



ENGINEERS  
AUSTRALIA

# Enhancing productivity in infrastructure delivery

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INFRASTRUCTURE SERIES DISCUSSION PAPER

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# 1 Introduction

Engineers Australia is the peak body for the engineering profession in Australia. With about 100,000 individual members across Australia, we represent individuals from a wide range of disciplines and branches of engineering. Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

This discussion 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.

## DISCUSSION PAPER OVERVIEW

Engineers Australia believes it is important to begin a focused discussion with diverse stakeholders to develop solutions toward a sustainable, productive, and resilient future.

## PURPOSE

The purpose of this document is to engage Engineers Australia members and the engineering-adjacent community in a discussion about what it will take to increase productivity in the infrastructure industry, and to determine how engineers can best contribute to meaningful evidence-based policy development.

## CONSULTATION PROCESS

This discussion paper has been developed based on a series of 3 roundtable discussions in 2020 with Engineers Australia members about the future of Australian infrastructure policy.

## FUTURE DIRECTIONS

The discussion paper is a step towards a policy directions paper, which will contribute to community discussion with governments in 2021.

## CONTACT DETAILS

Feedback on the paper and reflections on the questions raised are welcome and can be submitted to Engineers Australia via email at [policy@engineersaustralia.org.au](mailto:policy@engineersaustralia.org.au).



# 1 Managing the project pipeline

## LONG-TERM PLANNING

Engineering projects are almost always medium-to-long-term endeavours. They often take many years to reach completion, and their life cycle is measured in decades. However, these long-term project pipelines are often at odds with short-term electoral cycles, making strategic planning difficult. Improving the management of engineering project pipelines, especially long-term planning, is especially critical as Australia moves into a post-COVID-19 economic recovery.

Infrastructure owners must recognise that technical expertise in decision-making is vital to project success. Without adequate technical expertise at all levels and stages of infrastructure project planning, it will be difficult to maximise benefits and minimise risks.

Where government is the asset owner, consideration of strategic use resources standardised acquisition processes, and creation of a centralised data bank and decentralise flows of information may assist in the short term. Transparency and accountability of these processes are essential to market confidence. Depoliticised consensus-based decision-making is also critical. It is noted that some governments are already focused on this work.

Another essential component of informed ownership is data. Lessons learned must be captured and easily accessible to project teams. This will limit the risk of repeating mistakes, and will stimulate improvement and innovation with each new project.

## QUESTIONS FOR DISCUSSION

Is there adequate technical expertise at all levels and stages of infrastructure project planning within governments? What can be done to strengthen the available engineering expertise?



## INTEGRATING LONG-TERM NEEDS

The swift transitions required in response to COVID-19 pandemic restrictions have highlighted the need to reassess our infrastructure needs 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. Meaningful integration requires cross-party and multi departmental commitment to using iBody recommendations for priority projects.

Greater investment in long-term value-adding assets is needed. These should include Indigenous programs, extended consultation processes, and synchronised funding of projects with realistic project timelines, including regulatory approval time. Broadening priority analysis beyond a business case, and developing consistent national guidelines to aid prioritisation analysis may provide better outcomes.



## QUESTIONS FOR DISCUSSION

What would national guidelines for infrastructure prioritisation include, and what factors should be added to traditional Cost Benefit Analyses to broaden their effectiveness?

## DEVELOPING NEW PLANNING MODELS

New models for infrastructure planning, funding and delivery are critical as Australia emerges from this period of change. Old models are unlikely to adequately serve Australia's future infrastructure needs. Analysing international models can help determine suitable approaches for the Australian context.

One such model is the UK-based initiative Project 13. This is an industry-led movement focussed on improving the way infrastructure is delivered. It is based on core principles that enable a shift from a transactional to an enterprising model. Project 13's 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.<sup>1</sup>

In addition to investigating new models, Engineers Australia recommends developing a staged project pipeline over the medium term to effectively manage resources and minimise inefficiencies. This could involve developing baseline infrastructure first with a structured return on the investment, before proceeding to the next level of value-adding infrastructure while enhancing the process and resources. Collaborative cross-party commitment is essential to long-term infrastructure pipeline planning. Over the longer term, major key performance indicators (KPIs) must be met through structured rotation of enhanced resources and stable expansion of the activities.

