

Delivering Outcomes

A roadmap to improve infrastructure
industry productivity and innovation



Online

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Acknowledgements

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Acknowledgement of Country

Infrastructure Australia proudly acknowledges the Traditional Owners and Custodians of Australia, and their continuing connections to the land, waters and communities. We pay our respects to them and to their Elders past, present and emerging. In preparing for the future of our infrastructure, we acknowledge the importance of looking beyond the immediate past to learn from Aboriginal and Torres Strait Islander peoples' unique history of land management and settlement, art, culture and society that began over 65,000 years ago.

As part of Infrastructure Australia's commitment to reconciliation, we will continue to develop strong, mutually beneficial relationships with Aboriginal and Torres Strait Islander partners who can help us to innovate and deliver better outcomes for Aboriginal and Torres Strait Islander communities, recognising their expertise in improving quality of life in their communities.

Note on the artwork

The artwork *Moving Along Pathways* was created by Kamilaroi/Gamilaraay artist Dennis Golding, specifically for Infrastructure Australia's first Reconciliation Action Plan. The artwork depicts examples of Australia's first infrastructure.

Pathways and river systems are prominent in the artwork and reference the pathways First Nations peoples formed on land and water for transport and communication of knowledge and stories. Images of waterholes, campsites and boomerangs within the artwork acknowledge First Nations cultural practices, technology and places for gathering that continue to be operated today.

We invite your comments

Why are we accepting comments on the report?

Infrastructure Australia has developed this report to support policy makers, infrastructure owners, delivery agencies and the broader industry to improve productivity and to provide clear priorities for innovation, and the models to embrace it.

This report was developed through engagement with hundreds of stakeholders from industry and government. However, while engagement has been a focus in preparing the report, we acknowledge we may not have considered all relevant data, evidence or industry conditions.

The report provides a firm foundation for reform. However, we invite comments that can strengthen the evidence base or can support implementation.

Do you have comments on the report?

Infrastructure Australia welcomes your views on our recommendations, an expanded evidence base or potential future areas of analysis. If you would like to share your views, we would like to hear them.

What will we do with comments?

Infrastructure Australia will consider all comments received in response to the report. Amendments will be incorporated to reflect the balance of submissions or a strong foundation of new evidence. A refresh will be released later in 2022.

When should comments be provided?

The period for comment on this report will be six weeks. Comments are requested by 29 April 2022.

The submissions period, or the period for individual submissions, may be extended by Infrastructure Australia. Preference will be given to early requests for extensions. Please contact mail@infrastructureaustralia.gov.au to request an extension.

How should comments be provided?

Infrastructure Australia's website www.infrastructureaustralia.gov.au/publications/deliveringoutcomes hosts a webform as the preferred method for the communication of comments on the report.

Comments should clearly identify the relevant section of the report to which they are intended to apply. Submissions using the webform and with clearly identified areas of focus will be prioritised.

A pdf form is also available to attach as a cover sheet to submissions.

Chair's foreword

The reform roadmap offered by *Delivering Outcomes* lays the foundation for the transformation of the Australian infrastructure sector to become a 21st century industry supporting our national economic health and social vibrancy.

Australia's governments have made record commitments of investment in the Australian infrastructure sector to address a long-term under-funding of the nation's critical economic and social infrastructure. The substantial commitment of funds will both support many of our cities and regions to catch-up with recent growth, but also allow them to position for the future.

However, for this record pipeline of investment to be delivered, substantial change will be required to the way infrastructure is planned, procured, delivered and managed. As our *Infrastructure Market Capacity* program has demonstrated, constraints in the sector are likely to continue to grow, compounded by the impacts of the COVID-19 pandemic on global supply chains.

Over the past decade or more, the Australian construction industry has failed to keep pace with the global transformation of the sector, which is seeing a shift from a focus on manual work on site; to digitally enabled, pre-fabricated production processes delivered off-site by diverse and globally connected workforce. The reform roadmap in this report can put the sector on a path to embrace this change.

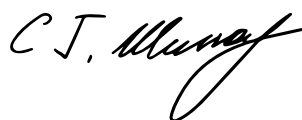
The benefits of this step change are immense. Better, cheaper, and more reliable infrastructure assets providing more flexible, better targeted infrastructure services to the community. Critically, these new delivery models will also enable new opportunities for Australian businesses to contribute to the sector, including across the diverse manufacturing base of our regions.

We have presented an ambitious, yet achievable reform roadmap to improve the productivity, innovation, and sustainability of the Australian infrastructure industry. A clear reform pathway, that if supported by government and industry, offers a substantial opportunity to increase the participation of Australian businesses and workers in the current investment cycle.

This roadmap sets out tangible actions over the next ten years to transform how infrastructure is planned and delivered in Australia to support a more productive, innovative, and financially resilient infrastructure sector. In doing so, these actions will achieve better, faster, more sustainable infrastructure delivery and improve outcomes for people and places.

This roadmap is designed to apply to all public infrastructure, including transport, energy, waste, water, telecommunications, and social infrastructure, and covers the entirety of the infrastructure investment lifecycle.

While many reforms are led by government, they cannot be achieved without the commitment of industry and the community. The reform agenda in this report provides a common starting point for national reform, and broad collaboration.



Col Murray

Chair, Infrastructure Australia

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Executive summary

A roadmap to a more productive and resilient future

A transformational change is needed in how we plan and deliver infrastructure in Australia. This change must focus on delivering better outcomes for the community and for business through a more productive, innovative and sustainable infrastructure sector.

The reforms in this roadmap focus on changes to the way projects are procured and delivered, however the consequences reach into how an asset is managed, operated and maintained across its lifecycle. The reforms identified by this report will have long-term consequences for the services received by infrastructure service users and the community.

This roadmap sets out a future where:

- outcomes provide the focus for infrastructure delivery
- partners are engaged earlier in developing delivery approaches
- integrated teams are brought together to innovate and collaborate to deliver outcomes for people and place
- digital transformation is used to develop intelligent solutions.

Best practice shows effective delivery will be enabled when infrastructure owners and delivery agencies:¹

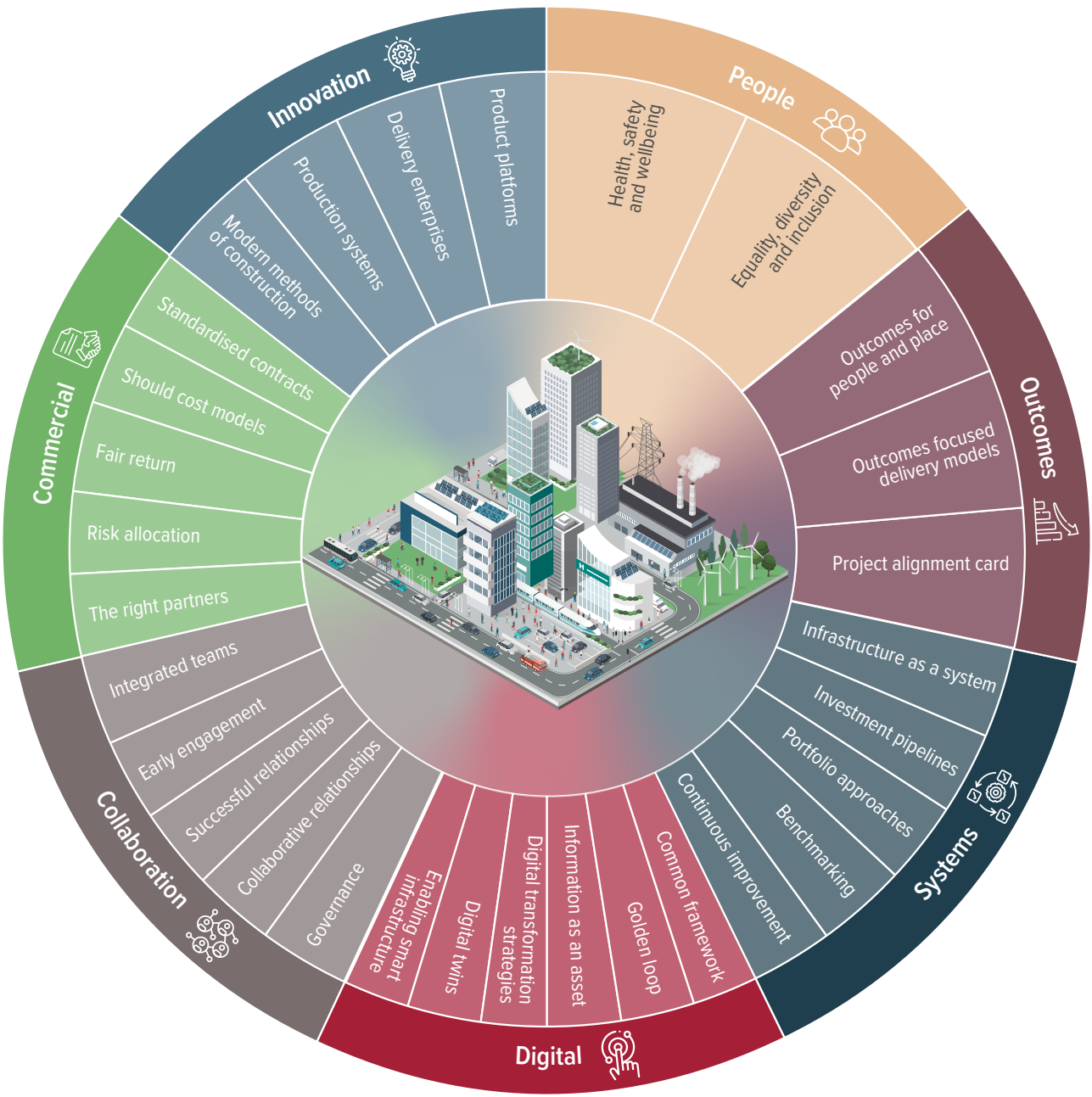
- take ownership of the complexity of their projects and of their relationships with their supply chains
- establish more effective relationships, selecting the right partners and engaging with them to deliver the most productive solutions
- create the conditions for participating organisations to work together to deliver the best possible outcomes for all.

The change starts with a clear recognition that the core purpose of infrastructure is to improve the outcome delivered by infrastructure for end-users and the community. Infrastructure owners and delivery agencies must be able to clearly articulate the outcomes they seek in terms of the change experienced by customers, community and environment.

To achieve this step-change, seven focus areas of reforms are needed:

- **Outcomes for people and places** – Infrastructure investment is driven by delivering economic, social and environmental outcomes to enable people and places to flourish and prosper.
- **Systems** – Managing and planning infrastructure as a system drives more informed decision-making leading to higher quality, faster and cheaper infrastructure solutions that better align to the needs of people and places.
- **Digital** – Digital transformation will drive productivity and innovation in infrastructure delivery.
- **Collaboration** – Collaboration and integration across the ecosystem will drive a financially sustainable and high performing infrastructure industry.
- **Commercial** – Commercial alignment and optimisation drives industry financial sustainability and enables innovation.
- **Innovation** – Delivery integration and innovative techniques enable increased productivity.
- **People** – People wellbeing and resilience is the foundation for a flourishing sector.

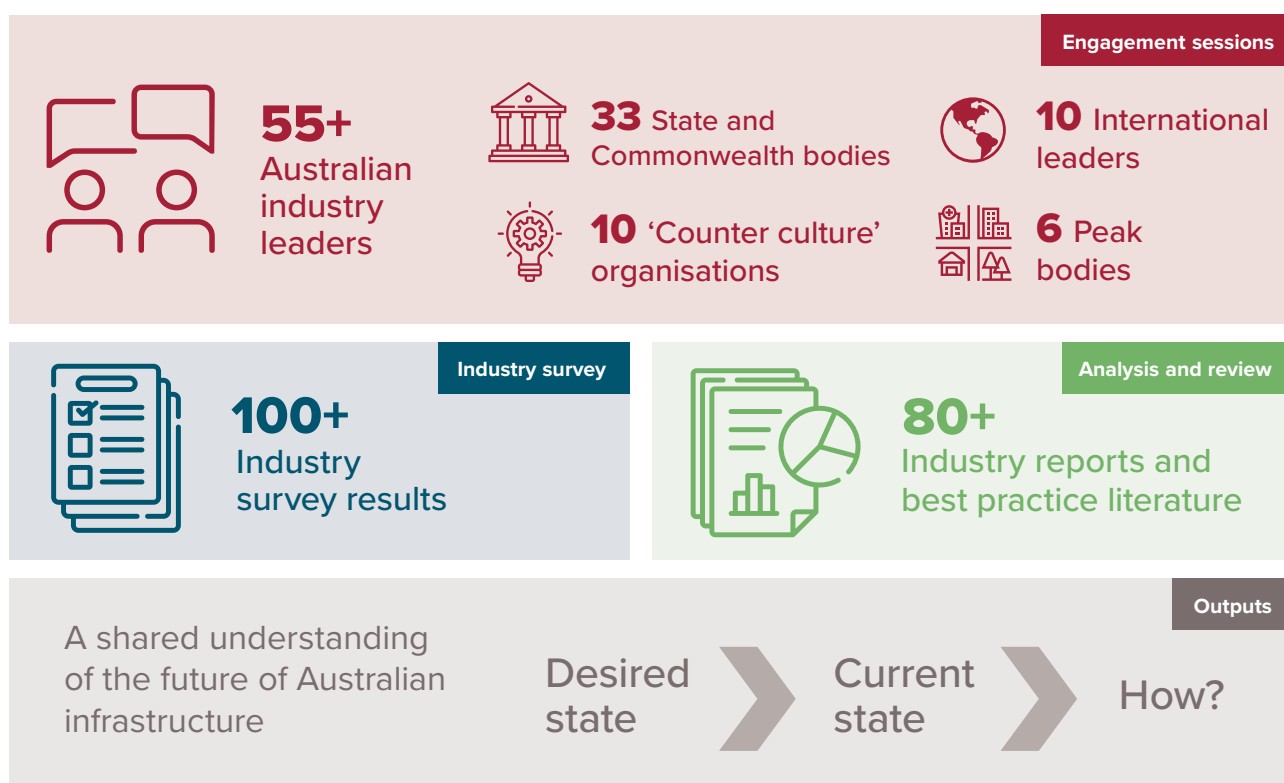
Figure I: This roadmap is defined by seven focus areas of reform, underpinned by 30 best practice principles



Development and structure of the roadmap

This roadmap has been informed by extensive consultation with stakeholders and leaders from all jurisdictions, examples of best practice from Australia and across the world, and recognised industry benchmarks (Figure II).

Figure II: Development of the roadmap



Fundamental to designing a logical and effective roadmap, extensive stakeholder engagement has enabled the development of a collective industry view of:

1. where the industry needs to get to – the 'future desired state'
2. what steps are required to enhance delivery
3. what are the requisite reforms needed to enable and drive change.

Commitment to change

The principles and recommendations set out in the roadmap highlight the need for behavioural change, recognising both the importance of establishing the right behaviours in creating value, as well as the need to create environments that enable the required behaviours. Successful implementation will require cross industry commitment and collaboration.

Infrastructure Australia is committed to supporting industry reform. The role of the organisation is to facilitate leadership in the adoption of the measures in this roadmap. Infrastructure Australia will collaborate with organisations, both public and private, that have a desire to adopt our recommendations as appropriate.

This roadmap is supported by the detailed analysis undertaken by Infrastructure Australia in the *2019 Australian Infrastructure Audit*, the *2021 Australian Infrastructure Plan* and the *2021 Infrastructure Market Capacity Report* and outlines a comprehensive action plan for the industry.

Many organisations are already on the journey to improve industry productivity. We acknowledge this leadership and we are committed to supporting those processes.

Recommendations

Overview

The following overview of the recommendations in the roadmap is broken down by focus areas.

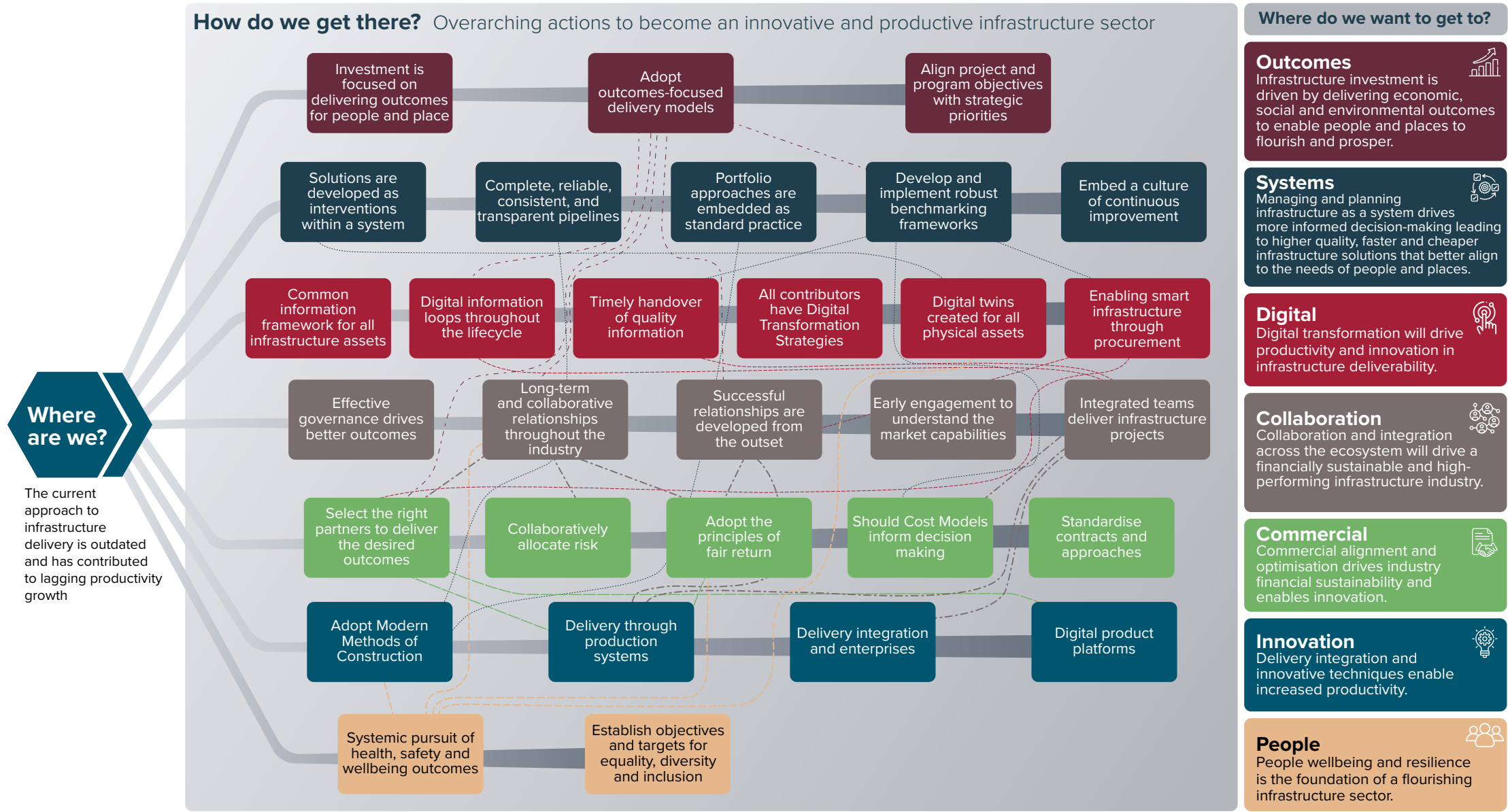
- 1. Outcomes for people and place
- 2. Infrastructure as a system
- 3. Digital transformation
- 4. Collaboration and integration
- 5. Commercial optimisation
- 6. Delivery innovation
- 7. People wellbeing and resilience

Each detailed recommendation is preceded by a statement of the desired future state, i.e. Where do we want to get to?

Each primary recommendation is followed by a series of detailed recommendations, and each detailed recommendation includes an expected timeframe for implementation broken down into five-year intervals. Each detailed recommendation also identifies (1) the proposed lead responsible for driving the reforms, and (2) critical stakeholders that will play an active and important role in supporting reform and delivering outcomes.

The following graphic, figure III, provides, for easy reference, a high-level summary of the overarching rationale and actions that are spelt out in detail in the following recommendations.

Figure III: The reform pathway showing the inter-relationship between recommendations



1. Outcomes for people and place

Recommendation 1.1

Improve infrastructure outcomes by ensuring investment is focused on delivering clearly articulated outcomes to enable people and place to flourish.

Recommendation 1.1.1 – Enhance the quality of decision-making and improve value for money by ensuring infrastructure investment is framed from the outset by a clear articulation of desired sustainability – economic, social, governance and environmental – outcomes to better enable the development of solutions that focus on the needs of people and places.

Recommendation 1.1.2 – Improve the consistency and quality of decision-making by developing a national framework for articulating and assessing outcomes and benefits across the breadth of infrastructure classes. This framework should leverage existing assessment frameworks, such as the Australian Transport Assessment and Planning (ATAP) Guidelines.

Recommendation 1.1.3 – Uplift the quality and maturity of infrastructure decision-making through the development and delivery of training for key decision-makers on timing of project announcements and investment assurance and due diligence.

Recommendation 1.2

Progressively adopt and implement outcomes-focused delivery models to support the delivery of outcomes for people and places and better enable the development of innovative, cost-effective and intelligent solutions.

