap into that knowledge and use it to change the built environment'.¹⁸ *There is an opportunity to bridge the 'gap between concrete and Country'¹⁹ through the incorporation of First Nations Australians' history and art into our built environment. With 39 per cent of Aboriginal and Torres Strait Islander people living in outer regional, remote, and very remote Australia, engagement with First Nations Australians representatives is essential when planning infrastructure for these communities.*²⁰

Approximately 15 per cent of the global population are living with a disability.²¹ Inaccessible infrastructure has a direct impact on the ability of individuals to contribute to society and the economy.

16 OECD Council on SDGs, *Issues Note: Gender Equality and Sustainable Infrastructure*, Organisation for Economic Cooperation and Development, March 2019, accessed 14 February 2022 <https://www.oecd.org/gov/gender-mainstreaming/gender-equality-and-sustainable-infrastructure-7-march-2019.pdf>

17 M Bower, 'Meet two Indigenous engineers helping to change the profession', *Create*, 12 November 2020, accessed February 2022 <https://createdigital.org.au/indigenous-engineers-helping-to-change-profession/>

18 R Cooper, 'Incorporating Indigenous knowledge into infrastructure projects', *Create*, 17 November 2020, accessed 14 February 2022 <https://createdigital.org.au/incorporating-indigenous-knowledge-infrastructure-projects/>

19 R Cooper, 'Incorporating Indigenous knowledge into infrastructure projects', *Create*, 17 November 2020, accessed February 2022 <https://createdigital.org.au/incorporating-indigenous-knowledge-infrastructure-projects/>

20 Australian Bureau of Statistics, *Estimates of Aboriginal and Torres Strait Islander Australians* [data set], ABS website, June 2016, accessed February 2022 <https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-aboriginal-and-torres-strait-islander-australians/latest-release>

21 A Agarwal and A Steele, *Disability Considerations for Infrastructure Programmes*, Evidence on Demand and UK Department for International Development, piv, accessed February 2022 https://assets.publishing.service.gov.uk/media/57a08954ed915d3cfd0001c4/EoD_HDYr3_21_40_March_2016_Disability_Infrastructure.pdf, doi: http://dx.doi.org/10.12774/eod_hd.march2016.agarwaletal

Transport and digital technology and energy access are critical, but inclusion of people with disability in all infrastructure planning and design processes is essential in all contexts to ensure accessibility in line with all user expectations. Improving access for people with disability can also benefit a whole range of other users, like cyclists, people with prams, the elderly, and pedestrians. In transport, whole-of-journey assessments must be made to ensure that people with disability are not excluded at any stage of a journey, whether it is multi-destination or requires mixed-mode transportation.

Recommendation 15: Engineers Australia supports a halt on tenders between 18 December and 4 January to allow for holiday leave, recognising that the wellbeing of project teams is essential to innovation, quality, and good project outcomes.

Recommendation 16: State and territory governments should provide specialist programs to support skilled migrants to transition into occupations that align with their skills and qualifications, and should provide greater opportunities for them to engage in leadership roles across the sector. Where such programs exist, they should be subject to five-yearly review to determine efficacy and allow for continuous improvement.

Recommendation 17: People from various socioeconomic and sociocultural backgrounds, with different genders, abilities, and experiences, must be included in the planning and design of infrastructure assets to maximise accessibility for all users.



10. Common design and industrialised construction

Common design implies that design is reduced to selection from a palette of pre-assessed and pre-manufactured options. There needs to be clarity on the applicability of this approach, and more scope for customised solutions.

While industrialised construction seeks to collect building information modelling to mine processes and data in search of efficiencies, and prefabrication reduces on-site construction time, project designs necessarily differ according to geographical and other requirements. Materials applicable to a dry inland climate may not work in a wet coastal environment. Engineers Australia recommends that government, in collaboration with industry, nominate specific processes or products to be purchased across the project pipeline, while providing mechanisms for implementing customised solutions as required.

Standardised infrastructure across states and territories makes longer-term integration and connectivity easier and saves money through high-volume procurement activities. There are benefits to automated design and production processes, but detailed testing, assessment and development of implementation strategies will be necessary before approving proposed solutions. Where government is the asset owner, consideration of strategic allocation of resources through standardised acquisition processes and the creation of a centralised data bank and decentralised flow of information is recommended and may assist in the short term. Transparency and accountability of these processes are essential to market confidence, as is depoliticised consensus-based decision-making.

Increased interstate cooperation and an increased focus on leveraging the supply chain should be key tenets of the infrastructure pipeline.

Research suggests that industrialised construction practices can reduce accidents, costs, time, labour, and waste. Automated systems can work in environments that may be dangerous, thereby reducing safety risks. There is evidence to support improved profitability and better outcomes for the end user achieved through application of industrialised construction principles, which clearly demonstrates the benefits of this approach. This will require development of a clear set of specifications, including guidelines on the development of specifications, quality control, and purchasing. Rather than focusing on common designs, Engineers Australia recommends focusing on national design standards, guidelines, and specifications, which would drive efficiency and control cost.

Recommendation 18: Engineers Australia recommends government and industry collaborate to nominate specific processes or products to be purchased across the project pipeline, while providing mechanisms for implementing customised solutions as required.

Recommendation 19: Engineers Australia recommends government and industry collaborate to ensure consistent national design standards, guidelines, and specifications, which would drive efficiency and control cost.