Long-term planning should include specialisation or elective content in industrialised construction (IC) practices and technology implementation in relevant tertiary institutions to prepare graduates for a shift in the industry. Long-term planning will also allow the status quo operating model to be re-evaluated and reorganised, and planning for integration of more standardised products in design to occur. In addition, planning projects for the long term will allow investment in innovation and incubation of new technologies to unearth cutting-edge supply chains.

<sup>1</sup> See *Project 13 – Smarter, better, high-performing infrastructure, from delivery to operation and customer outcomes.* <https://www.mottmac.com/download/file?id=36944&isPreview=True>

## ASSET MANAGEMENT PLANS

Increased state-to-state cooperation and a greater focus on leveraging the supply chain should be key tenets of government strategy. Standardised infrastructure across states and territories makes longer-term integration and connectivity easier and saves money through high-volume purchasing activities.

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.

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.

ISO 55000 Asset Management does not include a recommended duration of pipeline visibility. In Australia, visibility coincides with four-yearly budget processes, and gaining bipartisan commitment to projects beyond this time is challenging. Cross-party commitment to at least some longer-term infrastructure projects would provide greater certainty and confidence to the states and territories.



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## **BENEFITS OF COLLABORATIVE INFRASTRUCTURE PLANNING**

Provided there is an agreed framework for strategic outcomes and non-project-specific funding priorities, the pipeline has the potential to improve cross-party agreement on infrastructure. The benefits flow both ways: improved cross-party agreement on infrastructure improves forward planning of works, while successful delivery of the agreed list of infrastructure projects reinforces the value of cross-party decision-making.

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 in the federal system of government, where funding is allocated by both the Commonwealth and the states/territories, but once the 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 over a range of asset classes (with predetermined proportion allocations – not solely based on a benefit–cost ratio criteria) and a range of project values.

Pipelines need to reflect priorities, based on risk and value. Flexibility is essential as priorities change. As new information and risks develop or are identified, a pivot in priorities may be required. 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.

Unfortunately, in elections 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. A cultural change is required to address this issue and depoliticise infrastructure planning. One model for consideration is formation of a National Cabinet-style approach to major infrastructure investment.



### **QUESTIONS FOR DISCUSSION**

Would a National Cabinet sub-committee for infrastructure planning lead to better coordination of nationally significant projects?



# 2 Design

Innovation and research, rather than finance, should lead design. The initial focus should be on a best-practice assessment of weighted possibilities to encourage innovation, and better social, environmental and efficiency outcomes. Design should also be guided by broad stakeholder consultation, including with Indigenous groups and local communities, as well as by sound environmental evaluation.

## COMMON DESIGNS AND INDUSTRIALISED CONSTRUCTION

*Common designs* 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 (BIM) 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 interior climate may not work in a wet coastal environment.

Engineers Australia recommends nominating specific processes or products to be purchased across the project pipeline, while providing mechanisms for implementing customised solutions as required. This will require development of a clear set of specifications, including guidelines on the development of specifications, quality control, and purchasing.

Rather than focussing on common designs, Engineers Australia recommends focussing on national design standards, guidelines, and specifications, which would drive efficiency and control cost. Australia has excessive variance of design standards, guidelines, and specifications across the various levels of government relating to the same asset classes. Work over the last decade has seen efficiency increase in the road design space, with most agencies now moving to adopt Austroads design guidelines. This has ensured common standards for highway design across the country, which means design teams are not required to understand numerous standards relating to the same asset type.

Many local government design standards need to be replaced with one national design standard applicable to all local government areas (LGAs). Industrialised construction can be applied to building construction, but it largely depends on availability of materials and manufacturing capability, and also would mean that architectural design, flair or innovation is not a priority. There may also be applications in parts of the energy and water sectors, but the issue will be the scale of the market to provide a choice of manufacturers.

Australia is a comparatively small market. A small number of companies is likely to dominate prefabrication processes, which could lead to uncompetitive pricing. However, industrialised construction would be relatively easy to achieve through a pipeline framework by nominating specific processes or products, or a delivery timeframe that requires off-site manufacturing. But even if industrialised construction is achieved to a beneficial level, it is only one cost component of a project, and the increase in transport costs may offset the savings.