Recommendation 1.2.1 – Support the delivery of outcomes for people and place by implementing and utilising outcomes-focused delivery models that facilitate greater delivery partner and supplier collaboration. Embed consideration of project delivery strategy as part of early business case development (e.g. strategic needs assessment) for all infrastructure investment proposals.

Recommendation 1.2.2 – Increase adoption of, and create greater consistency for, outcomes-focused delivery models by developing supporting guidance and developing training, including identification of exemplar project examples.

Recommendation 1.2.3 – Progressively adopt outcomes-focused delivery models for all major projects and programs as standard practice to better enable the development of innovative, cost-effective and intelligent solutions.

Recommendation 1.3

Improve value for money and better enable people and places to prosper by ensuring project and program outcomes align with and contribute to the achievement of strategic priorities and respond to community needs.

Recommendation 1.3.1 – Improve the quality and consistency of infrastructure decision-making through the development and use of project alignment cards to ensure future investments are considered against strategic jurisdictional, organisational and community priorities.

2. Infrastructure as a system

Recommendation 2.1

Improve infrastructure value for money by ensuring solutions are developed as interventions within an infrastructure system.

Recommendation 2.1.1 – *Improve capital planning to ensure that infrastructure projects are assessed in the context of their network and program impact and dependencies rather than solely as stand-alone, independent projects. Embed assessment of project and program interdependencies in each stage of business case development.*

Recommendation 2.1.2 – *Improve value for money through the development of jurisdictional infrastructure interdependency strategies to enable and guide effective integrated planning, delivery and operation of solutions at a whole of system level.*

Recommendation 2.1.3 – *Progressively leverage digital tools and practices, such as digital twins, to enhance the optimisation, management, integration and re-use of new and existing assets across portfolios to achieve desired outcomes within an integrated system.*

Recommendation 2.2

Enhance resource, skills and capability planning across the infrastructure sector by developing reliable, transparent and consistent investment pipelines.

Recommendation 2.2.1 – *Support improved industry capacity, planning and coordination through active management of asset management plans to identify opportunities to smooth the infrastructure pipeline over the medium-term.*

Recommendation 2.2.2 – *Develop and publish jurisdiction-wide, cross-sectoral infrastructure investment pipelines that outline all current, committed and planned (but not committed) public and private infrastructure activity over a ten-year horizon to support greater investment consistency, reliability, and transparency.*

Recommendation 2.2.3 – *In partnership with industry, develop a national infrastructure skills strategy that sets out tangible and achievable actions to ensure education and training services align with and address the infrastructure sector's future skills needs to ensure effective delivery of Australia's infrastructure pipeline.*

Recommendation 2.3

Progressively adopt portfolio approaches to infrastructure planning to drive investment in new technologies and solutions, and improve the consistency, quality and speed of delivery and value for money.

Recommendation 2.3.1 – *Improve productivity and value for money by actively managing asset management plans to identify opportunities to develop long-term portfolios of works, support standardisation and drive investment into new technologies and modern methods of construction.*

Recommendation 2.3.2 – *Increase adoption of portfolio approaches by developing supporting guidance and training, disseminating lessons learned and identifying exemplar portfolio approaches.*

Recommendation 2.3.3 – *Embed portfolio approaches at a product level across public infrastructure as standard practice to support the implementation of platform approaches to infrastructure delivery and drive investment in higher quality, faster and cheaper solutions.*

Recommendation 2.4

Improve visibility of project and asset performance and best practice and enhance infrastructure value for money by developing and implementing robust benchmarking frameworks.

Recommendation 2.4.1 – Develop and implement internal benchmarking frameworks to drive greater visibility of organisational performance and improve decision-making. Embed benchmarking of projects and programs as part organisational business case and investment assurance processes.

Recommendation 2.4.2 – Enhance the quality of decision-making, improve value for money and inform the development of Should Cost Models by developing a national benchmarking framework across all classes of infrastructure, building upon existing Bureau of Infrastructure and Transport Research Economics (BITRE) work. This framework should be based on common infrastructure structures and be utilised on all federally-funded projects.

Recommendation 2.4.3 – Drive visibility of performance across sectors and jurisdictions by establishing inter-jurisdictional data sharing arrangements with all states and territories to support the systematic and regular sharing of benchmarking and performance data for major projects (over \$50 million) across all forms infrastructures.

Recommendation 2.5

Embed a culture of continuous learning across the infrastructure sector to support better, faster, cheaper and more innovative infrastructure solutions and delivery.

Recommendation 2.5.1 – Improve the quality and consistency of infrastructure decision-making by establishing and embedding organisational learning and improvement practices that routinely assess internal performance and capture, distil, and incorporate learnings into future decisions and planning processes.

Recommendation 2.5.2 – Drive improved decision-making, productivity and value for money by establishing processes to identify, capture and adapt whole-of-industry and international best practice and learnings.

Recommendation 2.5.3 – Facilitate the identification, distilling and sharing of best practices and lessons learned at a whole-of-industry level via an industry collaboration group to drive improved productivity and support higher quality, faster and cheaper infrastructure delivery.

3. Digital transformation

Recommendation 3.1

Develop and implement a common national information framework across all infrastructure assets in all jurisdictions to drive better data interoperability and information sharing and better, more informed decision-making.

Recommendation 3.1.1 – *Develop an understanding of the data and information needs across asset types and lifecycle phases to establish the baseline requirements for a common information framework.*

Recommendation 3.1.2 – *Develop and implement a common information framework, including a reference data library, protocols for security, access and information sharing and channels for assets to speak to one another for interoperability to set the foundation for better information sharing.*

Recommendation 3.1.3 – *Establish a data sharing framework between jurisdictions and a decision-making framework to drive better decisions based off better information sharing.*

Recommendation 3.1.4 – *Implement the common information framework for all new infrastructure assets in all jurisdictions and develop a roadmap for implementation across existing infrastructure assets to drive interoperability of data and information sharing across assets and jurisdictions.*

Recommendation 3.2

Infrastructure programs should integrate digital information loops throughout the lifecycle of infrastructure assets to drive better decision-making and improve the performance of existing assets.

Recommendation 3.2.1 – *Infrastructure projects and programs should define the information requirements of customers, users, and operators, with the information processes configured to give projects a clear focus on these requirements from project development through to operation.*

Recommendation 3.2.2 – *Establish clear information processes that provide the underpinning framework for projects and programs, establishing clear information requirements at each lifecycle stage and ensuring clear information deliverables throughout the delivery process.*

Recommendation 3.3

All infrastructure projects should ensure there is timely handover of quality information to set operators up for success.

Recommendation 3.3.1 – *Infrastructure owners and delivery agencies should involve operations and maintenance personnel during the project development phase to understand what information they require for a smooth handover and successful transition to operation of the physical asset and incorporate this into the project requirements.*

Recommendation 3.3.2 – *Infrastructure owners and delivery agencies should provide incentives in commercial models for the timely handover of quality information prior to the physical asset handover.*

Recommendation 3.3.3 – *In collaboration with infrastructure operators, infrastructure owners and delivery agencies should establish processes for assessing the completeness and quality of data prior to handover.*

Recommendation 3.3.4 – *State and territory infrastructure bodies should require demonstrable evidence during assurance reviews that quality information is to be handed over to the owner and operator prior to the physical asset handover point.*

Recommendation 3.4

All major contributors to infrastructure delivery should have Digital Transformation Strategies to drive digital transformation in the infrastructure sector.

Recommendation 3.4.1 – All contributors to the infrastructure ecosystem should support digital transformation by developing clear and committed Digital Transformation Strategies that outline their vision for digital transformation and their roadmap for improvement.

Recommendation 3.4.2 – Digital capabilities should be considered as an important criterion in partner selection for infrastructure projects and programs by infrastructure owners and delivery agencies.

Recommendation 3.5

All infrastructure projects and programs should create digital twins of the physical asset to drive efficiency and productivity improvements.

Recommendation 3.5.1 – Digital twins should be created for all infrastructure projects and used to simulate, model and inform future development, construction and operation to drive better decision-making and optimise the performance of infrastructure assets.

Recommendation 3.5.2 – Opportunities to link digital twins should be pursued to identify and analyse interdependencies between infrastructure assets to drive more informed decision-making and optimise how the infrastructure system operates.

Recommendation 3.6

Procurement and program development approaches should enable and encourage smart infrastructure solutions to drive more financially sustainable and efficient delivery of outcomes.

Recommendation 3.6.1 – Smart infrastructure interventions that optimise existing assets should be investigated as the first intervention over building new assets to drive more financially sustainable delivery of outcomes.

Recommendation 3.6.2 – Infrastructure owners and delivery agencies should review their existing procurement policies and frameworks to ensure value-for-money, smart infrastructure solutions are enabled and encouraged, along with the early engagement of appropriate partners to develop and implement these solutions.

4. Collaboration and integration

Recommendation 4.1

Implement visible and effective governance to enable infrastructure delivery and ensure the focus is on the right outcomes.

Recommendation 4.1.1 – Consider making major infrastructure decisions transparent for the public by publishing business cases and supporting analysis for major decisions to provide public confidence that investment decisions are data-based and will deliver the desired outcomes for society.

Recommendation 4.1.2 – Review existing governance arrangements with the goal to reduce variation in governance processes and requirements across jurisdictions and sectors.

Recommendation 4.1.3 – Governance for infrastructure projects and programs should clearly define how ‘value for money’ is assessed and measured, recognising that impact on the required outcomes for customers, communities and the environment is integral to value for money, alongside economic value and efficiency.

Recommendation 4.2

Long-term and collaborative relationships that span projects and programs are used across the infrastructure industry to drive better outcomes.

Recommendation 4.2.1 – Infrastructure owners and delivery agencies should actively identify opportunities to develop long-term, collaborative supplier relationships, through identifying suppliers that align with the overarching outcomes owners are seeking to achieve.

Recommendation 4.2.2 – Infrastructure owners and delivery agencies embed collaborative approaches within all contract forms. If an alternative approach is chosen, state delivery agencies should clearly demonstrate why their alternative approach is more appropriate during assurance reviews.

Recommendation 4.2.3 – Infrastructure owners and delivery agencies should lead the shift towards collaborative relationships and away from an adversarial culture by implementing models that incentivise collaboration between all parties.

Recommendation 4.3

Ensure statements of intent are developed at the outset of infrastructure projects and programs, outlining the desired behaviours for all parties.

Recommendation 4.3.1 – Engender trust-based relationships at the outset of infrastructure projects and programs by developing a ‘statement of intent’ that frames all strategic relationships. This ‘statement of intent’ should include the aims, measures of success, how the relationship will operate and be managed and how issues will be resolved. This framing should initially provide a clear shared expectation and become part of ongoing governance.

Recommendation 4.4

Owners should engage regularly with the market to develop an understanding of the capabilities within the ecosystem to drive better outcomes.

Recommendation 4.4.1 – *Engage regularly with all parts of the ecosystem in order to understand capabilities, perspectives and supplier requirements.*

Recommendation 4.4.2 – *This understanding of ecosystem capability should be used to inform procurement and engagement strategies that leverage partners capability when it can add most value in the development of solutions. This early engagement should, where appropriate, include the engagement of strategic suppliers in the strategic planning phases of project development.*

Recommendation 4.5

Integrated and collaborative teams are used to deliver infrastructure projects and programs more efficiently and effectively.

Recommendation 4.5.1 – *Integrated and collaborative teams should be used to deliver infrastructure projects and programs. These teams should establish processes and capabilities that integrate individuals drawn from different organisations together in high-performing delivery teams, recognising this is an essential part of developing effective delivery enterprises.*

Recommendation 4.5.2 – *Infrastructure owners and delivery agencies should ensure co-located teams are enabled with the right systems and tools to support an integrated, high-performing team environment, including shared access to data and common IT systems.*

5. Commercial optimisation

Recommendation 5.1

Enable more efficient delivery of value and outcomes, and uplift decision-making maturity, by focusing delivery model selection and procurement on choosing the right partners to deliver required outcomes.

Recommendation 5.1.1 – Improve the delivery of desired outcomes by framing procurement to focus on outcomes and value (moving away from heavily weighted price criteria), with the long-term view of all procurements being outcome-focused in line with the principles set out in this roadmap. This necessitates establishing outcomes at the enterprise level and cascading these through procurement decision-making.

Recommendation 5.1.2 – Foster more productive, longer-term relationships and improve alignment to desired outcomes by ensuring procurement criteria place at least equal weighting on supplier capability and behaviour. These criteria should be aligned with the desired outcomes.

Recommendation 5.1.3 – Support the transition to outcomes-based procurement by building internal capability and capacity of procurement professionals to effectively deliver outcomes-based procurement. Ensure training and guidance incorporates lessons learnt and feedback from industry and other jurisdictions.

Recommendation 5.1.4 – Support the transition to a more financially sustainable, productive and innovative industry by co-developing procurement best practice guidance. This should include, at a minimum, the principles of:

- outcomes-based procurement
- transparent, collaborative and equitable allocation of risk
- fair return for partner and supplier contribution
- transition to Should Cost Models
- contract and process standardisation.

Recommendation 5.2

Risks should be allocated (not transferred) to the party or parties best placed to manage them, enabling collaboration and more productive delivery.

Recommendation 5.2.1 – Leverage industry expertise to uplift risk quantification and allocation maturity through increased early supply chain engagement during the procurement strategy and pre-selection phases. This should include all relevant tiers of suppliers.

Recommendation 5.2.2 – Improve transparency and collaboration by developing a risk allocation matrix that contemplates which suppliers are best placed to bear (and manage) each risk in the ecosystem. This should be developed and shared with prospective bidders, iterated proactively and collaboratively through the selection process, and transparently communicated throughout the life of the contract.

Recommendation 5.2.3 – Support the long-term transition to more mature risk allocation and supplier engagement by adopting collaborative and transparent risk allocation principles as standard practice. Deviation from this approach should require justification during business case development and in procurement strategy documentation.

Recommendation 5.3

Contracting arrangements and commercial models should be founded on the principle of fair return, supporting a more financially sustainable and innovative industry.

Recommendation 5.3.1 – Support the financial sustainability of the infrastructure industry by reviewing payment terms and risk allocation against a collective aspiration of fair return, and the fundamental principle that contracts should be profitable and expectations reasonable.

Recommendation 5.3.2 – Enable a more equitable assessment of performance by ensuring supplier selection and performance criteria is linked (where data is available) to ‘should cost’ expectations. Where outcomes-based procurement has been used, payment mechanisms should be linked to performance against achieving these outcomes.

Recommendation 5.3.3 – Support lower-tier suppliers in receiving a transparent and fair return by extending the principles of fair return to all tiers of suppliers in the ecosystem, in line with the Security of Payments Act.

Recommendation 5.4

Owners should adopt Should Cost Models to improve decision-making maturity, transparency and assessment of performance against delivery of outcomes and value.

Recommendation 5.4.1 – Uplift decision-making maturity and assessment of performance by drawing upon available benchmarking data to develop and use Should Cost Models. Where insufficient data is available to inform an adequate Should Cost Model, international benchmarks, local proxies, and early supplier engagement should be used to inform cost as accurately and transparently as possible.

Recommendation 5.4.2 – Support the transition to greater adoption of Should Cost Models by building internal capability such that owners and delivery agencies are able to develop, maintain, and apply Should Cost Models. Ensure any training and guidance incorporates lessons learnt and feedback from industry and other jurisdictions.

Recommendation 5.5

Owners should adopt a standardised contract approach to infrastructure delivery, minimising bespoke contracts and clauses, to improve procurement efficiency, reduce risk and foster continuous improvement.

Recommendation 5.5.1 – Enable immediate-term procurement efficiency gains by looking for opportunities to simplify existing contracts and (or) leverage existing standard forms. Owners should liaise with other jurisdictions and look to Australasian Procurement and Construction Council advice for opportunities to standardise approaches to procurement.

Recommendation 5.5.2 – Support the transition to a more standardised approach to procurement by increasing the capability of procurement resources and introducing new approaches that avoid bespoke contracts or amendments to existing standard forms. Owners and suppliers should be capable and informed enough to adequately assess the need for a bespoke solution, only where a standardised solution cannot achieve (or is less effective at achieving) desired outcomes.

Recommendation 5.5.3 – Engender continuous improvement by capturing lessons-learned and ensure these are fed back into the procurement process. Continue to liaise with suppliers and other jurisdictions (early and often) throughout the transition to encourage greater adoption of standardised approaches.

Recommendation 5.5.4 – Enable the consistent and effective adoption of standardised approaches and contracts, by coordinating the collective review and development of a workable national solution. This should involve extensive industry and government engagement, assessment of international best practice examples (e.g. NEC and FIDIC contract suites), and lessons learnt from international jurisdictions.

Recommendation 5.5.5 – Enable more efficient and effective procurement by transitioning to a preference for the use of the national standard contract form and approaches (identified in Recommendation 5.5.4). Where a national standard has not yet been developed, the principles of being easy to read, simple, fair, and facilitate good management should be adopted. Deviation from this approach should require justification during business case and procurement strategy development.

6. Delivery innovation

Recommendation 6.1

Owners should set a clear presumption in favour of Modern Methods of Construction, enabling improvements in productivity, quality and safety.

Recommendation 6.1.1 – Facilitate the transition to greater use of Modern Methods of Construction by developing a Modern Methods of Construction Strategy. The strategy should provide industry greater confidence to invest in innovative technologies and techniques, foster collaboration, and set clear targets for adoption of the principles set out in this roadmap.

Recommendation 6.1.2 – Enable the adoption of standardised products by establishing a clear presumption in favour of delivering through portfolios or programs, and adopting standardised and interoperable components. This necessitates the use of delivery models, contract forms and technical specifications that are outcomes-focused and therefore do not stifle innovative proposals that utilise these standardised and interoperable components.

Recommendation 6.1.3 – Assist governments and industry by developing best practice guidance (based on the principles in this roadmap) for the adoption of Modern Methods of Construction. This should leverage existing local examples and lessons learnt from other jurisdictions, and include at a minimum the principles of:

- adopting Modern Methods of Construction
- delivery through production systems
- delivery integration
- digital platform approaches.

Recommendation 6.1.4 – Maintain momentum in the transition to innovative delivery approaches by regularly conducting maturity assessments of projects against best practice guidance, including (but not limited to) adoption of off-site techniques, production system methodologies, delivery integration and the adoption of standardised and interoperable components.

Recommendation 6.2

Delivery should shift from traditional construction to delivery through production systems, improving task reliability and enabling continuous improvement.

Recommendation 6.2.1 – Uplift reliability and predictability in delivery by actively promoting the production systems approaches, including delivery rehearsal and production system planning. Apply these principles across the portfolio and engage early with suppliers to plan and optimise delivery.

Recommendation 6.2.2 – Optimise construction delivery by using digital rehearsal on all projects where the technology and capability is available. Rehearsals should include all aspects of construction and be used to inform interactions through the ecosystem. Owners and suppliers should plan for developing digital rehearsal capability, and advocate for its use in procurement and in existing programs.

Recommendation 6.3

Delivery models should shift to greater integration and delivery through enterprise models, improving productivity and delivery of outcomes.

Recommendation 6.3.1 – *Enable enterprise delivery by progressively moving to more integration of information, process and organisation, recognising that integration at system and project level is a feature of best practice.*

Recommendation 6.3.2 – *Improve productivity by designing delivery models to bring partners and suppliers together within delivery enterprises, supported by an appropriate level of common information structure, common delivery processes and as part of integrated teams.*

Recommendation 6.4

Owners should adopt platform approaches to delivery, utilising standardised components and assemblies to enable economies of scale and a step-change in procurement and delivery productivity.

Recommendation 6.4.1 – *Look for opportunities to accelerate the development and use of product platforms to support building a market and demand for products. Look to existing local examples that could be early adopters and test the development of a true product platform.*

Recommendation 6.4.2 – *Support the transition to platform approaches by adopting enabling procurement and delivery approaches, including:*

- *procurement approaches that support early supplier engagement during product development*
- *delivery through integrated teams that can collectively develop assembly processes in advance of construction start.*

7. People wellbeing and resilience

Recommendation 7.1

Apply a proactive and systemic approach to achieving health, safety and wellbeing outcomes across the sector.

Recommendation 7.1.1 – Drive a focus on health, safety and wellbeing outcomes by ensuring senior leaders are responsible for wellbeing as well as health and safety performance in their organisations. This should include establishing, and subsequent monitoring and reporting of, objectives and benchmarks and pursuing a ‘zero appetite’ position for health, safety and wellbeing risk.

Recommendation 7.1.2 – Embed health, safety and wellbeing objectives and targets through each infrastructure investment as part of a holistic and consistent approach to achieving health, safety and wellbeing outcomes.

Health, safety and wellbeing objectives and targets should be captured and integrated within each business case, and progressively refined and monitored through design and into delivery. Procurement processes and contracts should clearly define expectations, including KPIs, regarding health, safety and wellbeing so that delivery partners understand expectations from the outset.

Recommendation 7.1.3 – Review and optimise work patterns to reflect and support the health, safety and wellbeing outcomes to ensure workplaces and worksites protect and promote workforce health, safety and wellbeing. For example, this may include implementation of a 5-day working week. Organisations should accurately track all hours worked by employees and implement measures to mitigate the potential for overwork.

Recommendation 7.1.4 – Work with and support industry to understand the underlying causes of, and best practice solutions to, poor levels of mental wellbeing in the infrastructure sector. This could include working with the Construction Industry Culture Taskforce to finalise and promote adoption of the industry Culture Standard.