11. Digital infrastructure and innovation

Broad uptake of digital technologies at all phases of asset lifecycles will enhance productivity in infrastructure delivery and operation. The use of digital twins, smart sensors, building information modelling systems, digital engineering and digital asset management tools will ensure Australia is future-ready and that our infrastructure can be managed efficiently, sustainably and effectively. The use of technology has numerous positive impacts on the sector. These include enabling more collaboration and coordination between teams and stakeholders and increasing innovation through improved data capture, enabling a more detailed view of projects.²²

The Australian Government's Digital Economy Strategy includes some promising measures, such as the Digital Atlas and a pilot program to develop data inventories for government agencies, which will promote transparency and provide evidence to support appropriate investment in infrastructure. However, greater emphasis must be placed on integrating nationally consistent digital approaches to infrastructure project planning and operations now if Australia is going to be ready for the demands of the future. Engineers Australia recommends the establishment of a unit focused on Australia's digital infrastructure future to support agile development and the rollout of digital infrastructure tools.

The exponential rate of technological change is driving a huge disparity between cutting-edge robotic and artificial intelligence (AI) technologies in laboratories and the more manual traditional processes run on-site. To guard against the widening gap, which will make it difficult for some industries to catch up, government and industry must allocate funding for training and upskilling the labour force. Engineers Australia can work with universities to ensure course content provides graduates with knowledge of up-to-date practices and emerging technologies.

Industry 4.0 refers to the Fourth Industrial Revolution, where automation and smart technologies are applied to traditional manufacturing and industrial practices. Industry 4.0 talks extensively about smart data and sensors implemented in workshops or on sites to gather useful data. At first glance, this can be intimidating to businesses, but universities could devise a small sensor and data collection module. Working with industry associations to approach SMEs, universities could provide subsidised technology to fix a sensor on one piece of equipment to demonstrate the ease with which smart systems can be implemented. This would educate SMEs and build confidence, while also providing key data on hidden non-value-added tasks and inspiring the gradual integration of more sensors on other equipment.

Seamless integration of studies and training into existing business structures to support the use of AI, smart sensors, industrialised construction practices, and other new and innovative technologies and processes, will reinforce an innovation-positive work culture. Programs and tools for businesses to benchmark their status will assist in determining the benefits of innovative and new technologies.

22 H Hawkes, 'How digital engineering tools helped bring this major infrastructure project to life' *Create* 14 July 2021, accessed 10 March 2022
<https://createdigital.org.au/digital-engineering-tools-level-crossing-removal-project/>

Risk and innovation need to be rewarded in the same way that standardisation is rewarded – through cost savings. Government, as the primary client for infrastructure, needs to take more risks on Australian innovation. Specifically, there is a need to take more risk on local SMEs and start-ups rather than relying on subcontractors to large corporations. This is particularly important as the sector faces new challenges such as an increased focus on low carbon infrastructure, ways to support population growth and integration of renewable energy. There is too much focus on de-risking, which pushes providers to do what they know works, rather than focusing on opportunities. In project management, the risk needle needs to be pushed more towards medium rather than low-to-negligible risk and planning to manage that level of risk needs to occur.

Increased commitment to targets dedicated to projects in innovation, practice improvement and development resulting in long-term benefit, will ensure Australia is not left behind as the world moves to a more connected and digital future.

Having certainty of pipeline will encourage innovation and ultimately efficiency, as research and investment will be able to be undertaken in an environment of certainty.

COVID-19 has forced a rethink of the way Australians live, work, and communicate. It has required a rapid response and adaptation in industries and communities everywhere. There is an opportunity for governments and the private sector to invest in research and development and emerging technologies, industries, and careers. There is also the chance to do so with a start-up mindset, which is less constrained than what has worked in the past, and instead reimagines what the future could be. In response to global supply chain disruptions, governments should support measures to improve the capability of Australian manufacturers. In the short term, implementing ‘buy local’ policies will help domestic suppliers in the procurement phase.

There are further opportunities to link to the innovation sector and set up innovation hubs in regional areas, for example, in agriculture and water. Maintenance upgrades and renovation, as well as a focus on reinvigorating manufacturing industries, will unlock regional growth and provide support for growing populations. Some examples include Gippsland, Victoria, where there is an opportunity to repurpose existing skills and capacity as forestry and power industry activity decreases, and the former car-making city of Geelong, which could be reinvigorated towards the production of electric and automated vehicles.

Recommendation 20: Governments must allocate funding for training and upskilling the labour force and subsidise programs to promote collaboration between industry and academia to encourage greater integration of current and emerging technologies. This will be essential to designing a better future for Australian infrastructure.

Recommendation 21: Governments must provide a streamlined grants process and additional funding for start-ups and scale-ups to support innovation (for more information, refer to Engineers Australia’s Commercialisation of Engineering Innovation Discussion Paper).

12. Conclusion

Infrastructure facilitates trade and investment, drives economic growth and mobility, connects communities, and ensures Australians have access to reliable energy, transport, telecommunications, health care, and water.

Longstanding challenges in infrastructure project governance, planning, collaboration, risk management, procurement, review, data gathering and dissemination, capability, design, sovereign supply chains and technology can be addressed through further development and implementation of the recommendations contained in this paper. There are significant opportunities for reform to enhance productivity and outcomes at all stages of infrastructure project lifecycles.

Collaboration across government, industry, tertiary providers, and the community, underpinned by diverse multidisciplinary technical expertise at all stages of the infrastructure project lifecycle and harmonised standards and guidelines, will deliver better outcomes for our cities, regions, and remote communities.

Engineers Australia is committed to supporting government, academia, industry, and the community to achieve best practice for whole-of-life infrastructure investment, risk analysis, governance, and design towards a safe, productive, and resilient Australia.

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Enhancing productivity in infrastructure delivery

Policy directions paper

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