Once enough research has been done on industrialised construction, guidelines for developing and implementing clear specifications, quality control and purchasing will need to be developed. Continuous improvement measures will be necessary to monitor technology to ensure industry continues to benefit from new and better products. Certainty and transparency of the pipeline will assist in building confidence across states and territories and the market more broadly.

Industrialised construction is an innovative building system whereby the design, process and manufacturing of structural components are automated and are developed in a factory prior to delivery and assembly on site.

Thorough assessment and testing of technical solutions to develop the implementation strategy for a consistent national framework should be considered. The strategy must provide flexibility and an effective mechanism for reporting of defects and unmet requirements. It must also be informed by innovative expertise through extensive consultation.



## QUESTIONS FOR CONSIDERATION

Should the initial focus be upon further research into the benefits of industrialised construction, or upon consistent national design standards to drive common design?

## ENABLING A SHIFT TOWARDS INDUSTRIALISED CONSTRUCTION

A consistent strategy based on risk and value analysis, and with clearly defined objectives, must be applied across all levels of government and between government departments to establish and promote industrialised construction (IC) in Australia. 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.

The exponential rate of change in new technology is driving a huge disparity between theoretically driven artificial intelligence (AI) models and cutting-edge robotic 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. This includes changes to course content at university and TAFE level to ensure graduates entering the workforce are familiar with industrialised construction practices and emerging technologies. This will provide seamless integration of studies and training into existing business structures and support the change for IC practice utilisation, further reinforcing an IC-positive work culture.

Programs and tools for businesses to benchmark their status will assist in determining the benefits of IC practices. Universities could assist through partnerships with government-run industry development bodies to devise low-barrier-to-entry capability projects. Even with the creation of new technologies and subsidies for their purchase, businesses need to know how changes to their current systems can benefit them and understand their potential. Essentially, universities would have funding allocated to look at medium-to-large IC integration issues within industry and identify a problem project for solution. Providing resolution through existing small-to-medium enterprise (SME) resources, where possible, will provide insight to the benefits of IC and limit fear of change.

Industry 4.0 talks extensively about smart data and sensors implemented across a workshops or 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. They could then work with the industry development body to approach SMEs and provide subsidised technology to fix a sensor on one piece of equipment within one process 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. Strong collaboration between universities and industry has already shown definite value in this area.

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Industry 4.0 refers to the Fourth Industrial Revolution, where automation and smart technologies are applied to traditional manufacturing and industrial practices.

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.<sup>2</sup> 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. In their article in *Procedia – Social and Behavioural Sciences*, Bari et al focused on a comparative study of conventional construction and industrialised construction in four low-rise building projects. The case studies revealed that those constructed using prefabricated systems saved money, time and labour, and produced a higher-quality product. The study also found that IC had greater environmental benefits through waste reduction.<sup>3</sup>



## QUESTIONS FOR CONSIDERATION

Would including industrialised construction practices and emerging technologies act as a primary enabler of industrialised construction practices?

## UNIQUENESS VERSUS STANDARDISED APPROACHES

The perceived challenge presented by standardisation to innovation in construction may contribute to market reluctance in embracing these practices. Employing levers such as training and university–industry collaboration to benchmark, review and demonstrate the benefits of standardisation practices will assist in mitigating market reticence. It will be important to compare the outcomes of previous programmes and draw conclusions and evidence. Measuring outcomes and strategic engagement of freed resources will assist in developing a system to support and guide flexibility and unique assessment.

It will be critical to provide clear guidance about how the potential applications of IC can align with stakeholders' long-term plans and needs, including support and guidance for flexibility and unique assessment. Progress and change must be achieved through stable, timed, and detailed planning with enough consultation and continuous adjustment of the strategy to meet changing market conditions and technological advances.

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. There is too much focus is on de-risking, which pushes providers to do what they know works, rather than what *could* work. The risk needle needs to be pushed more towards medium rather than low/negligible risk, and that level of risk planned for.

Increased commitment to targets dedicated to projects in innovation, practice improvement and development resulting in long-term benefit will ensure that 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.