Recommendation 7.2

Establish objectives and targets for equality, diversity and inclusion and ensure these are systematically pursued to foster a resilient, diverse and inclusive workforce.

Recommendation 7.2.1 – Foster a resilient, diverse and inclusive infrastructure sector by ensuring senior leaders are responsible for establishing equality, diversity and inclusion objectives and for demonstrating continuous improvement against stated targets:

Senior leaders should be trained to fully appreciate the challenges and benefits of equality, diversity and inclusion, and understand good practice methods for achieving effective outcomes.

- Senior leaders to become advocates for equality, diversity and inclusion and across industry more broadly.
- Develop diversity and inclusion policies, strategies and plans, and address matters such as parental leave and flexible working arrangements.
- Embed equality, diversity and inclusion KPIs, including recruitment, development and promotion targets, in reporting.

Recommendation 7.2.2 – Establish and embed equality, diversity and inclusion objectives through each infrastructure investment as part of a holistic and consistent approach to achieving outcomes. Equality, diversity and inclusion objectives should be captured and integrated within each business case, and progressively refined and monitored through design and into delivery. Procurement processes and contracts should clearly define expectations, including KPIs, regarding equality, diversity and inclusion so that delivery partners understand expectations from the outset.

Recommendation 7.2.3 – Industry should work collaboratively to develop and implement an industry survey to develop a deeper understanding of the relative experiences and challenges across all groups working in the infrastructure sector so that targeted measures can be implemented to achieve equality, diversity and inclusion outcomes.

Recommendation 7.2.4 – Champion equality, diversity, and inclusion across the infrastructure sector, and publish metrics and performance against benchmarks on an annual basis, building on the framework developed by the Workplace Gender Equality Agency.

Recommendation 7.2.5 – Uplift industry knowledge and understanding by adopting transparent reporting on the performance of equality, diversity and inclusion strategies to enable sharing of good practice and lessons learned.

Recommendation 7.2.6 – Implement measures, such as more gender equitable approaches to recruitment and promotion, to reduce the gender pay gap. Increase pay transparency and implement reporting on gender pay gaps.



1. Delivering industry productivity and innovation

Australia's current and future attractiveness as a place to live, and for businesses to invest in, is underpinned by the quality, accessibility and performance of our economic and social infrastructure.

Economic infrastructure, such as road, rail, energy networks, telecommunications and water, are critical enablers of economic growth and prosperity for our cities and regions. Social infrastructure, such as schools, hospitals, arts and cultural centres, and justice and emergency services, directly underpin the liveability and economic vibrancy of our cities and regions and enhance the quality of life for all Australians.

In an increasingly connected global economy, our cities and regions are facing greater competition than ever to attract and retain highly skilled and mobile labour. Professionals in knowledge intensive sectors such as engineering, health, education and digital have the choice of residing anywhere – be it Australia or other global economic centres such as London or New York. Our cities and regions are also competing to attract new business investment and capital, including within the infrastructure sector.

Many leading infrastructure economies, such as the United Kingdom and Canada are pursuing significant reform to the way infrastructure is delivered and operated in order to ensure they are attractive places to live and work in, as well as safe and secure places to invest.

The competitive pressures have been compounded by the COVID-19 pandemic, which has radically changed existing patterns of use for infrastructure and constrained the availability of international skilled labour. Pressure on local labour markets has increased, emphasising the importance of skills development and transfer in Australia. Infrastructure is, and will continue to be, a key pillar in the economic response to COVID-19.

The quality and performance of our infrastructure assets, systems and networks have never been more important to Australia's long-term prosperity. High-quality and high-performing infrastructure assets, systems and networks require an innovative, productive and financially sustainable infrastructure sector. Industry and government must remain in-step so as to ensure Australia remains a prosperous nation and capitalises on the opportunity arising from infrastructure investment in response to COVID-19. A financially sustainable infrastructure sector is critical to ensuring all Australians, regardless of where they live, can readily access economic opportunities, social services and facilities, education services and community amenities.



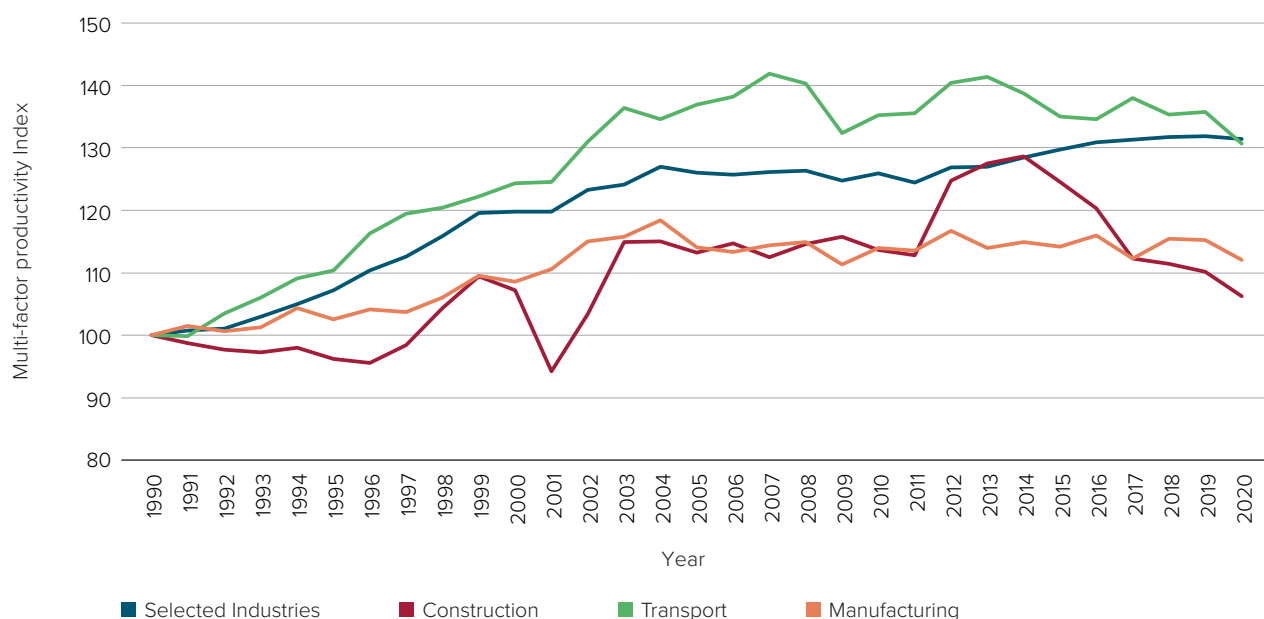
1.1 A new approach to planning and delivering infrastructure in Australia is needed

Despite the importance of infrastructure to our future prosperity and quality of life, the infrastructure sector is facing entrenched challenges impacting its immediate and long term financial sustainability.

The current approach to infrastructure delivery is outdated. Traditional models create silos with interfaces and hand-offs between contributing organisations and teams. This approach is not fit for a digital future that demands integration and collaboration.

These outdated models have contributed to lagging construction sector productivity growth over the past three decades (see Figure 1).

Figure 1: Industry multifactor productivity



Note: Selected Industries includes the following: Agriculture; Forestry and Fishing; Mining; Manufacturing; Electricity; Gas; Water and Waste Services; Construction; Wholesale Trade; Retail Trade; Accommodation and Food Services; Transport, Postal and Warehousing; Information, Media, and Telecommunications; Financial and Insurance Services; Arts and Recreation Services.

Source: Australian Bureau of Statistics²

The potential of digital engineering, better information management processes, the treatment of data as an asset, and integrated digital approaches to asset management have the potential to transform the infrastructure sector and support enhanced productivity and innovation. However, the potential transformative benefits of digital remain largely unharnessed by government and industry stakeholders. The uptake of digital processes and practices remain low.

Traditional infrastructure delivery is undermined by an approach that focuses on procurement of suppliers to deliver defined solutions at lowest price. It is typical for designers to be engaged to engineer solutions that meet a pre-determined client view, with contractors then chosen through a competitive tender process that focuses narrowly on the capital cost to deliver a defined scope. This model creates delivery organisations where parties have differing underlying incentives and interests, creating negative and divergent tensions from the outset of delivery.

In many cases, lowest initial price and maximum transfer of risk are taken as measures of value for money. This process is cascaded through the supply chain as wider capability is brought together to deliver solutions.

This approach is flawed in a range of respects:

- Effectiveness of the solution in delivering the required outcomes for users does not form part of the relationships between the owner or delivery agency and ecosystem partners (e.g. designers, contractors, sub-contractors and suppliers) engaged to deliver the solution.
- With no direct relationship between scope and the required outcomes, the lowest price to deliver work does not represent value for money.
- In a rapidly changing and increasingly complex built environment where intelligent solutions should effectively integrate engineering and technology, it is not reasonable to expect that consultants have the required depth and breadth of capability to develop effective solutions in isolation.
- Contractors are unable to fully bear high impact risks when they are simply transferred through procurement processes.

Transferring risks when delivering large, complex infrastructure projects results in such risks being priced into tenders and passed on to sub-contractors. When an adverse event arises, the circumstances are unlikely to be exactly as foreseen in the contract resulting in disputes – and lengthy and costly resolutions.³

“The client may therefore pay for risk twice – once to pay the supply chain for holding or managing the risk, and then to bear the actual cost of the risk when its transfer ultimately proves impossible.”

The emphasis on price-based tendering and the transfer of risk ultimately leads to dysfunctional business models. Contractors generate low margins and, in an environment with so much uncertainty and inefficiency, place an emphasis on managing cash flow and recovering overhead.

This disintegrated approach, where strategic delivery partner selection is determined through price-based tendering, where contractors must manage significant uncertainties and risk and where they generate low margins, has contributed directly to the poor productivity record of construction.

By separating design from construction and creating an in-series approach to how supplier and sub contractors are subsequently engaged, there is little flow of information and knowledge from the supply chain to the front end of the project where value is created.

These issues are enduring and significantly impede the infrastructure sector's productivity and ability to adopt innovative approaches and processes, challenge the sector's financial sustainability, and impact the functionality and efficiency of our infrastructure being delivered.

1.2 Infrastructure services require a new, modern approach to planning and delivering infrastructure

Responding to the challenges identified in the *2019 Australian Infrastructure Audit*, the *2021 Australian Infrastructure Plan* identifies the importance of supporting recommendations driving industry productivity and innovation to deliver greater value for money and improved outcomes for communities. Long-term thinking that considers the role of government in the next generation of infrastructure investments is critical, supported by improved focus on planning, portfolios and pipelines. Other key areas of opportunity include enhancing individual project outcomes and applying a digital by default approach.

In summary, high-quality and high-performing infrastructure services require an innovative, productive and financially sustainable infrastructure sector able to deliver high-quality assets, capable of supporting high-quality infrastructure services.

1.3 The record investment pipeline will require new ways of work

Australia is on the cusp of an unprecedented wave of investment in public infrastructure projects. Investment in major public infrastructure over the next five years across Australia will exceed \$218 billion (defined as projects exceeding \$50 million in Tasmania, Australian Capital Territory and the Northern Territory, and \$100 million in New South Wales, Victoria, South Australia, Queensland and Western Australia) over the next five years across Australia will exceed \$218 billion. This scale of investment, and the rate of growth needed to achieve it, has never previously been seen.

The new record investment builds substantially on waves of investment committed in past years. Infrastructure Australia's *2021 Infrastructure Market Capacity* report notes that the Major Public Infrastructure Pipeline reflects growth of 100% as compared to current activity. The peak of annual investment, estimated at over \$52 billion in 2023, has not previously been delivered, and reflects many multiples beyond spending rates experienced in response to the Global Financial Crisis. In addition, there is a significant pipeline of private sector infrastructure expenditure over and above this, which also places enormous pressure on Australia's capacity to deliver the infrastructure needed.

The scale of demand for skills and resources is highly likely to exceed the normal capacity increases expected in the market. Demand for plant, labour, equipment, and materials to deliver the *Major Public Infrastructure Pipeline* over the next five years will be two-thirds higher than the previous five years (to 2019–2020). The most intense resource pressures are labour and materials, accounting for 60% and 30% of resource demands over the next five years, respectively.

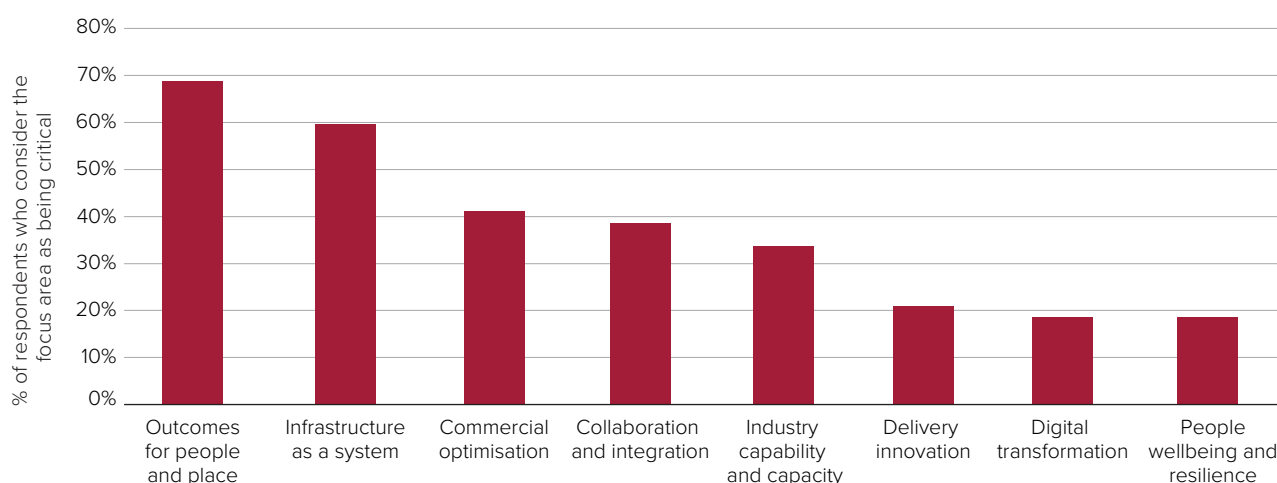
1.4 Recognising that the core purpose of infrastructure is to deliver outcomes for people and places

The core purpose of infrastructure is to improve outcomes for people and places. This means recognising that the use of the infrastructure is of primary importance – with all other processes, such as operation, planning, procurement, design and construction in support of this end.

When we invest in infrastructure it is with a view to delivering better outcomes for people and for places. These outcomes should provide the focus when prioritising and developing investment proposals and should provide the basis for engaging with partners.

This roadmap promotes an outcomes first approach, recognising that infrastructure solutions (both physical and non physical) are framed by the outcomes they deliver for people and the places they live and work. This is consistent with the views of senior public and private sector leaders in the infrastructure sector, which identified a focus on outcomes as the most critical enabler of change (see Figure 2).

Figure 2: Areas of focus most critical to supporting a productive, innovative and financially sustainable Australian infrastructure sector



Note: The above chart presents the proportion of respondents (n=119) who identified the area of focus as being the most critical, second most critical or third most critical.

Source: Infrastructure Australia 2021, Future of Australian Infrastructure Delivery: Online survey of infrastructure stakeholders.

Infrastructure projects should be about developing and delivering solutions that secure better outcomes. Success should be measured in terms of how effectively delivery processes have engaged the right capability and enabled innovative, cost-effective solutions to deliver desired outcomes for people and places.

An outcome focused infrastructure sector must consider value in terms of the impact the investment will have in delivering the required outcomes.

A core premise of this roadmap is that any infrastructure system should be developed, enhanced and managed with a continuing focus on delivering better outcomes for people and places. This outcomes focus is core to the new delivery models that will improve the way infrastructure is delivered in Australia.

When the end-to-end process of development is focused on improving outcomes, there is greater opportunity for creativity and innovation, and for better collaboration between stakeholders. It also gives the supplier ecosystem the opportunity to offer more effective solutions.

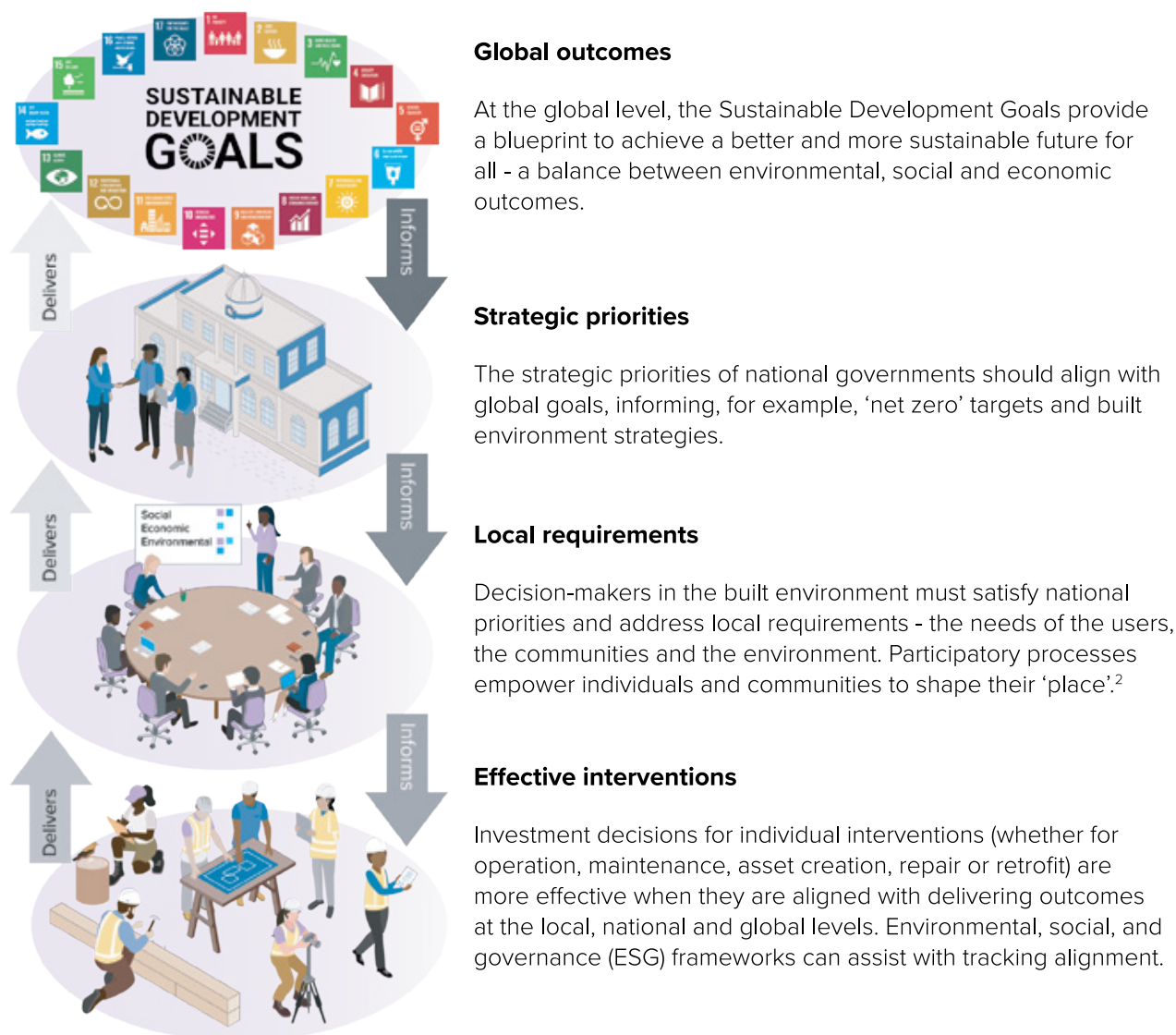
By making outcomes the focus for projects and programs we improve our ability to:

- deliver desirable outcomes for people and the wider environment
- integrate new solutions properly into the existing system
- realise available value from what we have already built
- embed resilience through a focus on systems, outcomes and benefits
- unlock the potential of digital transformation across infrastructure.

Development of infrastructure must take place within a context where outcomes are aligned, from strategic priorities, through to local requirements and into the proposed project outcomes.

Infrastructure owners and delivery agencies should establish outcomes that align with their defined strategic priorities while also reflecting the requirements and priorities of customers and communities.



Figure 3: Process for developing aligned outcomes for infrastructure investmentSource: Centre for Digital Built Britain⁴

Developing aligned outcomes for infrastructure investment requires processes at global, strategic, local and individual levels, as shown in Figure 3. In addition to the UN Sustainable Development Goals, we also need to address national and sub-national priorities and regional requirements to ensure the attractiveness of investments and talent in competitive markets to drive productivity.

The Australian Government, alongside state and territories, should offer a framework to identify their own distinct goals and the areas of shared alignment. These strategic outcomes must in-turn be integrated with the requirements of the local community and local environment (customer outcomes) – which in turn allows outcomes to be defined for investment projects (project outcomes).

Infrastructure owners must develop processes that provide this understanding of local requirements. These processes must include both long-term perspectives on community need and sentiment as well as participatory approaches, empowering individuals and communities to shape their 'place'.

Such a focus on outcomes is an important shift. The role of infrastructure clients is not just to build more, or even to build better, but to contribute to people and places. It is only when we shift from focusing on creating infrastructure to improving the outcomes enabled by infrastructure that people and place can thrive together.