## QUESTIONS FOR DISCUSSION

How can governments be encouraged to engage local SMEs and start-ups to deliver on infrastructure programs and foster innovation?

<sup>2</sup> Kamruddin, Mohammad, Mahbub, *Barriers and Impact of Mechanisation and Automation in Construction to Achieve Better Quality Products*, Vol 222 *Procedia – Social and Behavioural Sciences*, p111-120, 2016. <https://doi.org/10.1016/j.sbspro.2016.05.197>

<sup>3</sup> Bari et al. *Environmental Awareness and Benefits of Industrialized Building Systems (IBS)*, Vol 50 *Procedia – Social and Behavioural Sciences*, pages 392-404, 2012 <https://doi.org/10.1016/j.sbspro.2012.08.044>

# 3 Contracts and project management

## TENDERING

In general, the cost of submitting a tender is not taken into consideration except in the case of extremely large projects. SMEs must be very selective about which projects justify the risk of spending productivity and capital on a contract bid that may be unsuccessful. Minimal recognition is given to costs associated with the first stage of projects. This means that, once bids are won, time and money is not allocated to reviewing the proposal, even when there may be more effective solutions, and often contracts do not allow for changes. Additionally, feedback loops are reportedly often inefficient, ineffective or non-existent.

One proposed solution is projects being funded and built in phases, allowing for greater collaboration and more diversity of design submissions from the design and tender stages. Measuring and incorporating intangible benefits into initial project valuation through broad stakeholder consultation and analysis will assist in incentivising good behaviours.

Equal responsibility and stakeholder collaboration will contribute to de-risking projects. This solution will also support a shift in focus from price to value, as the asset owner owns the outcomes for the customers. Strategies to enable integration across the end-to-end delivery process are essential.



## AREAS FOR DISCUSSION

What are other ways to ensure that the effort of submitting a tender is recognised by project proponents?

## DECIDING WHICH PROJECT TO PUT TO MARKET

Government funding should only be given to projects that are market ready. If the project is not market-ready, funding can be sourced elsewhere. Bank lending criteria do not allow for funding of ill-conceived or incomplete project plans, so governments could consider applying similar funding criteria.

However, in recent years there has been a growing industry perception that once a business case for a project has been prepared, the project gains automatic 'approval' to proceed to detailed design and construction. The result is the preparation of numerous business cases for projects that may not have gone through a formal strategic planning process to warrant consideration and may not have relevance to broader economic growth and productivity. Accordingly, usually an extensive options analysis has not been completed, and benefits tend to be exaggerated or simplified. Often, changing externalities have not been considered, as well as land ownership, operational costs and asset maintenance cost. Adopting a high-level sieve with defined performance criteria would help provide clarity of investment priority and limit incomplete designs and projects being let to market.

Some examples of how this could work: projects addressing freight efficiency must accommodate fuel-efficient vehicles; mass rapid transit projects must include detailed service design plans, demonstrate patronage increase where investment is proposed, deliver improved placemaking and, with regard to buses, allow for conversion to electric; and projects seeking to reduce congestion must demonstrate significant peak hour travel time savings.

One criterion to guard against premature project announcements should be to ensure concurrent independent estimate, delivery schedule and contingency models are accepted prior to commencement. An independent review of the delivery strategy and risk allocation for the preferred procurement strategy at the final stage is appropriate, as well as conducting independent reviews after completion.



## QUESTIONS FOR CONSIDERATION

What criteria could governments apply to determine if a project should be funded?

## PROMOTING DIVERGENT THINKING

Divergent thinking comes from diverse perspectives and innovative approaches to project management. Applying best-practice assessment in the project concept phase and engaging the right representative group of people in decision-making and as change champions throughout the project lifecycle is vital. Establishing a diverse project team challenges the status quo and influences divergent thinking.

In terms of risk and value, those who are involved in, responsible for, or affected by change should be encouraged to participate in its outcome. Risk, value and efficiency are key drivers in project outcomes and the subsequent controls should be tangible derivatives of these outcomes. The government is accountable for risks and is responsible for ensuring the cross-section is representative.

There is an opportunity to challenge traditional project management models focused on cost, time and quality, and instead embed creativity and innovation in the early project stages. Embedding divergent thinking into project team decision-making at critical stages during a project's management phases and not just at inception will maximise benefits and minimise risk.



## QUESTIONS FOR CONSIDERATION

What are the characteristics of a project team that will facilitate divergent and productive thinking?

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# 4 Knowledge capture and sharing

## LESSONS LEARNED

An essential component of driving desired behaviours is access to lessons learned. Providing a platform for lessons learned with limited intellectual property (IP) controls would promote continuous improvement and avoid repeated mistakes.

Development of a consistent Work Breakdown Structure (WBS), Cost Breakdown Structure (CBS) and Risk Breakdown Structure (RBS) in the early stages of projects – and at certain levels for different types of projects or sectors – will ensure capital estimate and actual data (both cost and schedule) are consistently developed. Developing and implementing a consistent approach to contingency control will also help with this. Agencies and contractors will still have flexibility to plan and deliver projects at lower levels of WBS/CBS/RBS with reporting during delivery phase if these reports are set at appropriate levels. Development of a national database for Reference Class Estimates and Parametric Estimates could assist..

Best practice requires continuous improvement with an ongoing cyclical review. If this needs to be incentivised, then capturing lessons learned should be a condition of project funding, and a review needs to be functional and link into the new project area. For example, feedback from a continuous improvement review of construction of a rail project should be incorporated in updating policy and procurement models for the industry and/or major projects. Reviews should also be made available as a form of knowledge that is applied to future projects. Engineers Australia advises considering whether it should be mandatory to include lessons learned from prior projects in project proposals.

## QUESTIONS FOR CONSIDERATION

Should project approval processes mandate a requirement for analysis of lessons learned across other projects as a condition of project approval and funding?





# 5 Workforce planning

## DIVERSITY AND INCLUSION

Different perspectives allow for creative solutions. Building inclusive and diverse teams ensures that problems are addressed holistically, and that the solutions provided are founded on varied perspectives, knowledge, experience and skills. Diversity powers innovation.

Engineering skills are vital to addressing the global challenges presented by population growth, climate change, rapid technological change, and globalisation. The value of diversity in promoting innovation, economic growth and sustainable development is well documented.<sup>4</sup> However, progress in achieving an engineering profession that is as diverse as the community it serves has been slow.

Insufficient representation of people from diverse backgrounds and experiences across the engineering profession reflects stereotypes and misconceptions about engineers, the nature of engineering work, and the value of engineering activities. Engineering is often inaccurately portrayed as requiring prohibitively complicated mathematics, physics and demanding physical labour.

Strategies and actions to address these stereotypes should be developed and promoted to challenge perceptions and encourage a cultural shift to embrace engineering as a dynamic and opportunity-rich career choice. Strategies to attract more people from underrepresented groups to the profession include showcasing diverse representation across engineering occupations, tangible physical demonstrations of engineering work, and changing the narrative to emphasise the positive contribution of engineering activities to our nation and its communities.

Hiring and promotion decisions are impacted by cognitive biases, stereotyping and related behaviours. Without adequate diversity of representation at the executive level, these decisions often reinforce the status quo and uphold existing structures. Solutions require long-term thinking, ownership, planning and training. This issue requires buy-in and engagement at all levels, and workplaces need to be cooperative and supportive in helping each other to understand and challenge the status quo. Training in diversity awareness and bias mitigation in decision-making is critical.

<sup>4</sup> See UN Women, *Facts and Figures: Economic Empowerment*, July 2018, <https://www.unwomen.org/en/what-we-do/economic-empowerment/facts-and-figures> as an example.

Educational materials and programs for industry could include information on how to set diversity targets and how to create student and graduate programs with the promise of career development; support for improvements in inclusive recruitment processes; and how to ensure senior executive-level sponsors are visibly engaged.

Engineers Australia is committed to addressing the cultural, institutional, organisational and societal factors that limit diversity and inclusion in the profession. More information can be found in Engineers Australia's [\*Diversity and Inclusion Positioning Statement\*](#).<sup>5</sup>



## QUESTIONS FOR DISCUSSION

How can Australia invest in industry education programs and materials focussed on practical advice for attracting people to engineering from underrepresented backgrounds, and then retaining them in the profession?