1.5 Developing an enabling culture

This roadmap amounts to an industry change plan. It will improve the productivity of the sector, lift capacity and capability, promote innovation, embed sustainability and strengthen the Australian industry. These reforms will ensure the sector is well placed to withstand disruptions, such as the challenges facing supply chains during COVID-19, but also ensure infrastructure better addresses the needs of the community.

To deliver this scale of change, a corresponding change in underlying culture in both the public and private sectors is needed.

This requires creating a culture that is diverse and inclusive, enables delivery integration and collaboration, that is outcome and system focused and that embraces innovation. Embracing this change will enable more Australians, from a greater range of backgrounds, as well as a greater number of Australian businesses to share in the record investment in the sector. This broad engagement will also improve the resilience of the supply chain and create a more productive and innovative infrastructure sector.

What defines culture can be challenging to pinpoint. A practical and widely accepted definition describes culture as the aggregation of 'artefacts, espoused values, and shared assumptions'.⁵ At an industry level this definition should highlight the important role of values and behaviour in enabling change. This roadmap highlights the need for behavioural change, recognising both the importance of establishing the right behaviours in creating value, as well as the need to create environments that enable the required behaviours.

Culture touches every facet of what we do and the way we do it. A positive culture creates higher functioning and more accessible infrastructure. A positive culture makes an industry or organisation more attractive, helping to ensure a bigger pool of talent to manage and deliver infrastructure.

Industry and governments jointly acknowledge a range of challenges impacting the culture of the infrastructure sector. To combat these challenges, significant effort on the part of industry and government has already been made to enhance the infrastructure sector's cultural standing, and a range of reform initiatives are already underway. We recognise that governments, the agencies within them and private firms, are operating at differing starting points.

There is a need for the industry to promote the more consistent and widespread adoption of best practices that will create positive working environments, making the sector more attractive for future employees at all levels.

This roadmap sets out recommendations across a spectrum of areas, from whole-of-system planning to delivery integration and innovation. These recommendations will help us to foster an enabling and prosperous culture for infrastructure.

1.6 Why do we need this roadmap?

The current approach to infrastructure planning and delivery in Australia impedes productivity, stifles innovation and challenges the financial sustainability of the sector. Decision-making falls short of consistent best practice, procurement and contracting arrangements can drive poor investment outcomes, a lack of project coordination contributes to capacity constraints, and the potential of digital transformation remains unharnessed. These issues are enduring.

Overcoming these constraints is not a minor change. It requires a paradigm shift that aligns all parts of the infrastructure ecosystem and enables them to work together to transform infrastructure outcomes in Australia.

Best practice shows effective delivery comes when infrastructure owners and delivery agencies:⁶

- take ownership of the complexity of their projects and of their relationships with their supply chains
- establish more effective relationships, selecting the right partners and engaging with them to deliver the most productive solutions
- create the conditions for participating organisations to work together to deliver the best possible outcomes for all.

Transformational change can only occur by getting projects and programs right from the start. This roadmap has been developed to support the required transformational change in how we plan and deliver infrastructure in Australia to improve the productivity, innovation and financial sustainability of the sector.

The roadmap presents a framework of best practice principles that have been developed with the input of senior government and industry leaders across the infrastructure sector. Together, the principles present a coherent, systematic framework for transforming how we plan, procure, manage and deliver public infrastructure projects and programs.

1.6.1 Why do we need this roadmap now?

Record levels of infrastructure investment presents the need for transformational change in the infrastructure sector. Alignment of strategic vision, the injection of economic stimulus, public and private sector recognition of the need to change, and fast-tracked decision-making have created the necessary environment for the adoption of reform.

To deliver the ambition of record investment, change in the sector must happen now, while the infrastructure industry is united in addressing the unprecedented challenges posed by COVID-19. Without significant intervention, our current productivity and innovation stagnation trends will continue and see this opportunity unrealised. In an increasingly competitive global economy, Australia is at risk of being left behind.

This roadmap is a circuit breaker. It is a framework for the required paradigm shift that aligns all components of the infrastructure value chain – from public sector project owners, industry, supply chains, and community – to work together to achieve a productive, innovative and financially sustainable infrastructure industry.

Box 1: Capitalising on infrastructure investment

Capitalising on infrastructure investment

Infrastructure investment has formed a key plank in Australia's economic response and subsequent recovery from the COVID-19 pandemic. The Australian Government and state and territory governments have committed to deliver a combined \$225 billion in infrastructure investment over the four years between 2020–21 and 2023–24.⁷ This is in addition to the infrastructure currently being delivered, and investment committed by the private sector.

It is vital that this infrastructure investment is planned, procured and delivered effectively to ensure we as a nation reap the economic and social benefits of this record investment. In doing so, ensuring our cities and regions continue to prosper and flourish in the long-term.

Following the injection of the current phase of infrastructure investment to support economic recovery, increasingly constrained government budgets will limit the opportunity for further investment. In response to this fiscal outlook we will need to deliver better, faster and more integrated infrastructure for less. Maintaining the competitiveness and liveability of our cities and regions for future generations demands this.

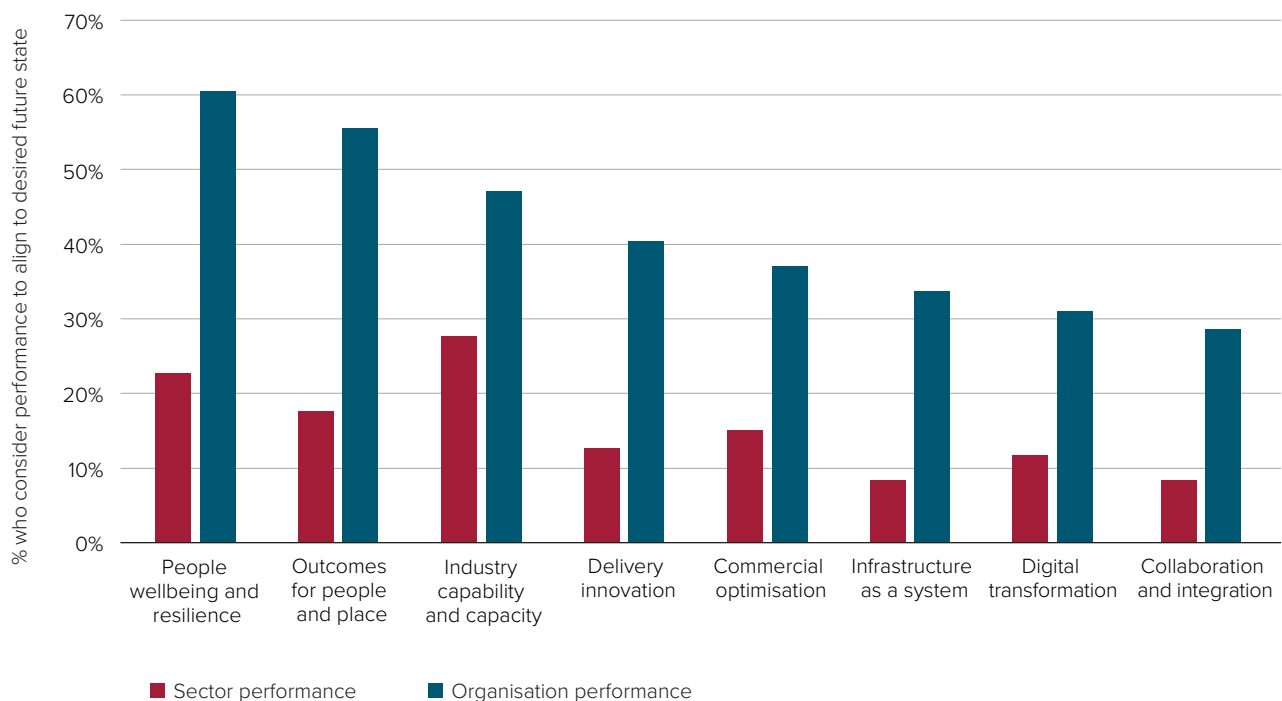


1.6.2 What is the scope of this roadmap?

This roadmap applies to the diverse range of public infrastructure projects and programs, including transport, energy, waste, water, telecommunications, and social infrastructure. It sets out best practice principles from project and program inception through to delivery to achieve better, faster, greener delivery and improved outcomes. These reforms are intended to support better services for infrastructure users and communities.

This roadmap has been prepared in the recognition that there is a continuum of maturity, capability and capacity among owners and delivery agencies across sectors and jurisdictions. This is further challenged by the infrastructure sector's perception of its own performance. The overwhelming majority of stakeholders surveyed consider their organisation to perform well relative to a perceived best practice standard, while simultaneously considering the broader sector to perform poorly relative to perceived best practice (see Figure 4).

Figure 4: Current Australian infrastructure sector performance and organisational performance

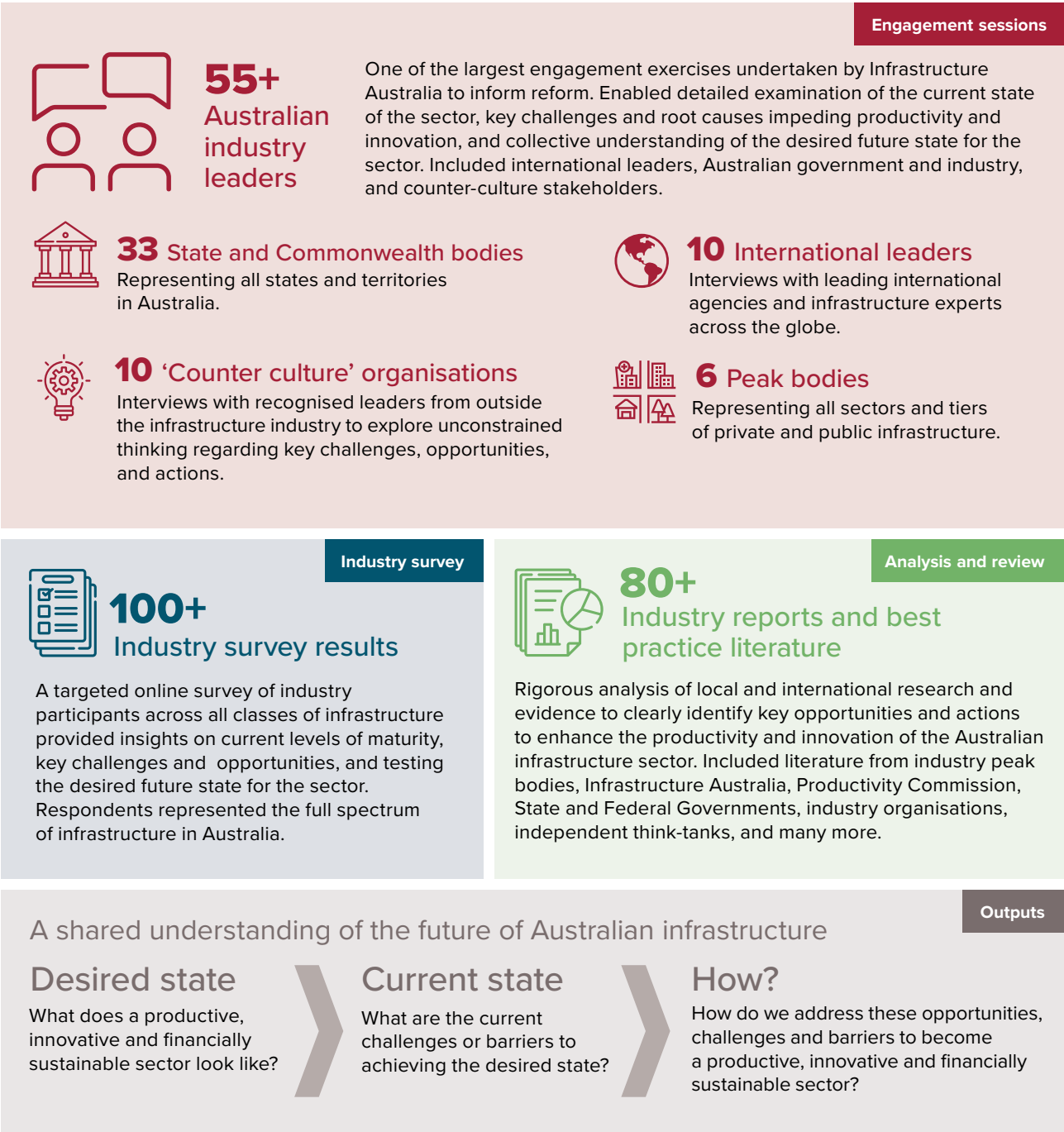


Source: Infrastructure Australia 2021, Future of Australian Infrastructure Delivery: Online survey of infrastructure stakeholders (n=119).

1.7 How was this roadmap developed?

Understanding and articulating a collective industry view of the ‘desired state’ is a critical step in determining where the industry needs to get to, what steps are required to enhance delivery, and what are the requisite reforms needed to enable and drive change. It is fundamental to designing a logical and effective roadmap. Figure 5 illustrates the key activities undertaken to capture the perceptions, challenges, opportunities and wider insights from the plethora of stakeholders engaged and body of knowledge built to date.

Figure 5: Development of the roadmap involved extensive industry engagement sessions, online surveys and analysis.



2. A whole of system perspective

Executive summary

Recommendations

Outcomes for people and place

Infrastructure as a system

Digital transformation

Collaboration and integration

Commercial optimisation

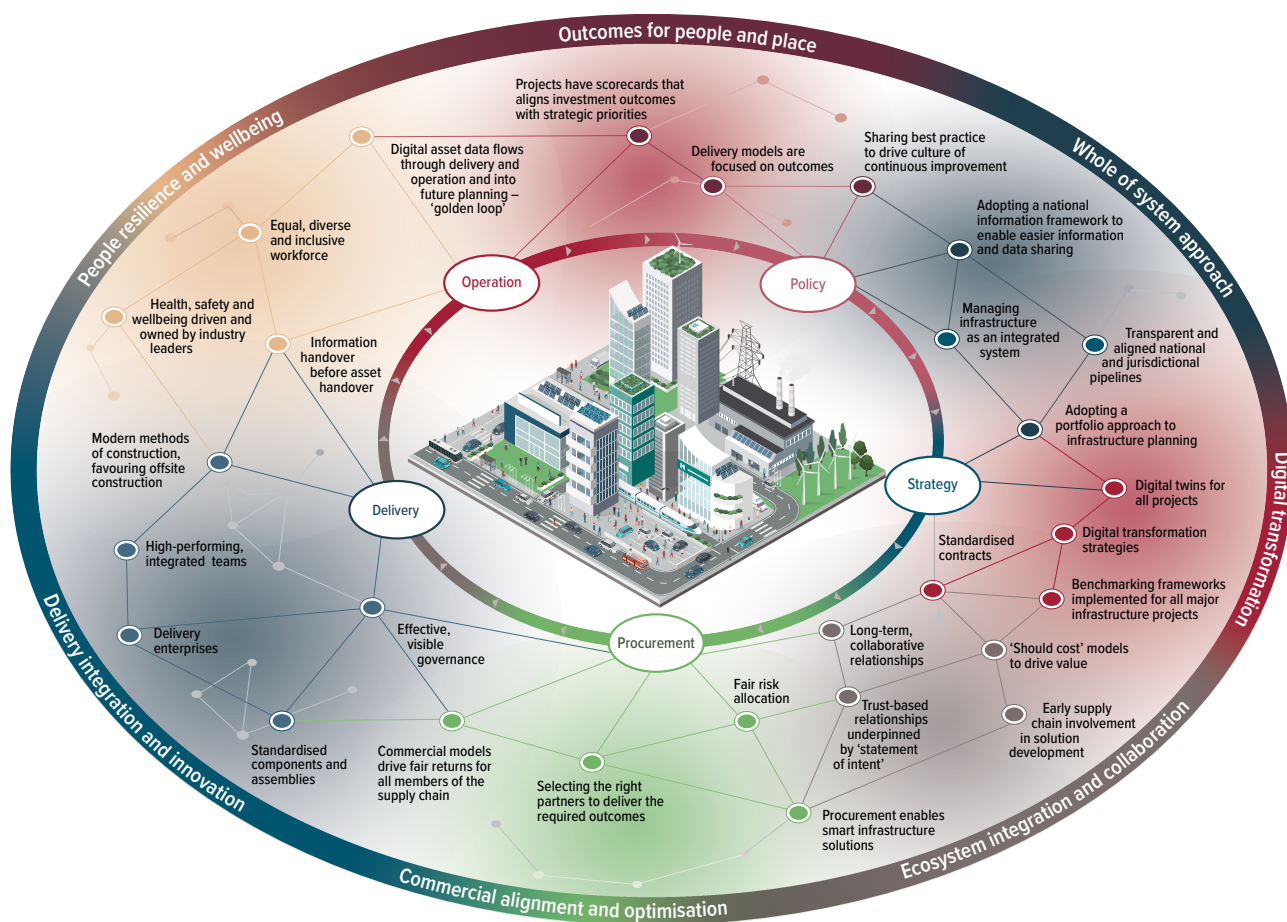
Delivery innovation

People, wellbeing and resilience

2.1 The challenges facing infrastructure investment need a whole of system response

Effective interventions require an aligned and integrated response, shifting away from the transactional and hierarchical approach traditionally used in infrastructure delivery. This roadmap for improving the productivity of infrastructure delivery, and supporting innovation, has been developed as a whole of ecosystem response – founded in the recognition that all parts of the ecosystem have a role to play in the direction and future state of the industry (Figure 6).

Figure 6: A whole of ecosystem response is needed to deliver outcomes for people and places

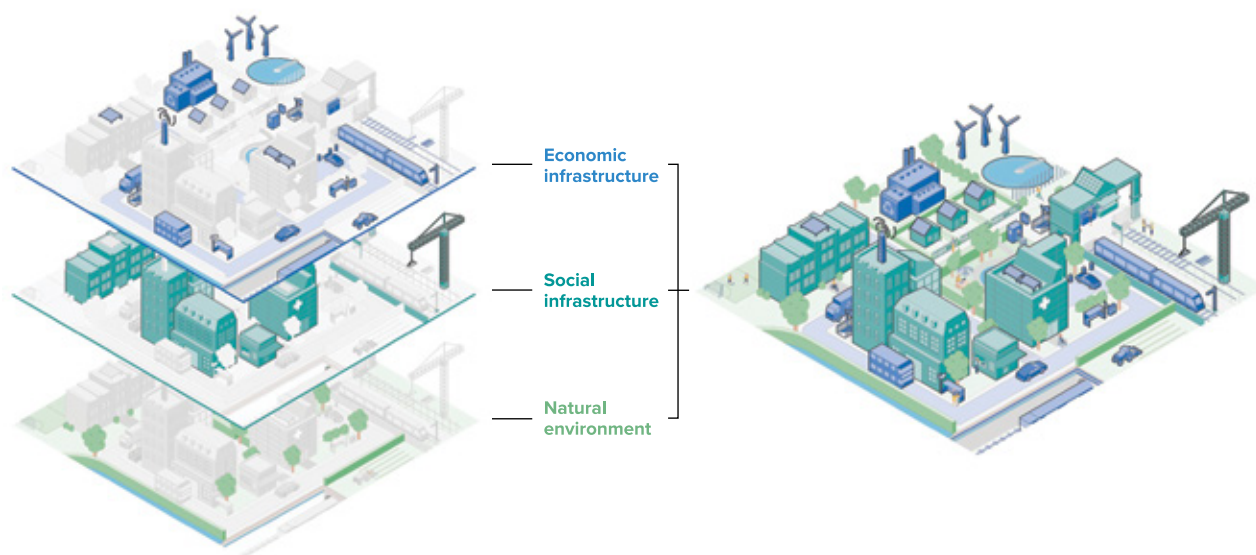


2.2 Planning and delivering infrastructure solutions in a system of systems context

Infrastructure is a complex system essential for our wellbeing. For people and places to flourish, the built and natural systems must work together and be managed as a deeply interconnected system. Infrastructure is a complex 'system of systems' of connected assets. It is systems, and not projects, that provide the mobility, energy, sanitation and all other infrastructure services on which we rely. These services are the connection between the outcomes we desire and the systems we manage to achieve them.

To get the most out of what we already have and to ensure the full potential is realised for what we plan to build, we must understand infrastructure at a systems level. Policies and strategies must be re-framed to ensure this systems-based perspective is the foundation of everything we do.

Figure 7: Infrastructure system of systems



Source: Centre for Digital Built Britain®

Within this systems-based view, infrastructure projects are best seen as interventions into the existing system, with a focus on the impact of each asset and its subsequent lifecycle on the broader system – even small construction or refurbishment projects are interventions into existing complex systems with physical, economic, governance and social characteristics. Embracing this perspective will enable us to integrate new assets into the system more effectively.

As digitisation progresses and we develop more cyber-physical systems, interconnectivity between infrastructure assets is increasing, allowing for a more data-driven view of this system of systems. Digital technology is a significant enabler to taking a systems perspective of infrastructure. As the representation of a physical asset in the digital world, digital twins provide the opportunity to begin each infrastructure decision from a simulated view of the existing system. This provides options for both the optimisation of existing assets and the addition of new assets able to be modelled and assessed within a digital representation of the system, prior to any physical interventions being progressed.

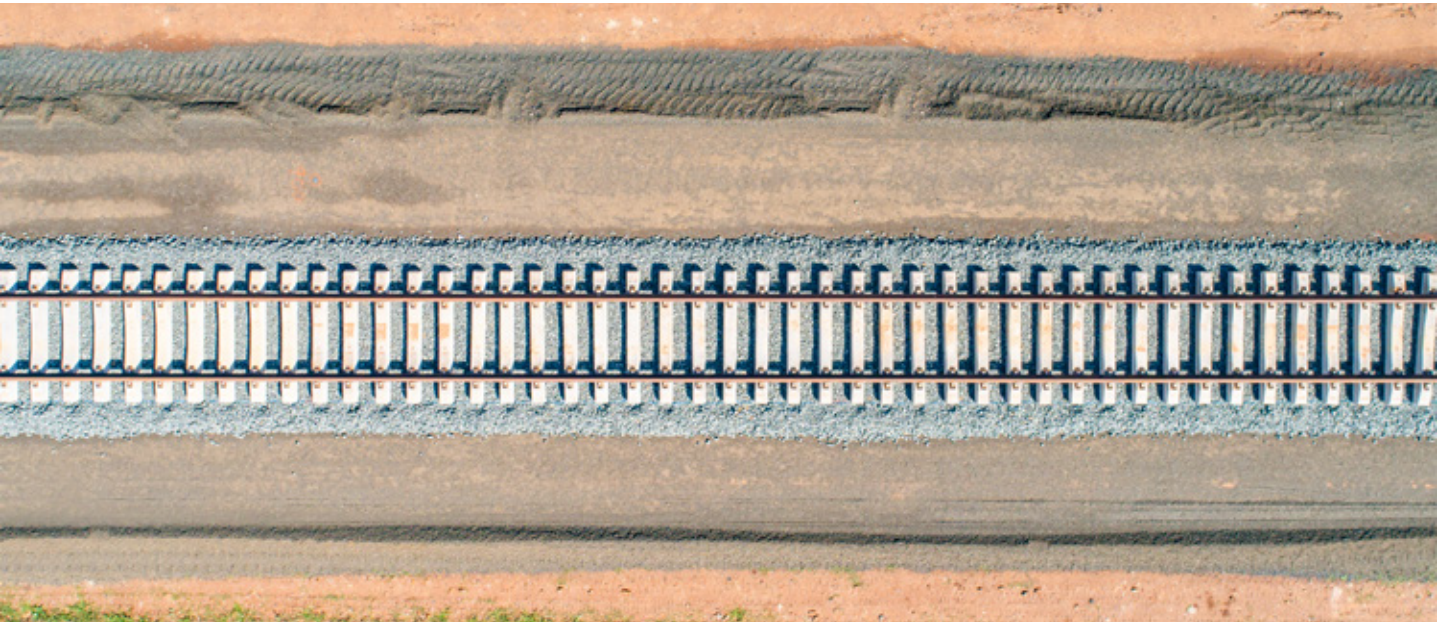
This systems approach demands collaboration, with the stakeholders managing and developing infrastructure working together using integrated business models and processes. The traditional delivery models for infrastructure projects have not reflected this system perspective, placing an overriding emphasis on the traditional engineering and construction of distinct assets.

Managing this infrastructure system requires a better understanding of the function, capacity and condition of the infrastructure we already have. The ‘enduring questions’ of Australia’s infrastructure system, shown in Table 1, highlight the spectrum of questions that need to be considered to develop this understanding.

Table 1: Enduring questions of an infrastructure system

Category	Enduring questions
Infrastructure baseline	• What infrastructure do we have? • What is its capacity, geospatial location, and value? • What is the condition of the infrastructure?
Infrastructure performance	• What services does it provide? • How well does the infrastructure perform as a system? • How well does the infrastructure perform as a service for end-users? • What is the connection between infrastructure performance and key national metrics?
Infrastructure impacts	• What are the environmental impacts of infrastructure? • What are the social impacts of infrastructure? • What are the economic impacts of infrastructure? • What are the governance impacts of the infrastructure?
Infrastructure use	• How do people use infrastructure? • How do businesses use infrastructure? • How will this change over time? • How does the community contribute to service design?
Infrastructure systems data	• What infrastructure systems data exists? • What is the quality and consistency of infrastructure data? • What additional data would enhance decision-making? • Which better decisions would improve outcomes?

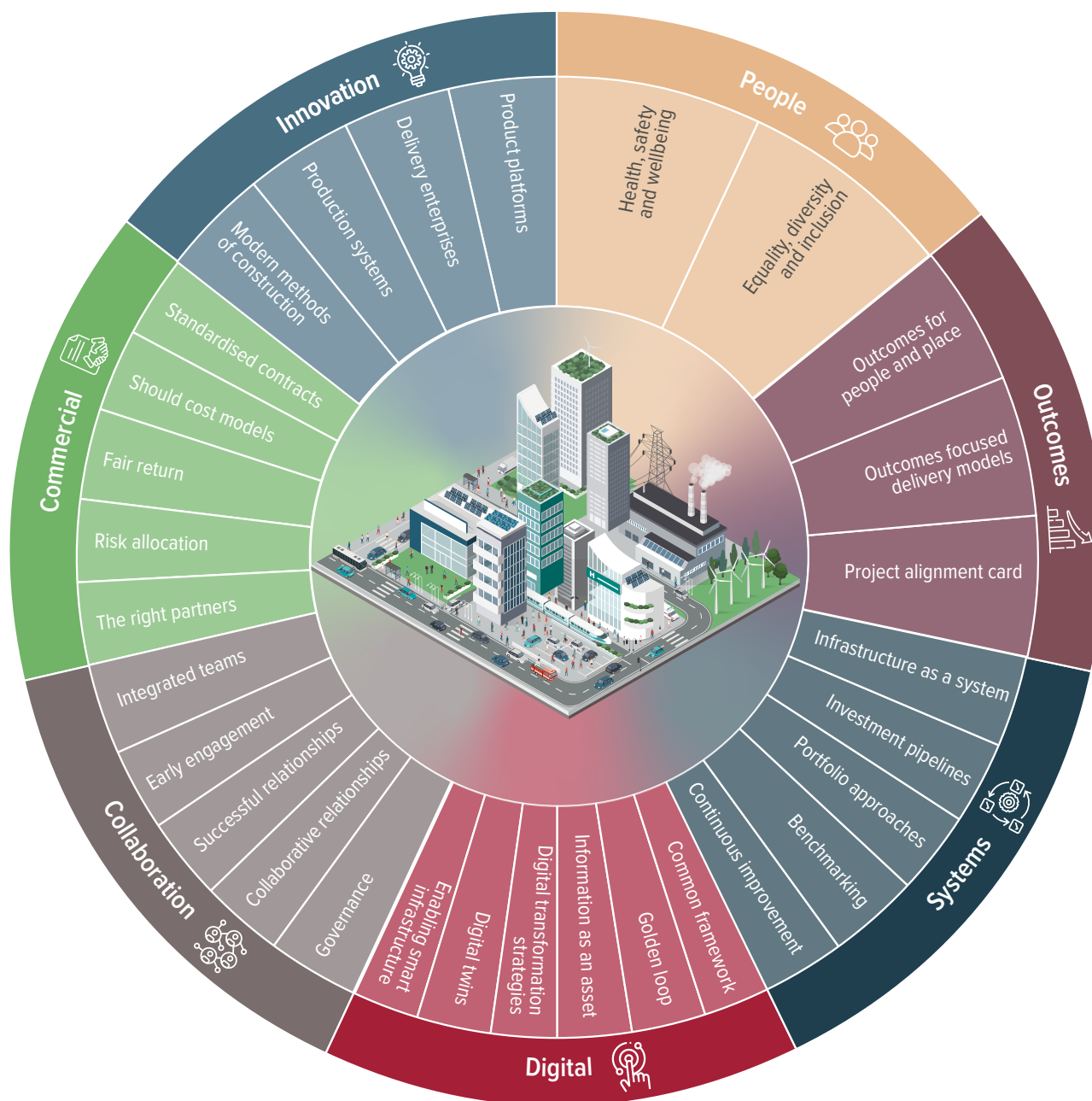
Source: amended from BITRE⁹



2.3 The framework of this roadmap

This roadmap has adopted a whole of system approach to transforming the delivery of infrastructure in Australia. The roadmap is structured along seven overarching focus areas of reform which combine to form a coherent, systematic framework of best practice principles for transforming how we plan and deliver infrastructure in Australia (Figure 8). Key to this framework is the recognition that our people – the designers, engineers, planners, operators, construction workers, policy makers, procurement teams and project managers and the community it is delivered for – are the foundation of the infrastructure sector.

Figure 8: Seven focus areas of reform, underpinned by 30 best practice principles



3. A roadmap for enhancing infrastructure outcomes

The roadmap to reform

This section of the roadmap presents seven focus areas of reform, framed by best practice principles for promoting transformative change in the infrastructure industry. These principles present a holistic framework for planning, procuring, managing, and delivering public infrastructure projects and programs to drive better outcomes for all Australians.

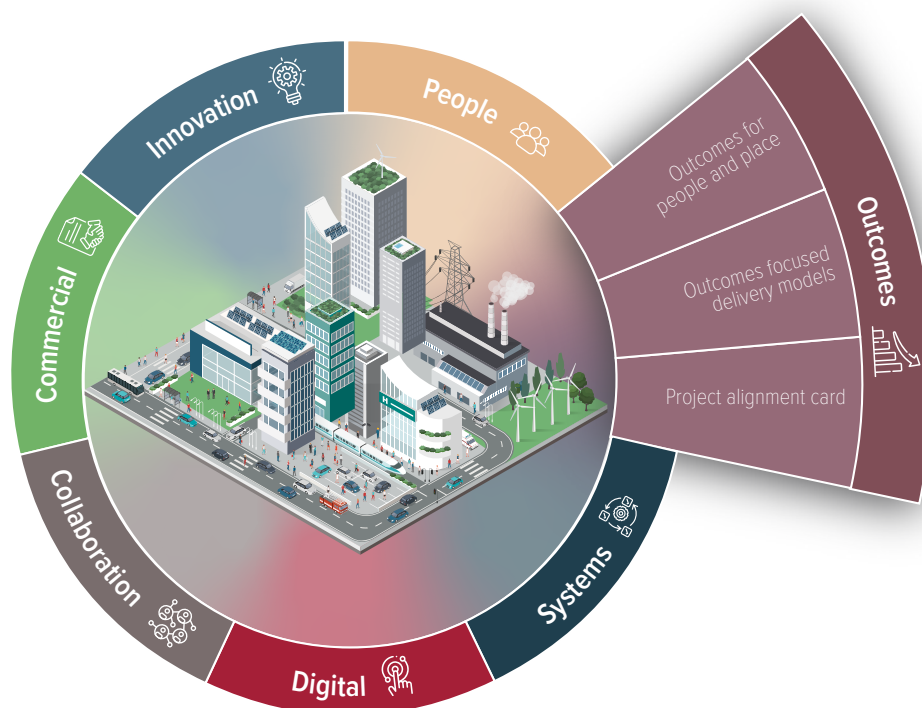
The roadmap has been developed by drawing on insights from key industry stakeholders and leaders from all jurisdictions in interviews and surveys, examples of best practice from Australia and across the world, and recognised industry benchmarks. It also is supported by the analysis in and recommendations of the *2021 Australian Infrastructure Plan*.

This section presents:

- the **desired future state**, which identifies where we want to get to as an industry
- the **case for change**, why we want to drive change and what it can achieve
- an assessment of the **overall current state** in Australia, including any key blockers or points of inertia between the future and current state
- **recommendations** for how to achieve the desired future state.



3.1 Outcomes for people and place



3.1 Outcomes for people and place

Infrastructure investment is driven by delivering economic, social, governance and environmental outcomes to enable people and places to flourish and prosper.

The fundamental role of infrastructure is to deliver social, economic, governance and environmental outcomes to enable people and places to flourish and prosper. These outcomes set the absolute purpose and objectives for investing in infrastructure solutions. Consequently, the development of new distinct assets will not always be the right answer. A focus on outcomes enables collaborative delivery models that leverage input from across the supplier ecosystem, bringing together engineering, technology and innovation to deliver intelligent and cost-effective solutions.

Current planning and delivery processes primarily focus on delivering a defined scope for discrete, sector-specific assets, rather than outcomes.

Supporting this, traditional delivery models are scope based and often fail to provide adequate articulation of the outcomes required. As a result projects, rarely create the environment for engage with partners in how outcomes can be delivered most effectively.

This section supports the implementation of the *2021 Australian Infrastructure Plan*, which focuses on delivering outcomes for people and place throughout its recommendations. The Place Chapter specifically examines a series of four recommendations localising outcomes for people and places to four specific geographies Fast-growing Cities, Smaller Cities and Regional Centres, Small Towns, Rural Communities and Remote Areas, as well as Northern Australia and Developing Regions.

3.1.1 Outcomes for people and places should be recognised as the core measures of investment success

Where do we want to get to?

Infrastructure projects and programs are focused on delivering outcomes to enable people and places to flourish.

- All interventions on the infrastructure system are focused on the core role of infrastructure being to deliver outcomes for people and places.
- Outcomes provide the focus for projects and programs and are recognised as the ultimate measure of success. Projects and programs are driven from the outset by a clear articulation of desired economic, social, governance and environmental outcomes and benefits, rather than a predefined scope. Desired project and program outcomes align to strategic national, jurisdictional and sectoral priorities.
- Infrastructure owners and delivery agencies have robust processes in place to understand customer and community needs and environmental impacts to support the identification and articulation of outcomes.
- The focus on outcomes enables the development of solutions that optimise the existing infrastructure system, and more effectively deliver outcomes through the development of intelligent solutions rather than defaulting to the addition of new assets. A focus on outcomes encourages consideration of non-traditional, intelligent and cost-effective solutions.

“ We need to ensure all projects are delivered with a focus on the best outcomes for the Australian community. ”

– Industry leader

The fundamental role of infrastructure is delivering economic, social, governance and environmental outcomes to enable people and places to flourish and prosper. Outcomes are the changes experienced by people and places from investment in infrastructure. Outcomes, in turn, inform the benefits to be realised from investment.

Australians care about the quality of the service that infrastructure enables, the accessibility and choice of services, the reliability of services, and the opportunities that services provide. While important, Australians care less about how long a project took to build or how much it cost.

Desired outcomes set the absolute purpose and objectives for investing in infrastructure solutions. Making outcomes the focus of infrastructure investment forms the basis for unlocking our ability to:¹⁰

1. integrate new solutions and interventions properly into the existing infrastructure system
2. realise greater potential and value from the existing built form
3. enhance the resilience of existing infrastructure systems
4. realise the full value of the supply ecosystem in delivering desirable outcomes
5. unleash the potential of digital transformation across infrastructure.

Infrastructure is more complex and interconnected than ever. This is particularly true in our largest cities. It is vital that infrastructure projects and programs are identified and selected based on how they shape the development of Australia's cities and regions and how they deliver outcomes for Australians.

Box 2: Articulating desired outcomes**Articulating desired project outcomes**

Desired project outcomes should be clearly articulated from the outset of a proposed intervention and consider:

- alignment with national, jurisdictional and sector priorities
- the change required from the intervention, including customer, community and environment and whether it is growth or living standard related, as well as its contribution to sustainability outcomes
- sector-specific and local context.

Current state

Current planning and delivery processes typically focus on delivering outputs on discrete, sector-specific assets (such as traffic through-put for new roads, water storage volume for new dams, and student numbers for new schools), rather than outcomes (such as access to reduced travel times, industry growth or education attainment) or multi-faceted benefits (such as reduced emissions, increased food security or employment outcomes).¹¹

Public infrastructure investment proponents often fail to adequately define desired outcomes or identify a clear problem in which their investment is seeking to respond.¹² Furthermore, many investment decisions are made without meaningful community engagement to understand how proposed interventions align with the needs of, and deliver meaningful benefits to, the broader community.¹³ Current community engagement is too often focused on how a project will be delivered, rather than seeking to understand the strategic case for a solution. Additional focus is needed to understand alignment of an intervention with community's overall needs and long-term expectations.

Furthermore, benefits are often framed as outputs, and benefit realisation is applied inconsistently. For example, despite clear state and territory guidance on the preparation of benefit realisation plans as part of the business case stage, it is common for projects and programs to proceed without a robust benefit realisation plan with clear and measurable benefits aligned to desired investment outcomes.¹⁴ Post-completion reviews, which seek to understand the success of interventions in addressing the identified problem, are also a requirement in most states and territories, as well as the *Infrastructure Australia Assessment Framework*. Post-completion reviews are not consistently undertaken and rarely shared publicly, provided limited sharing of experience and best practice.



Box 3: Greater Parramatta and the Olympic Peninsula case study – articulating outcomes, not outputs**Case study: Greater Parramatta and the Olympic Peninsula (GPOP)
Place-based Infrastructure Compact (PIC)**

The Greater Parramatta and the Olympic Peninsula (GPOP) – a 6,000-hectare area at the core of Greater Sydney – is one of the fastest growing areas in Greater Sydney and will continue to be a major generator of new jobs and housing in the future.

The Greater Sydney Commission, in consultation with the community, recognised that the new jobs and homes required to support this growth needs to be integrated and effectively planned to ensure better delivery of place-based outcomes. To that end, the Greater Sydney Commission created the Place-based Infrastructure Compact (PIC) for GPOP: a strategic planning model that looks holistically at a place to better align growth with the provision of infrastructure and services.

Ultimately, the GPOP PIC enables better place outcomes for the community, industry and governments brought about by a collective understanding of the high-level sequencing of precincts and of infrastructure priorities.

Source: Greater Sydney Commission¹⁵



For many projects and programs, it is common practice to focus on delivering a defined scope of work at the lowest estimated cost to meet projected demand. Even when desired outcomes have been identified (for example, travel time or reliability and safety for transport related projects) there is little or no consideration on whether the proposed investment is achieving lasting and beneficial economic, social, governance or environmental outcomes at their respective origin and destination as part of the business case stage or post completion.¹⁶

“Planning needs to be based on multi-decade benefits to the nation of Australia, not just discrete projects – which requires a shift in how we utilise tools like benefit cost ratios and benefits realisation plans in assessing outcomes.”

– Industry leader

Failure to adequately define desired outcomes at the outset means it is very difficult to fully demonstrate that projects are achieving intended outcomes and represent value for money to the community. This is reflected by an inconsistent approach to benefit realisation and management across projects, sectors and jurisdictions.

Box 4: Principles of best practice benefits realisation

Principles of best practice benefits realisation

The NSW Government's principles of best practice benefits realisation are:

1. A benefit is a measurable improvement resulting from an outcome which is perceived as an advantage by a stakeholder.
2. Benefits must be aligned to the organisation's strategic goals.
3. Benefits need to be first understood as outcomes. Benefits are the reason an investment is made.
4. Benefits must be measurable and evidence-based in order to demonstrate that an investment provides value.
5. Benefits can only be realised through change and change can only be sustained by realising benefits.
6. Benefits need to be owned by appropriate sponsors and managers, not by the program/project manager.
7. Intermediate benefits are needed to realise end benefits (and are just as important).
8. Benefits are dynamic; they need to be regularly reviewed and updated.
9. Keep the number of benefits monitored and reported to a sensible, manageable number.
10. Benefits management should be integrated with other organisational processes, including Project Management.

Source: NSW Government.¹⁷



Many government and industry stakeholders consulted noted that political imperatives often impede agencies' ability to apply an adequate focus on desired outcomes during early planning.

It remains common practice for projects to be announced or receive funding commitments prior to business case development.¹⁸ The resultant pressure to rush projects through relevant planning and delivery processes means delivery agencies often revert to an 'input and output' approach to defining projects and programs. This approach can lock-in sub-standard approaches for communities for many decades as infrastructure service patterns can be relatively fixed, and further investment to enhance or supplement infrastructure can be challenging to justify against competing pressures.

Early government announcements can also create community expectations about the viability, appropriateness, and likely success of a proposed solution.¹⁹ This materially compromises the ability of agencies to deliver infrastructure solutions that achieve desired outcomes.²⁰

The need to reframe project success around outcomes, rather than measures such as time and cost, was identified by government and industry stakeholders as a critical element in announcing projects to the public:

“ We need to reframe project success around outcomes, rather than cost and budget. It takes political bravery to start a project in which we don't know how much it will cost. ”

– State infrastructure body

NSW Government stakeholders highlighted the recent development of NSW ministerial guidance on project announcements to mitigate the impact of early project announcements, a first in Australia.

The current approach means there is a bias towards built form solutions. Owners and delivery agencies too often seek to respond to an identified need by building new infrastructure without adequate consideration of the full suite of alternatives.²¹ Furthermore, it is common for project objectives to be framed specifically in terms of a preferred capital solution, meaning there is an underlying risk that business cases are focused, from the outset, on a capital solution.²²

A common desire from many stakeholders was the need to shift away from a 'build-first' mentality towards one where existing assets are optimised. This was highlighted as a key opportunity in the *2019 Australian Infrastructure Audit*.²³

“ Low- or non-capital 'better-use' solutions to infrastructure problems could help to avoid or delay investment in expensive new or upgraded assets. These solutions could stretch public funding for infrastructure further, bringing productivity benefits for more users sooner. ”

A shift is required whereby the delivery of outcomes for people and place are recognised as the ultimate measure of success.

Recommendation 1.1

Improve infrastructure outcomes by ensuring investment is focused on delivering clearly articulated outcomes to enable people and place to flourish.