## PREPARATORY STUDIES

Engineering is the largest employer of STEM graduates from both university and vocational training courses, but it is still struggling to build a diverse workforce and has the lowest female participation of all STEM fields. There is a lot of work to do to ensure that engineering is well-represented across the breadth of STEM initiatives.

Early engagement with STEM, from preschool onwards, is essential. Research shows that fostering engagement in STEM education in primary school positively influences later participation in STEM disciplines, particularly in the senior secondary years.<sup>6</sup> As the application of science and mathematics, engineering should be incorporated into subjects such as science, design and technology, and mathematics to ensure students understand and are aware of engineering as an option when considering further education.

More information can be found in Engineers Australia's [\*National STEM Strategy 2019–2023: 'Create tomorrow's engineers' strategic priority\*](#)<sup>7</sup> document.



## QUESTIONS FOR DISCUSSION

What is needed to make effective awareness campaigns for schools that demonstrate the variability, broad application and opportunities offered by the engineering profession?

<sup>5</sup> See Engineers Australia, *Engineers Australia's Diversity and Inclusion Positioning Statement*, May 2020, <https://www.engineersaustralia.org.au/sites/default/files/resource-files/2020-05/EA%20Diversity%20and%20Inclusion%20Positioning%20Statement%20%20FINAL.pdf>

<sup>6</sup> Rosicka, C, for the Australian Council for Educational Research, *From concept to Classroom: Translating STEM Education research into practice*, June 2016, p.224

<sup>7</sup> See Engineers Australia *National STEM strategy 2019-2023*, November 2018, <https://www.engineersaustralia.org.au/sites/default/files/EA%20STEM%20Strategy%202019%20to%202023%20FINAL.pdf>

# 6 Conclusion



Infrastructure will play a vital role in Australia's post-COVID-19 economic recovery. Consequently, it is important that consideration is given to the planning and management of infrastructure projects, especially those occurring over a longer timeframe, as well as to the development of engineering as a profession.

Long-term planning with cross-party agreement is essential to infrastructure development, as is including appropriate technical expertise at all levels and adequately capturing lessons learned. This long-term thinking must be integrated into the project pipeline and new project models considered, such as the UK's Project 13. This will allow investment in emerging technologies and innovative supply chains. Staged project pipelines, standardised infrastructure across states/territories, and collaborative infrastructure planning will all help to increase efficiency.

Innovation and research, rather than finance, should lead design. The initial focus should be on a best-practice assessment of weighted possibilities to encourage innovation, and better social, environmental and efficiency outcomes. Design should also be guided by broad stakeholder consultation, including with Indigenous groups and local communities, as well as by sound environmental evaluation. Innovative technologies, such as industrialised construction and smart sensors, should be researched and implemented, and training in these areas provided, especially as part of tertiary-level engineering courses. It is also important to maintain flexibility between standardised and unique approaches.

Project processes also need to be made more efficient. The costs of tender submission should be taken into account and could be mitigated by funding and building projects in phases. Project management systems should be standardised, and government funding should only be given to projects that are market ready. Standards, codes of practice and any other governing risk control management documents should be made consistent across jurisdictions, while still allowing flexibility for deviation if there is a demonstrably better alternative. There should be regular reviews conducted after project completion, with the results made publicly available. Providing a platform for lessons learned with limited intellectual property controls would also promote continuous improvement and avoid repeated mistakes. The community should also be further educated on the importance of non-capital solutions in addressing Australia's infrastructure gap.

Greater diversity, especially at executive levels, and promoting the engineering aspect of STEM education in schools to enhance engineering's attractiveness as a profession is a priority. Engineers Australia remains committed to addressing both these issues, as outlined further in the [Engineers Australia Diversity and Inclusion Positioning Statement](#) and [National STEM Strategy 2019–2023: Create tomorrow's engineers strategic priority](#) document.

The areas for consideration outlined in this document are designed to provide a springboard for further discussions and policy development. They will be used as the basis for roundtable discussions and the development of an Engineers Australia Directions Paper in 2021. Engineers Australia looks forward to a robust and solutions focussed discussion about our country's infrastructure future.



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