0-5

Recommendation 1.1.1

Enhance the quality of decision-making and improve value for money by ensuring infrastructure investment is framed from the outset by a clear articulation of desired sustainability – economic, social, governance and environmental – outcomes to better enable the development of solutions that focus on the needs of people and places.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory treasuries, state and territory infrastructure bodies

0-5

Recommendation 1.1.2

Improve the consistency and quality of decision-making by developing a national framework for articulating and assessing outcomes and benefits across the breadth of infrastructure classes. This framework should leverage existing assessment frameworks, such as the Australian Transport Assessment and Planning (ATAP) Guidelines.

Proposed lead: Infrastructure Australia

Supported by: State and territory treasuries, state and territory infrastructure bodies

0-5

Recommendation 1.1.3

Uplift the quality and maturity of infrastructure decision-making through the development and delivery of training for key decision-makers on timing of project announcements and investment assurance and due diligence.

Proposed lead: State and territory infrastructure bodies

Supported by: State and territory treasuries, state and territory public sector skills commissions

3.1.2 Delivery models should be focused on outcomes and engage partners to support the effective delivery of desired outcomes

Where do we want to get to?

Owners and delivery agencies consistently seek to implement outcomes-focused delivery models to support realisation of outcomes for people and places.

- Delivery models are set up to deliver desired outcomes, with relationships between key partners and suppliers formed with a focus on delivering outcomes. A clear articulation of required outcomes and benefits provides the focus for delivery teams and are the success measures on which the project's performance is based.
- Desired outcomes and benefits align project or program behaviours, culture, roles and responsibilities, expectations, processes, and delivery and commercial structures across all delivery partners and suppliers.
- Clearly defined and articulated project and program outcomes and benefits enable all parties to contribute directly to how they are delivered, rather than clients prescribing how such outcomes should be delivered. A shared end-to-end focus on outcomes and benefits enables greater delivery partner and supplier collaboration on innovative, cost-effective and intelligent solutions and encourages continuous improvement.
- Consideration of delivery models is undertaken early to inform the first business case stage (i.e. strategic needs assessment or case for change) and procurement strategy.

“Delivery models need to be based on collaboration and a relationship that puts the outcome and benefit to society as most important.”

– Industry leader

Infrastructure delivery in Australia has traditionally involved contractors delivering a series of unconnected projects focused on short-term outputs based on predetermined solutions. Delivery processes and relationships are formed narrowly around the scope of the project. Often, by the time delivery teams are formed there is little recognition or consideration of the outcomes being delivered.

As the Productivity Commission noted:²⁴

“Institutional and governance arrangements for the provision of much of Australia's public infrastructure are deficient and are a major contributor to unsatisfactory outcomes.”

– Productivity Commission

Infrastructure planning and delivery in Australia will be increasingly challenged by mounting government fiscal constraints, a growing and ageing population, a built environment requiring increasingly interconnected and interdependent interventions, and increasing community expectations around service level standards.

It is imperative that governments leverage outcome-focused, collaborative delivery models that are better designed to manage complexity and deliver outcomes and benefits for people and places. This was strongly emphasised in stakeholder consultations which highlighted the need for new approaches to delivery which encourage and enable innovation in solution development.

Outcomes-focused collaborative delivery models have several benefits compared to traditional approaches:

- Delivery agencies are better enabled to define and align roles and responsibilities, culture and behaviours, and processes and structures around desired outcomes, goals and purpose.
- Ecosystem innovation, creativity and collaboration is encouraged by focusing on desired outcomes rather than defining what proposed intervention should be delivered. This enables the ecosystem to propose and develop solutions that may have otherwise be excluded from consideration.
- Longer-term collaborative relationships between delivery agencies, supply chain and ecosystem partners are promoted, particularly those partners that traditionally have had a weak voice in supporting solutions development.

- Transformational change is supported by actively assessing the appropriateness of delivery models against outcomes and benefits to be realised rather than adopting familiar but potentially inappropriate models.
- Supporting the identification and design of appropriate procurement and contracting arrangements that are best placed to deliver the desired outcomes.

In doing so, the above better enables the development of internal capability within owners and delivery agencies. Outcomes-focused delivery models have the potential to support a more integrated approach to delivery that leverages input from across the ecosystem, bringing together engineering, technology and innovation to deliver intelligent and cost-effective solutions.

Box 5: Characteristics of an effective outcomes-focused delivery model

Characteristics of an effective outcomes-focused delivery model

Characteristics of an effective outcomes-focused delivery model include:

- desired outcomes and goals are clearly articulated and form the measures of success on which performance and commercial structures are based
- delivery partners are engaged to deliver outcomes not scope
- outcomes are recognised by all members of the delivery team as the ultimate measures of success
- outcomes form the basis for aligning delivery team behaviours, culture, roles and responsibilities
- outcomes are considered at every step of planning, procurement, delivery and operations
- delivery agencies and owners are core partners in the delivery of outcomes.

Current state

Traditional delivery models are scope based and often fail to provide any articulation of the outcomes required, and rarely create the opportunity to meaningfully engage with partners in how project benefits can be delivered most effectively.

Delivery model selection in Australia typically occurs once the project has been scoped and a preferred solution has been identified, in line with most state and territory business case and investment assurance guidance.²⁵

While organisation and project objectives are typically considered, the assessment and selection of delivery models is primarily focused on total cost of ownership, risk allocation and mitigation, required resources and capability, fitness for purpose, and innovation and flexibility.²⁶ A focus on desired outcomes and benefits investment is not a critical consideration, and often overlooked altogether when selecting delivery models.²⁷

Delivery agencies' ability to choose or design an appropriate outcomes-focused delivery model is impeded by the lack of a systematic approach to data collection, collation and dissemination of learnings, and identifying best practice across jurisdictions and sectors.²⁸

Stakeholders identified factors inhibiting the development and use of outcomes focused delivery models include:²⁹

- a general lack of trust and poor collaboration on both sides of the commercial relationship
- perceptions of risk associated with outcome-focused collaborative models
- unrealistic time pressures on market engagement processes.

Public sector and industry stakeholders also noted that it is common for delivery agencies to select delivery models that have worked previously or they have experience in implementing, rather than what may be right for the project. New or different delivery processes are regarded as potential sources of risk.

Box 6: Anglian Water's Strategic Pipeline Alliance case study – an outcomes-focused delivery model**Case study: Anglian Water's Strategic Pipeline Alliance – an outcomes-focused delivery model**

Anglian Water's Water Resources Management Plan involves delivering resilient water supplies for future generations of customers. This requires being able to transfer water resources around the region from areas of greater water security in North Lincolnshire to Essex where water is less secure.

Rather than define the intervention in terms of an output to meet its objectives, Anglian Water framed the intervention around achieving the desired objective for its customers.

In doing so, Anglian Water has been able to identify and pursue a range of innovative and cost-effective solutions that form part of its integrated system of assets to meet its desired outcomes. This has involved developing 500km of interconnecting pipelines that will enable water resources to move more freely around the region from areas of surplus to where water is less secure.

The scheme is being delivered by the Strategic Pipeline Alliance (SPA) which is made up of construction and engineering businesses Costain, Farrans, Jacobs and Mott MacDonald, along with representatives of Anglian Water itself as the fifth formal partner. The collective role of the SPA is to complete one of the largest strategic water transfer infrastructure projects in UK history at over £350M.

To deliver the scheme, Anglian Water decided early on to create an Enterprise that was wholly focused on delivering outcomes rather than a prescribed scope. This enabled the focus of all delivery partners to be aligned on the outcomes being sought by Anglian Water – principally delivering an additional 363 megalitres of water per day to secure water supplies for the future. This outcome was underpinned by a clear purpose *'To make the East of England resilient to the risks of drought and to secure water supplies for future generations.'*

Key elements to Anglian Water's approach included:

- **Alignment to owner:** Establishing an integrated delivery enterprise which enabled Anglian Water to consider the required environment, culture, approach and processes required, beyond the capabilities and capacity required to build the scheme. A key anchor of the delivery enterprise was the alignment of purpose, goals and outcomes to Anglian Water's own purpose, goals and priorities.
- **Clearly described purpose, goals and outcomes:** Anglian Water described the purpose, goals and the outcomes for the Enterprise very clearly in the procurement documents. Anglian Water outlined the capabilities and behaviours that were required to successfully deliver the goals and outcomes and ultimately meet the purpose.
- **A focus on outcomes not scope:** The commercial model and the contract are clearly centred around the delivery of outcomes, with the reward mechanism based on any out-performance earned from delivering the outcomes successfully. The fee only accounted for 12% of the overall maximum score during procurement assessment and no work was priced in the process.
- **Anglian Water is core partner:** In recognition of the scheme's importance to the company's future, core operational and water resources roles were transfer into the Enterprise. This resulted in the development of smart and affordable solutions quicker than would ordinarily be achieved through traditional external client advisory or approval roles, while also supporting making major decisions more quickly than would have otherwise been possible.
- **A new operating model:** Drawing on industry best practice and benchmarking, the Enterprise created a new production based operating model which must consider at every step the desired outcomes to be delivered, which include customer and environmental outcomes.

The above approaches and processes have supported the creation of a totally integrated and mutually dependent Enterprise that is completely aligned to the desired outcomes, goals and purpose of Anglian Water.

Source: Institution of Civil Engineers³⁰

Recommendation 1.2

Progressively adopt and implement outcomes-focused delivery models to support the delivery of outcomes for people and places and better enable the development of innovative, cost-effective and intelligent solutions.

0-5

Recommendation 1.2.1

Support the delivery of outcomes for people and place by implementing and utilising outcomes-focused delivery models that facilitate greater delivery partner and supplier collaboration. Embed consideration of project delivery strategy as part of early business case development (e.g. strategic needs assessment) for all infrastructure investment proposals.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** State and territory treasuries and relevant industry associations*

0-5

Recommendation 1.2.2

Increase adoption of, and create greater consistency for, outcomes-focused delivery models by developing supporting guidance and developing training, including identification of exemplar projects examples.

***Proposed lead:** State and territory treasuries*

***Supported by:** Infrastructure owners and delivery agencies and relevant industry associations*

5-10

Recommendation 1.2.3

Progressively adopt outcomes-focused delivery models for all major projects and programs as standard practice to better enable the development of innovative, cost-effective and intelligent solutions.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** State and territory treasuries and relevant industry associations*

3.1.3 Projects and programs should adopt an overall alignment card that aligns desired outcomes with strategic priorities and community needs

Where do we want to get to?

Project and program investment outcomes align with and contribute to the achievement of strategic priorities and addressing community needs.

- Project and program objectives should align with strategic priorities and reflect the priorities and needs of local communities and customers. All investments will create a project alignment card that publicly reports the project's objectives and benefits, and its contribution to meeting strategic government and departmental priorities. This will provide a reference point to be used throughout the project or program lifecycle.
- Project alignment cards should be referred to within contracts, forming part of the contractual documentation. They will be referred to throughout the business case assurance and processes, used to inform contractual processes, and form the baseline for robust post-completion evaluation.
- The outcomes agreed through the project alignment card should also be used to design key performance indicators (KPIs) for the project or program.

“Infrastructure investment and planning needs to consider wider community and national benefits in the context of the particular region and over the longer term. Consideration needs to be given to sequencing and benefits of all potential projects in a region and how their individual contributions can come together for a long-term sustainable outcome. The playing field is not always even, so if we want projects in regional areas or across northern Australia to move forward, the strategic long-term outcomes need to be considered.”

– Government leader

Infrastructure planning should take place within a context where outcomes are aligned from top to bottom: from global and national strategic priorities, through local requirements, to investment decisions for individual interventions (see Figure 3 in **Section 1**).

Owners should enable programs by understanding and articulating their contribution to national and state government priority outcomes. In any investment there will be overarching priorities or goals that provide a framework for the proposed investment – and that provide the starting point for the identification of outcomes.

Outcomes must also reflect the requirements and priorities of local customers and communities. Processes to help identify and understand their requirements and how they would prioritise a range of possible outcomes is an essential owner capability – understanding the voice

of customers and communities. Developing this alignment will enable a clear articulation of outcomes for the proposed investment.

Demonstrating this alignment should include the adoption of a project or program ‘alignment card’, used at the outset of the project. The alignment card should help to drive outcome-focused decision-making throughout design, procurement, delivery and into operations.

“Projects need to be accountable for delivering on strategic goals and ultimately, outcomes.”

– Industry leader

The reforms in this report as well as Environmental, Social and Governance (ESG) frameworks can assist with developing alignment and providing a line of sight for outcomes, and have informed *Infrastructure Australia's Approach to Sustainability*. This approach requires:

- investment in the built environment being aligned with clearly articulated outcomes
- the adoption of processes that determine and prioritise local outcome requirements rather than adopting a predetermined framework
- recognition that the built environment must be managed as an interconnected 'system of systems', as the outcomes from individual project and programs cannot achieve the outcomes at the higher levels without effective planning.

Current state

The *2019 Australian Infrastructure Audit* highlighted that while Australia's infrastructure needs are diverse they share common objectives.³¹

However, stakeholder interviews highlighted how projects fail to properly articulate how they aim to deliver national and state policy ambitions. Business case processes focus on benefit cost ratios that do not reflect social policy objectives or give decision-makers the information they need about where costs and benefits fall.

Prioritisation of investment is typically seen as a financial or economic justification. While value for money should include a clear representation of the impact proposed investment will have on outcomes, emphasis is placed on financial ratios that require benefits to be monetised. Cost-benefit analysis fits most comfortably where benefits are growth related and can be monetised.³² In contrast, where benefits cannot be readily monetised or quantified, such as for social and environment impacts, cost-benefit analysis can be complex and difficult to undertake and analysis often is dependent upon expert, qualitative-based judgments.

As noted in the *2019 Audit*:³³

“Some social outcomes, such as those related to quality of life, are more intangible and difficult to quantify in CBA... Projects focused on [qualitative] outcomes could then be placed at a comparative disadvantage to other projects when competing for scarce funding resources.”

However, government guidelines are sometimes criticised for a bias against qualitative-based judgements in favour of quantitative assessments wherever possible.³⁴

Owners do not always maintain processes to understand local priorities or give customers and communities a meaningful voice in how investments are framed. International best practice initiatives such as Project 13 recognise that customer engagement and understanding is a core capability of an infrastructure owner. However, the requirement for infrastructure owners to have a genuine understanding of customer needs and priorities, underpinned by appropriate capabilities in engagement, is not well recognised despite its more recent focus and emphasis within Australian infrastructure planning and delivery processes and guidelines, including the refreshed *2021 Infrastructure Australia Assessment Framework*.

In traditional delivery arrangements the recognition and understanding of desired investment outcomes dissipates rapidly as projects move into the development phase. From the early stages of solution development, the focus is on the nature and scope of solution. Long before partners come on board, the outcomes to be delivered are often superseded by scope and technical requirements.

This approach can be driven by a traditional approach to procurement, that places an emphasis on price-based procurement to select partners. This requires increasing definition of scope (solution, volumes, quantities) as procurement progresses through the supply system and partners and suppliers are engaged.

Recommendation 1.3

Improve value for money and better enable people and places to prosper by ensuring project and program outcomes align with and contribute to the achievement strategic priorities and respond to community needs.

0-5

Recommendation 1.3.1

Improve the quality and consistency of infrastructure decision-making through the development and use of project alignment cards to ensure future investments are considered against strategic jurisdictional, organisational and community priorities.

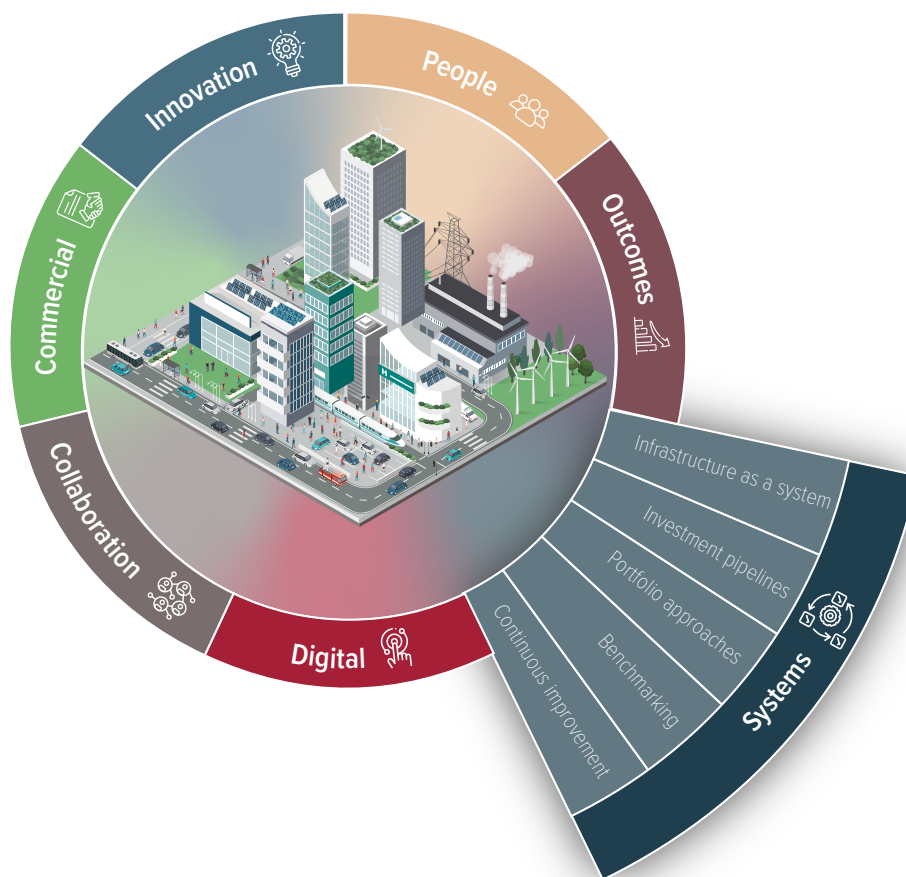
Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory treasuries



3.2 Infrastructure as a system





3.2 Infrastructure as a system

Managing and planning infrastructure as a system drives more informed decision-making leading to higher quality, faster and cheaper infrastructure solutions that better align to the needs of people and places.

The infrastructure underpinning the prosperity and liveability of our cities and regions is more connected, interdependent and complex than ever. However, our current planning and delivery processes do not adequately enable a holistic approach to delivering solutions and outcomes for people and places. Consequently, we are missing out on opportunities to create capture greater value.

Adopting a whole of system approach to planning, designing, delivering and managing infrastructure solutions ensures the infrastructure sector delivers the outcomes Australians need. This requires consistent and transparent investment pipelines

to support the creation of portfolios of projects and programs to enable investment in new technologies and solutions, rigorous and comprehensive benchmarking to drive performance, and a culture of continuous improvement underpinned by the systematic identification, distillation and sharing of best practice.

This section supports the implementation of recommendations of the *2021 Australian Infrastructure Plan*, including Recommendation 3.1: *To improve industry productivity and value for money by having a coordinated project pipeline with a mature approach to procurement and risk management.*

3.2.1 Infrastructure should be managed and developed as an integrated system

Where do we want to get to?

Managing infrastructure as an integrated system supports identification of optimal solutions, both asset and non-asset, to achieve desired outcomes.

- Infrastructure solutions are managed as ‘interventions’ on the system. The addition of each asset and its subsequent lifecycle is understood in relation to the broader system with new assets effectively integrated into this existing system.
- Delivery processes effectively utilise digital technology to take a system perspective with digital twins used to provide simulated views of the existing system, and with options for both the optimisation of existing assets and the addition of new assets developed within these digital representations of the system.
- Managing this infrastructure system is underpinned by clear ongoing strategies to better understand the existing infrastructure and its contribution to people and place outcomes.
- Project and program outcomes are defined in alignment with the wider integrated infrastructure system. The planning of individual projects and programs recognises the interdependencies of projects across different forms of infrastructure. The identification of system interdependencies occurs early in the solutions development process, enabling opportunities to exploit beneficial, and mitigate problematic, interdependencies. Genuine consideration is given to the optimisation, management, integration and re-use of existing assets to achieve desired outcomes within the integrated system.
- Consideration of how projects and programs affect the broader infrastructure system occurs at each stage of business case development.

“The nature of our projects and environment has changed dramatically – all projects impact each other and are literally or digitally interconnected. We need to understand how the system interacts as a whole.”

– State treasury

The built environment is a deeply interconnected and complex system. Assets and networks are inextricably linked with themselves, the community, and the natural environment. Infrastructure is a ‘system of systems’.

Infrastructure provides more than just the critical services we require – it makes Australia’s cities and regions highly liveable and attractive, enhances our quality of life, and supports economic productivity and prosperity.³⁵ Industry 4.0, with its promise of transformative technologies and increased interconnectivity between physical and digital worlds, means the infrastructure ‘system of systems’ will become even more integrated over time.

The decisions we make now will impact generations to come. Silos in policy, decision-making, development and operation produce suboptimal outcomes.

As our cities and regions grow and change and sectors converge, there is a need to think more holistically about infrastructure planning. A new hospital should not be planned without considering transportation links, or an urban precinct without adequate consideration of the intended mix of social and economic activity. Thinking holistically about infrastructure can enhance opportunities for creating and capturing greater value.³⁶

Box 7: Benefits of adopting a system of systems approach to infrastructure planning

Benefits of adopting a system of systems approach

Adopting a system of systems approach to infrastructure planning will support infrastructure owners and delivery agencies to better deliver value to Australian communities by:

- Focusing on the desired outcomes being delivered for people and places.
- Better understanding existing and future interdependencies and implications for system performance.
- Better understanding of how management and operation of existing assets and networks affects performance and achievement of desired outcomes.
- Better identifying solutions to achieve desired outcomes through better use and management of the system.
- Assisting in avoiding silo-based planning decisions that fail to select the best solution and consequently impose significant costs on users and taxpayers.
- Enabling new interventions and solutions to be better integrated with the existing system.

Current state

Infrastructure in Australia is predominantly viewed as a series of discrete, independent, and sector specific physical assets. This is underpinned by current planning, appraisal and delivery processes that consider infrastructure investment as a series of individual projects.³⁷

Business cases are prepared in isolation on a project-by-project basis, by separate sector-focused agencies that are competing for the same pool of funding, and do not promote coordination and prioritisation.³⁸ Often, non-capital options are excluded from decision-making processes, limiting genuine attempts to develop integrated solutions.³⁹ These silo-based processes emphasise discrete, sector-specific planning, and subsequently are poorly placed to adequately identify and exploit potentially valuable, or mitigate potentially costly or hazardous, interdependencies.⁴⁰ This practice is reinforced when projects are announced or committed funding prior to business case development.⁴¹

This is despite existing business case and investment assurance guidance across a range of jurisdictions explicitly requiring consideration of a proposed infrastructure solution's impact on existing assets and services, and how the proposal will be integrated into the existing environment.⁴²



Box 8: London 2012 Olympic Games and systems integration**Case study: London 2012 Olympic Games – successful systems integration**

The venues and infrastructure for the London 2012 Olympic Games were delivered on time and within budget. Most critically, the venues and supporting infrastructure delivered as part of the Games have achieved the desired outcome of catalysing the regeneration of East London.

Systems integration was a core element of the successful delivery of the Olympic Games. The delivery partners enabled the integration process by creating a distinction between relatively self-contained ‘vertical’ buildings, the permanent and temporary venues, and interconnected ‘horizontal’ infrastructure (such as utilities, roads and bridges). This limited the number of interfaces with other systems, allowing principal contractors for the main venues, such as the Velodrome and the Aquatics Centre, to be ‘king of their island’, focusing on designing and integrating the elements of what were, in themselves, large, complex projects.

The delivery partners also created a process to identify how slippages or changes in one venue or connecting infrastructure – for example, water or energy supply – had an impact on others. This included a program integration group and integration committees to manage the Olympic Park as a complete system, and the interfaces between the 15 to 20 principal contractors working on the program at any one time.

Source: Davies, A., McKenzie, I⁴³



There have been notable recent efforts in Australia to understand infrastructure system interdependencies and performance in greater detail. Driven by an increased awareness of the need to prepare and respond to climate change induced risks on the infrastructure system, some jurisdictions have begun to assess infrastructure interdependency at a whole-of-system level. The most notable of these being New South Wales' Cross-Dependency Initiative Sydney Pilot Project (see Box 9).

Box 9: New South Wales' Cross-Dependency Initiative Sydney Pilot Project

Case study: Cross-Dependency Initiative (XDI) Sydney Pilot Project

The New South Wales State Government, via the (then) Office of Environment and Heritage partnered with Climate Risk to launch the XDI Sydney Pilot Project, a large-scale, multi-utility analysis program. The project is a three-year city-wide pilot to identify areas of climate risk to critical infrastructure, and importantly, the cross dependencies between these different types of infrastructure.

The XDI Sydney Pilot Project is a large-scale, multi-utility project covering approximately four million individual assets across six infrastructure types within Sydney, including critical public and private infrastructure in power, water, roads, rail and telecommunications sectors. It uses GIS spatial data for weather, engineering and financial data to analyse large numbers of utility assets for risks and the effect of co-dependencies.

The project provides detailed insights into hazards, exposure and vulnerability across the infrastructure system, and can be constantly updated as assets are added or removed. It enables asset owners to see which risks to third party infrastructure assets will affect their own system and equally the consequences of their own vulnerability to other critical infrastructure. Interdependent risks are quantified financially and using non-financial key performance indicators such as the number of customers affected by an outage.

XDI encourages 'collaborative adaptation' so that all affected providers can contribute to the costs of upgrading or replacing an asset, making considerable savings compared to adapting their own assets.

Source: NSW Department of Planning and Environment⁴⁴

Some sectors have made significant progress towards greater integrated system planning, particularly within transport, urban water and electricity transmission, albeit with a sector-specific focus.

For example, many state governments have recently re-oriented and reformed their transport agencies with the intent of developing more holistic, integrated transport solutions. This is resulting in more integrated transport agencies (rather than separate agencies for each transport mode) with a greater focus on network outcomes, asset management and operations, and customer experiences rather than discrete civil engineering solutions.⁴⁵ Another example can be found in the development of the Integrated System Plan (ISP) for the National Energy Market. The ISP is a whole of system plan that seeks to maximise value to end consumers by designing the lowest cost, secure and reliable energy system capable of meeting any emissions trajectory determined by policy makers at an acceptable level of risk.⁴⁶

Recommendation 2.1

Improve infrastructure value for money by ensuring solutions are developed as interventions within an infrastructure system.

0-5

Recommendation 2.1.1

Improve capital planning to ensure that infrastructure projects are assessed in the context of their network and program impact and dependencies rather than solely as stand-alone, independent projects. Embed assessment of project and program interdependencies in each stage of business case development.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** State and territory treasuries, state and territory infrastructure bodies*

0-5

Recommendation 2.1.2

Improve value for money through the development of jurisdictional infrastructure interdependency strategies to enable and guide effective integrated planning, delivery and operation of solutions at a whole of system level.

***Proposed lead:** State and territory infrastructure bodies*

***Supported by:** State and territory treasuries, infrastructure owners and delivery agencies and relevant industry associations*

5-10

Recommendation 2.1.3

Progressively leverage digital tools and practices, such as digital twins, to enhance the optimisation, management, integration and re-use of new and existing assets across portfolios to achieve desired outcomes within an integrated system.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** State and territory treasuries, and relevant industry associations*

3.2.2 Transparent investment pipelines should provide visibility of future demand and enable future resource, skills and capability planning

Where do we want to get to?

Reliable, transparent and consistent investment pipelines support enhanced resource, skills and capability planning across the infrastructure sector.

- Comprehensive, consistent, current and reliable pipelines of existing and future commercial activity are published to provide clear visibility of the anticipated investment program over a ten-year horizon at national and jurisdictional levels across all infrastructure types. Jurisdictions will refresh their comprehensive investment pipelines every six months.
- Published investment pipelines will provide the whole ecosystem with a clear understanding of future demand to enable greater planning and more confident decision-making about investment across its workforce, skills and training, processes and technologies, and financially sustainable solutions.
- Greater transparency will support a more effective industry response. In addition, publishing comprehensive investment pipelines will support wider participation across the ecosystem, particularly among small and medium-sized enterprises and regionally-based suppliers.
- Informed by the pipeline, governments, contractors, suppliers, and education establishments work together to develop and implement training and education programs to meet the future skills required to deliver Australia's infrastructure pipeline.

“ [The desired state requires] a long-term sustainable pipeline of work for industry to encourage skills development and investment in the future of the industry. ”

– Industry leader

Preparing, maintaining and publishing comprehensive, reliable and transparent pipelines of current and long-term future investment activity is critical to achieving value for money in infrastructure provision.⁴⁷ This is particularly true within the context of Australia's record infrastructure pipeline.

Published long-term investment pipelines developed through rigorous long-term planning provide the ecosystem with a clear view of future demand to effectively plan and coordinate their resources.⁴⁸ The benefits of consistent, reliable and transparent investment pipelines have long been recognised and include:⁴⁹

- **Increased certainty of investment:** announcing major projects in advance of construction encourages investment institutions to support the financing of infrastructure.
- **Enable greater innovation:** knowledge of future potential projects encourages industry to invest in developing cost-effective, innovative and low-carbon solutions.
- **Competition:** supports domestic and international interest in the market and a higher level of competition for projects.

- **Skills development:** government delivery agencies and industry partners are encouraged to invest in training and development programs and additional skilled resources, leading to greater capability to deliver future projects and programs.
- **Capacity building:** provides both government agencies and industry with the confidence to invest in greater resources, tools and equipment, positioning the sector to better respond to the future pipeline and deliver more efficiently.
- **Greater small and medium-sized enterprise (SME) and local supplier participation:** supports wider ecosystem participation, particularly among SMEs and regionally based suppliers, contributing to greater industry resilience, capability and capacity.

Critically, a consistent, reliable and transparent pipeline builds market confidence over time, enabling the above benefits to be realised with increased focus.

In practice, the development of robust, long-term pipelines of future activity is challenging. Pipelines must account for the environment in which projects and programs are planned, prioritised and delivered across multiple jurisdictions, and the budget constraints that impact on their prioritisation and release.

To be effective, pipelines need to balance identifying a consistent level of activity across the infrastructure system, have a reasonable degree of reliability, be underpinned by a transparent decision-making framework, be sufficiently flexible to adapt to changing external factors and be regularly updated and published over an extended time (see Table 2).

Table 2: Effective infrastructure pipelines

Characteristics	Description
Leadership	The development of a robust project pipeline is championed by a nominated department or agency with appropriate authority.
Consistency	Pipelines, to the extent possible, present a smooth, consistent and coordinated pipeline of activity to be delivered over an extended period of time.
Transparency	Pipelines are underpinned by transparent decision-making processes for identifying, reviewing and compiling a prioritised list of planned investments on regular basis.
Reliability	Pipelines, to the fullest extent possible, present reliable and current information and insights on planned major activities across all forms of infrastructure. Information presented is updated regularly to maintain relevance and currency.
Flexibility	Pipelines, informed by long-term strategic planning frameworks, are sufficiently flexible to adapt to changing policy and external conditions so that priorities remain relevant over time and avoid expensive path dependency.

Source: OECD⁵⁰

Current state

In the past five years all state and territory jurisdictions have developed and published annual or semi-annual infrastructure pipelines or forward work programs of varying detail and breadth. These are in addition to Infrastructure Australia's *Infrastructure Priority List* which is updated and published on a semi-annual basis.

While there is no uniformity in approach, state and territory infrastructure pipelines typically provide, at a minimum, a summary of:

- major projects and programs funded or committed for funding over a four or five-year period across key sectors (e.g. transport, health, education, sport and culture etc.)
- indicative capital cost estimates
- the stage of development of nominated projects and programs.

Some jurisdictions have provided longer-term views of their forward pipelines, such as provided in *Tasmania's 10 Year Infrastructure Pipeline and the Northern Territory 10 Year Infrastructure Plan*.⁵¹ The provision of a ten-year horizon for project sequencing should be an objective of infrastructure delivery agencies. This longer-term horizon requires flexibility in management to ensure it is refined to meet industry capacity considerations.

Some jurisdictions, again highlighted by Tasmania and Northern Territory, have also integrated private infrastructure and construction projects within their respective pipelines to provide a more holistic picture of the investment pipeline within their jurisdictions. In some instances, jurisdictions have sought to provide information on uncommitted projects in early stages of planning, such as outlined in the NSW Infrastructure Pipeline (see Box 10).⁵²

Box 10: NSW Infrastructure pipeline**NSW Infrastructure Pipeline**

The NSW Infrastructure Pipeline outlines all NSW Government infrastructure projects expected to come to market over the next three to five years with a minimum capital value of \$50 million. Critically, it includes projects the NSW Government has committed to commence planning, but have not yet received funding. The pipeline, first published in 2017, includes projects across the transport, health, education, justice, sports and culture sectors.

The NSW Government Construction Leadership Group (CLG), led by Infrastructure NSW, developed the pipeline in recognition of the importance of collaborative partnerships between industry and government to deliver infrastructure projects for the people of NSW.

The pipeline aims to assist the NSW Government in attracting investment and early participation in the design, construction, management and operation of major infrastructure projects across the whole of NSW.

Initial efforts by jurisdictions to publish infrastructure pipelines should be applauded. However, there is potential for further progress to:

- enhance inter-jurisdictional coordination across national, state and local governments
- support greater long-term visibility beyond four or five years into the future, particularly at the agency level and portfolio level

- provide more visibility of non-committed projects that are in early stages of planning
- improve integration with private sector committed and planned investment.

Current infrastructure and commercial pipelines do not provide a long-term, reliable and transparent view of investment activity. According to the *2019 Australian Infrastructure Audit*, 'Visibility of pipeline' is one of the key challenges faced by the sector.⁵³ The ecosystem is not fully incentivised to invest in its capability and capacity, processes and technologies to support future delivery. Furthermore, governments, contractors, suppliers, and education establishments do not have the necessary line of sight to develop and implement the required training and education programs to meet the future skills required to deliver Australia's infrastructure pipeline.

Industry groups, with seed funding from government agencies, have developed solutions to provide an integrated view of the national and supra-national infrastructure pipeline. Most notably, at the national level Infrastructure Partnerships Australia has developed the *Australia & New Zealand Infrastructure Pipeline* (ANZIP) of public infrastructure projects across the two respective countries.⁵⁴ At a state level Infrastructure Association of Queensland (IAQ) and Queensland Major Contractors Association (QMCA) have partnered to prepare the *Queensland Major Projects Pipeline Report*.⁵⁵

While these pipelines are independent of Australian (and New Zealand) governments, they do rely on information sourced directly from governments.



Recommendation 2.2

Enhance resource, skills, and capability planning across the infrastructure sector by developing reliable, transparent and consistent investment pipelines.

0-5

Recommendation 2.2.1

Support improved industry capacity, planning and coordination through active management of asset management plans to identify opportunities to smooth the infrastructure pipeline over the medium-term.

Proposed lead: State and territory treasuries

Supported by: Infrastructure owners and delivery agencies and relevant industry associations

0-5

Recommendation 2.2.2

Develop and publish jurisdiction-wide, cross-sectoral infrastructure investment pipelines that outline all current, committed and planned (but not committed) public and private infrastructure activity over a ten-year horizon to support greater investment consistency, reliability, and transparency.

Proposed lead: State and territory treasuries and/or infrastructure bodies

Supported by: Infrastructure owners and delivery agencies

0-5

Recommendation 2.2.3

In partnership with industry, develop a national infrastructure skills strategy that sets out tangible and achievable actions to ensure education and training services align with and address the infrastructure sector's future skills needs to ensure effective delivery of Australia's infrastructure pipeline.

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Department of Education, Skills, and Employment, National Skills Commission, state and territory treasuries and infrastructure bodies and industry associations

3.2.3 Owners should adopt portfolio approaches to infrastructure planning to drive investment in new technologies and solutions

Where do we want to get to?

The adoption of portfolio approaches to infrastructure planning drives investment in new technologies and solutions, improving consistency, quality and speed of delivery and value for money.

- Longer-term portfolio approaches to infrastructure planning and delivery support longer term relationships and greater standardisation – supporting innovation and transformational change.
- Adopting a portfolio approach to projects and programs that is more manufacturing-led will improve productivity and deliver better value for money. An approach that encourages the standardisation of elements of design and, where appropriate, enables the adoption of longer-term contracts across portfolios will give industry the certainty required and make it commercially viable for suppliers to invest in innovative new technologies.
- Delivery agencies regularly review their investment pipelines to identify opportunities to bring work together into longer-term portfolios and programs, rather than as a series of individual projects. This goes hand in hand with increasing the use of product standardisation, design for manufacture and assembly (DfMA) and platform delivery. Delivery agencies will increasingly adopt portfolio approaches where a program has repeatable assets, there is strong modern methods and construction potential, there is a long-term pipeline of work (e.g. schools, hospitals, etc.), or there is an opportunity for innovation to drive better value.
- The ecosystem is aligned and responsive to portfolio thinking. Small and medium enterprises (SMEs) make a significant contribution to the industry supporting product development and bringing innovation to support client challenges and requirements. This greater engagement with SMEs helps overcomes the wider industry challenges on capability and skills.
- Delivery agencies will increasingly look across public infrastructure to identify further opportunities to create portfolios at a product-level. This will support the use of platform approaches to infrastructure delivery.

“ There’s not one piece of relevant or important infrastructure which doesn’t require at least a few years of planning and execution. ”

– Industry leader

Portfolio approaches to infrastructure planning that encourage the identification of repeatable design elements and manufacturing-led processes can improve productivity and deliver better value for money for Australian communities. Portfolio approaches to infrastructure planning and delivery supports and enables:

- creation and nurturing of longer-term relationships across the ecosystem through longer-term contracting arrangements which supports continuous improvement in safety, time, cost and quality
- identification and adoption of standardised elements and on-site solutions across projects and programs
- greater adoption of manufacturing-led processes to deliver safer, quicker and more financially sustainable infrastructure solutions and improve productivity
- greater investment across the ecosystem in innovative technologies, approaches and capability as a consequence of greater certainty in pipeline of work
- greater engagement with SMEs to support product development and harness innovation while also enhancing capability and capacity across the ecosystem.

Greater adoption of portfolio approaches can support a transformational shift across the infrastructure sector from site-based construction towards a higher-productivity production system in which the bulk of a project or program is built from standardised prefabricated components offsite in a manufacturing facility.

Box 11: How to identify portfolio opportunities**Policy insight: Identifying opportunities for longer-term portfolios**

A longer-term portfolio approach is likely to be appropriate where any or all of the following is true:

- The infrastructure program has repeatable assets and strong modern methods of construction potential.
- There is a long-term and consistent pipeline of work, such as with education, health and road infrastructure programs.
- There is an opportunity for innovation to drive better value.

Source: UK Cabinet Office 2020⁵⁶

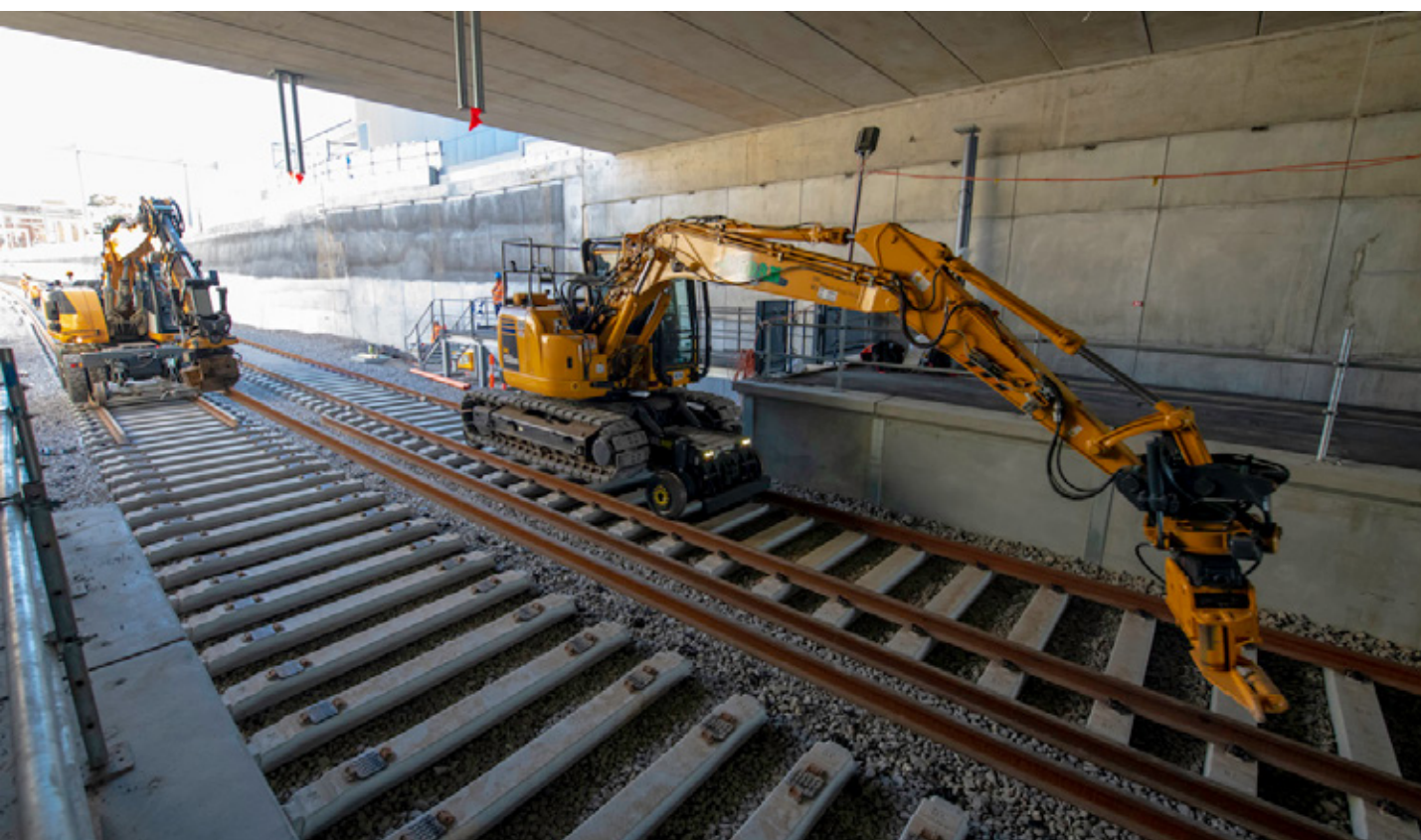
Current state

As reported above, infrastructure planning and delivery processes in Australia are predominantly focused on discrete, independent, and sector specific projects.⁵⁷ Data reliability can also be challenging. Projects are typically developed to specific client specifications with bespoke designs developed from scratch, with limited scope for repetition. Governments of all levels face challenges in being able to consistently determine what, where and when infrastructure solutions should be scoped and delivered.⁵⁸ These practices are significant barriers to adopting portfolio approaches in Australia.

Significant progress has been made recently by many delivery agencies across a range of sectors in developing and implementing robust long-term strategic asset planning and management processes.⁵⁹

However, there is a significant opportunity for owners and delivery agencies to embed the examination of strategic asset plans to identify longer-term portfolios of projects and programs as standard practice.

There are some notable examples of delivery agencies adopting portfolio approaches to enhance infrastructure planning and delivery, including the Level Crossing Removal Project (LXRP) in Victoria and School Infrastructure NSW (see Box 12 and Box 13).



Box 12: Level crossing removal project**Case study: Victorian Level Crossing Removal Project (LXRP)**

LXRP aims to remove 75 level crossings across metropolitan Melbourne by 2025, while also delivering a range of rail network upgrades such as new train stations, track duplication and train stabling yards.

Rather than allocating individual contracts to remove each level crossing on an individual project basis, the Victorian Major Transport Infrastructure Authority (MTIA) has adopted a portfolio approach. This has involved grouping multiple projects into packages and contracting these packages across five program alliances.

The portfolio approach has driven a longer-term manufacturing mindset to development and delivery across each of the program alliances, rather than a bespoke approach to single-site projects.

This has enabled identification and investment in solution standardisation and repeatability. The certainty created through the full allocation of work packages to the five program alliances has enabled them to attract and retain large-scale, high performing teams driving continuous improvement. It also directly incentivised the program alliances to investment in skills development, new processes and equipment, longer term supply chain agreements, and workplace.

Perhaps most critically, the upfront investment made by program alliances has been offset by efficiencies realised across subsequent packages as progressive cost performance has been achieved.

Source: Australian Constructors Association⁶⁰

Box 13: School Infrastructure NSW school upgrade portfolio**Case study: School Infrastructure NSW – Adopting a portfolio approach to enhance school infrastructure design and delivery**

School Infrastructure NSW (SINSW) has undertaken a strategic review of its investment pipeline of \$1.8 billion in new and upgraded schools with the intent to enhance and change how it designs and delivers school infrastructure across NSW.

This has led SINSW to adopting a portfolio approach in its delivery strategy, enabling it to identify opportunities to standardise its design and delivery approach for new and upgraded schools. Projects were reviewed based on their ability to be standardised and repeated and potential to leverage modern methods of construction.

The object is to enable SINSW to build more quality schools in less time, providing greater delivery certainty, with less impact on the environment, local communities and existing school operations. From this, SINSW has identified 20 projects as strong candidates for Design for Manufacture and Assembly (DfMA). See **Section 3.7.1 – Modern methods of construction**, for more on how a portfolio approach has enabled DfMA delivery for SINSW.

Source: Schools Infrastructure NSW⁶¹

Recommendation 2.3

Progressively adopt portfolio approaches to infrastructure planning to drive investment in new technologies and solutions, and improve the consistency, quality and speed of delivery and value for money.

0-5

Recommendation 2.3.1

Improve productivity and value for money by actively managing asset management plans to identify opportunities to develop long-term portfolios of works, support standardisation and drive investment into new technologies and modern methods of construction.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory treasuries, state and territory infrastructure bodies, and relevant industry associations

5-10

Recommendation 2.3.3

Embed portfolio approaches at a product level across public infrastructure as standard practice to support the implementation of platform approaches to infrastructure delivery and drive investment in higher quality, faster and cheaper solutions.

Proposed lead: State and territory treasuries, state and territory infrastructure bodies

Supported by: Infrastructure Australia, Infrastructure owners and delivery agencies and relevant industry associations

0-5

Recommendation 2.3.2

Increase adoption of portfolio approaches by developing supporting guidance and training, disseminating lessons learned and identifying exemplar portfolio approaches.

Proposed lead: State and territory infrastructure bodies

Supported by: Infrastructure Australia, infrastructure owners and delivery agencies and relevant industry associations

3.2.4 National and jurisdictional benchmarking frameworks should be in place to drive performance

Where do we want to get to?

Implementation of robust benchmarking frameworks drive visibility of project performance and best practice across the infrastructure sector, leading to improved infrastructure decision-making.

- Robust national and jurisdictional project and program benchmarking frameworks are implemented across all forms of infrastructure. A national benchmarking framework enables collection and analysis of performance information, including capital and operating costs, schedule, carbon and commonly agreed measures of performance. This drives a consistent and visible view of performance across portfolios, industries and jurisdictions and supports industry-level continuous improvement.
- The adoption of a nationally consistent benchmark framework provides greater visibility of best practice and encourages the exchange and application of industry level learning among owners and delivery agencies. This transparent identification and distillation of best practice underpins industry wide improvement, with infrastructure organisations working together to drive best practice performance.
- Major projects and programs undertake benchmarking of key deliverables as standard practice, including capital and operating costs, schedule and agreed outcomes at each stage of business case development. Over time, benchmarking supports the development of more accurate cost and performance metrics to underpin robust decision-making and successful project and program delivery.
- National benchmarking informs the development of Should Cost Models, underpin whole-of-life cost evaluation, support project and program performance comparison and analysis, and enable the development of commercial thresholds against which partners are incentivised.

“ It’s astounding – as an industry, we still don’t know how much infrastructure costs. ”

– State treasury

Benchmarking, through consistency and measurement, is the backbone of performance and continuous improvement.

Benchmarking involves the analysis of information from past projects and programs to identify standards and good practice, and a point of reference to compare actual or planned project performance. This covers cost, schedule and performance benchmarks to support the selection, budgeting and design of projects for government sponsored infrastructure projects.⁶²

Benchmarking helps both government and industry make more informed and transparent decisions about the future of infrastructure priorities.⁶³ It enables clients and delivery agencies to make critical decisions with greater confidence, ensure value for money for taxpayers and avoid missed benefits and excess costs. Benchmarking supports and enhances planning and delivery by:

- creating a starting point for the exchange of best practice and industry-level learning and encouraging innovation⁶⁴
- providing visibility of performance across portfolios, industries and jurisdictions based on a basket of common measures
- enabling clients to better understand ahead of the tender process the optimal performance of their project⁶⁵
- improving planning approaches and more accurate identification of risks through project and cross-industry analysis⁶⁶
- engaging of upper management and executive leadership team in understanding underlying issues for performance problems⁶⁷
- providing insights and information to enable more informed investment, procurement, delivery and operation decisions.⁶⁸

Box 14: Best practice benchmarking principles**Best practice approach to benchmarking**

The United Kingdom's Infrastructure and Projects Authority has developed a best practice benchmarking methodology based on the following seven steps:

- 1. Confirm the project objectives and set the metrics:** Each project and program has distinct objectives, and each objective can be linked to a benchmark. Benchmarks should extend beyond project costs to whole life project performance and include outputs, operational performance as well as wider outcomes. Each benchmark should be underpinned by a set of metrics.
- 2. Break the project up into major components for benchmarking:** Components could be assets (e.g. schools, hospitals, train stations) or non-assets and functions (e.g. land or project management costs). Components can be compared to those from a range of other projects to produce indicative benchmark costs.
- 3. Develop templates for data gathering:** Templates developed collaboratively with delivery partners will help ensure relevant stakeholders understand how the project metrics should be calculated.
- 4. Scope sources and gather data:** Data may be generated internally by the project team or organisation, or externally sourced either through collaboration with other organisations or procuring data from a third party. Data should be relevant, reliable and comparable.
- 5. Validate and re-base data:** Data should be validated and re-based in order to allow for direct comparisons (e.g. across time periods). An appropriate inflation model and index should be used.
- 6. Produce and test the benchmark figure:** This figure should relate directly to the components developed at Step 3 and clearly explain the project performance.
- 7. Review and repeat, if necessary, before using data for benchmarking:** If the benchmarking information is insufficient to make robust benchmarking analysis then return to Step 1 and source additional data from third parties if necessary.

Source: Infrastructure and Projects Authority⁶⁹

Current state

Benchmarking is limited in the Australian infrastructure sector. This is despite Australian governments having access to significant completed project data which currently sits unused.⁷⁰

There is no single, integrated, detailed benchmarking analysis of major projects or programs across different forms of infrastructure in Australia. Project cost benchmarks in Australia are typically constrained to single sectors and based on relatively small samples of projects. Contemporary benchmarking studies remain largely limited to providing broad estimates of construction costs and time and provide limited practical insights in controlling costs and supporting greater decision-making.

“ We need a central function for cost benchmarking to develop a real understanding of cost, and dispassionate analysis of what goes wrong or right in infrastructure. ”

– State government

In 2014 the Productivity Commission recommended the development and implementation of a national, cross-sector benchmarking framework for major projects.⁷¹ This resulted in the Bureau of Infrastructure and Transport Research Economics (BITRE) developing a national pilot road project construction cost and procurement process benchmarking study in 2015 (which was subsequently updated in 2017).⁷² The analysis undertaken by BITRE has highlighted that the capital costs of road projects vary significantly within, and across, jurisdictions. Major unit costs vary significantly and are not consistently explained.

In 2018, BITRE announced it was scoping an expansion of the road project benchmarking study to include water infrastructure projects.⁷³ Additionally, benchmarking studies have been developed to support specific major projects. For example, Turner and Townsend developed indicative cost benchmarks on airport construction for Brisbane Airport Corporation.⁷⁴ Internal agency benchmarking has also been used to support the delivery of major infrastructure programs (see Box 15).

Box 15: Level Cross Removal Project program benchmarking**Case study: Level Crossing Removal Project – program benchmarking to support delivery**

To support the Level Crossing Removal Project (LXRP), the Major Transport Infrastructure Authority (MTIA) developed a benchmarking tool that includes insights from previous level crossing removals, the Regional Rail Link Project and projects delivered by VicRoads. MTIA adds new data over time, which ensures that the tool can provide realistic construction cost estimates.

The benchmarking tool has standardised work breakdown structures to generate clear visibility around costs, providing insights on why there may be variances (up or down) to the benchmark rates.

MTIA uses the benchmarking tool to develop a benchmark cost estimate for each additional works package. MTIA provides the five LXRP program alliances with a high-level price to assist them when developing their cost estimate.

MTIA incentivises program alliances to submit a target outturn cost that is less than the benchmark by increasing their performance award if they are successful. In this way, MTIA's benchmarking tool encourages LXRP program alliances to compete against MTIA when developing cost estimates for additional works packages, instead of competing against each other.

Notably, supported by the benchmarking framework, LXRP program alliances have achieved a progressive reduction in typical risk allowances, indirect costs, design costs and variability between actual outturn costs and target outturn costs. This has been supported by early clear scope definition, risk mitigation and design re-use and standardisation.

Source: Victorian Auditor-General's Office⁷⁵



The absence of a consistent national framework and central data collection platform for capturing and measuring infrastructure project delivery is a key barrier to project and program benchmarking.⁷⁶

The implementation of benchmarking in Australia is also impeded by a lack of transparent, consistent and open data sharing between jurisdictions and delivery agencies. Furthermore, there is no requirement under current intergovernmental funding agreements for states and territories to provide the Australian Government with project data of strategic value.⁷⁷ There is no requirement to provide a breakdown of actual and budgeted project costs against standardised major cost units, progress against agreed outcomes or consistent performance metrics, or project schedule performance against a consistent set of project milestones.

Recommendation 2.4

Improve visibility of project and asset performance and best practice and enhance infrastructure value for money by developing and implementing robust benchmarking frameworks.

0-5

Recommendation 2.4.1

Develop and implement internal benchmarking frameworks to drive greater visibility of organisational performance and improve decision-making. Embed benchmarking of projects and programs as part organisational business case and investment assurance processes.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: The Department of Infrastructure, Transport, Regional Development and Communications, Infrastructure Australia, and industry associations

0-5

Recommendation 2.4.2

Enhance the quality of decision-making, improve value for money and inform the development of Should Cost Models by developing a national benchmarking framework across all classes of infrastructure, building upon existing BITRE work. This framework should be based on common infrastructure structures and be utilised on all federally funded projects.

Proposed lead: The Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure Australia, and industry associations

0-5

Recommendation 2.4.3

Drive visibility of performance across sectors and jurisdictions by establishing inter-jurisdictional data sharing arrangements with all states and territories to support the systematic and regular sharing of benchmarking and performance data for major projects (over \$50 million) across all forms infrastructures.

Proposed lead: The Department of Infrastructure, Transport, Regional Development and Communications

Supported by: State and territory treasuries, state and territory infrastructure bodies

3.2.5 Continuous improvement should be driven by an ongoing process of identifying, distilling and sharing best practice

Where do we want to get to?

A culture of continuous learning is embedded across the infrastructure sector, supporting better, faster and cheaper infrastructure delivery.

- A culture of continuous learning and improvement is embedded across the industry. Project and program performance is reviewed across jurisdictions in relation to cost, schedule, agreed outcomes and other relevant metrics. Information systems enable continuous measure of 'as delivered' and 'as operated' performance against agreed outcomes and performance metrics.
- Lessons are actively captured by owners and delivery agencies throughout the life of projects and programs. Lessons are actively shared throughout the project lifecycle to improve processes and delivery. Feedback, case studies and performance metrics are captured and disseminated to share learnings across the value chain to support continuous improvement.
- Leadership forums use benchmarks and visibility of performance to identify and distil best practice. Leadership across the value chain supports a drive for industry-wide improvement by creating a shared expectation around adoption of best practice.

“ A continuous improvement mindset is key to our future of work. ”

– Industry leader

The community rightly expect that publicly funded infrastructure investments are planned, managed and delivered in a way that achieves promised outcomes and benefits on time and within allocated budgets.

Continuous improvement, through an ongoing, consistent, and robust cycle of identifying, distilling, and sharing lessons learned and best practice is critical to supporting project delivery and ensuring infrastructure solutions deliver on outcomes for people and place. Cross-sector and cross jurisdictional leadership, with clear visibility of performance to identify, distil and share best practice, is a key driver of transformational change.

Continuous learning and improvement are underpinned by rigorous and independent project and program processes, including post completion reviews that provide insights on what works, what does not work and why.

Systematic project and program reviews are important for all infrastructure investments and enable governments and delivery agencies to:

- assess, most critically, whether projects and programs have achieved intended objectives and benefits and assess whether the solution represented value for money relative to what was originally promised
- assess whether cost and outcome assumptions adopted in the business case were appropriate, and whether outcomes could have been achieved in a more effective and efficient way⁷⁸
- improve understanding of the relationship between the proposed solution, costs and outcomes achieved, supporting better informed and more realistic decision-making on major infrastructure investments⁷⁹
- demonstrate accountability to the public about whether investments have achieved intended benefits and outcomes and provide evidence-based explanations of why actual outcomes may have varied from expected outcomes⁸⁰
- support the identification, sharing and application of learnings and best practices from other projects and programs around the country and over time to improve future decision-making and more accurate identification of risks⁸¹
- identify and implement corrective actions on current projects and programs or in similar investments.

Box 16: Effective project and program post-completion reviews

Effective project and program post-completion reviews

Objectivity: Project and program reviews should be objective and impartial, and supported by clearly distinguished statements of fact. Results, conclusions and recommendations need to be supported by evidence and must be comprehensible.

Independence: A credible review requires a review team with appropriate expertise and independence from all staff involved operatively in the planning and delivery of the project.

Participation of relevant parties:

A rigorous and credible review needs to be as participatory as possible with all relevant parties consulted to ensure different perspectives are considered to enable a robust evidence base, and relevant parties are invited to comment on the review.

Transparency and Focus: Reviews must be clearly defined and focused, including objectives of the review, central questions and areas of enquiry, methodologies and approach, and reporting requirements. Reviews should be published, or at a minimum made available to all relevant parties involved in the planning and delivery of the investment.

Reliability: The utilisation and preparation of basic data is necessary to prove the assessment and conclusions in a credible fashion. The results in evaluation report must be comprehensible.

Utility: Review recommendations should be actionable, relevant, realistic and with clear timeframes, and aimed at improving future decision-making on major infrastructure projects and programs. Feedback to political and operative decision-makers must be guaranteed through clearly established governance for the implementation of the review results.

Source: Adapted from Austrian Development Corporation⁸²



Current state

In Australia, there is currently no systematic collection of lessons learned and public reporting on the effectiveness of government spending on infrastructure projects.⁸³ The Australian infrastructure sector lacks a methodical evaluation culture and is not leveraging its experience in planning and delivering infrastructure solutions to support better informed and more realistic decision-making on future investments.⁸⁴

As reported in the *2019 Audit*:⁸⁵

“There is a dearth of published post-completion reviews and little evidence of sharing of lessons of experience.”

Public reporting on the performance of government-funded infrastructure projects and programs is extremely limited. Post-completion reviews of major infrastructure investments are rarely undertaken or published (it should be noted that there are limited examples – see Box 17) and there is little evidence of governments and delivery agencies publicly sharing lessons or best practice.⁸⁶ Consequently, there is limited transparency as to whether investments are justified or are providing value for money relative to promised outcomes and benefits.

This is despite all state and territory governments requiring some form of assessment of benefits realisation during project closeout as part of their respective investment assurance frameworks.

Box 17: Example of a post-completion evaluation

BITRE post-completion evaluations of road investment projects

Since 2005, BITRE has conducted two rounds of post-completion economic evaluations of road investment projects in Australia – one between 2005–2007 and the second between 2014–2016. However, the BITRE analysis covers only 12 state government projects completed between 1994 and 2013, costing a total of \$2.2 billion. This compares with construction work done for the public sector of nearly \$175 billion over the same period.⁸⁷

BITRE's analysis of 12 case studies identified significant room for improvement in estimating the benefits of proposed projects, in particular the over-estimation of expected project benefits during the project planning phase.

Source: BITRE⁸⁸

This absence of outcomes reporting limits the ability of the ecosystem to further its understanding of delivery processes, the achievement of desired outcomes and appropriateness of cost assumptions.

There are a range of leadership forums (e.g. the Construction Industry Leadership Forum (CILF), and NSW and Victorian Construction Leadership Groups (CLGs)) that exist to promote collaboration and action around procurement and delivery. However, these forums could be enhanced through the systematic sharing of detailed insights on project outcomes, cost performance and best practice on a national or jurisdictional basis.

Each year, Infrastructure NSW analyses information collected during the Infrastructure Investor Assurance Framework (IIAF) process and provides the NSW Government with a Trends and Analysis Report. This report provides foundational analysis of the performance of projects in NSW, including significant trends in performance. This approach offers a foundation for broader analysis of best practice.

Consultations with government and industry stakeholders indicates that perhaps the largest factor is the sector's immediate focus on procuring and delivering the current pipeline of investment. Embedding continuous improvement is not a consistent priority for governments and delivery agencies. The absence of focus is in spite of the National Partnership Agreement (NPA) on Land Transport Infrastructure Projects supporting evaluation and requiring the sharing of completed reviews, see Box 18.

Box 18: The National Partnership Agreement requirements for post-completion reviews⁸⁹

Section 4.3 Project Evaluation

The Funding Recipient agrees to cooperate in the evaluation of projects to facilitate Project performance reviews and continuous improvement of investment decision-making.

The Department may conduct an evaluation, to determine the extent to which Project transport outcomes have been achieved and review the accuracy of demand forecasts and cost estimates used to assess the Project.

Funding Recipients may be required to provide information to assist in this evaluation for a period of time, as agreed.

If a Funding Recipient conducts a Project evaluation without involving the Department, they must provide a copy of the evaluation report to the Department.

Source: The Department of Infrastructure, Transport, Regional Development and Communications

Rigorous post-completion reviews can also be resource intensive, and delivery agencies may not have the requisite expertise or capacity to undertake reviews in a timely manner. Delivery agencies' ability to assess and measure project outcomes is often impeded by the lack of setting robust performance measures or developing adequate benefits realisation plans during the business case stage.⁹⁰ Lastly, there is no requirement under current funding agreements for funding recipients to provide a rigorous, independent assessment of project outcomes or provide information of strategic value as part of the post-completion review.⁹¹

It is critical that the sector move beyond an ad hoc, unplanned approach to continuous improvement. The opportunity ahead is for governments and industry to progress towards establishing and embedding default approaches to continuous improvement. This should occur through development of policy and guidance and leveraging industry forums to drive adoption and consistency in approaches. This should also be extended to training and development of in-house expertise and knowledge to support and ensure a robust cycle of identifying, distilling, and sharing lessons learned is routinely adopted.



Recommendation 2.5

Embed a culture of continuous learning across the infrastructure sector to support better, faster, cheaper and more innovative infrastructure solutions and delivery.

0-5

Recommendation 2.5.1

Improve the quality and consistency of infrastructure decision-making by establishing and embedding organisational learning and improvement practices that routinely assess internal performance and capture, distil, and incorporate learnings into future decisions and planning processes.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory treasuries, state and territory infrastructure bodies

0-5

Recommendation 2.5.2

Drive improved decision-making, productivity and value for money by establishing processes to identify, capture and adapt whole-of-industry and international best practice and learnings.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory treasuries, state and territory infrastructure bodies, and Infrastructure Australia

0-5

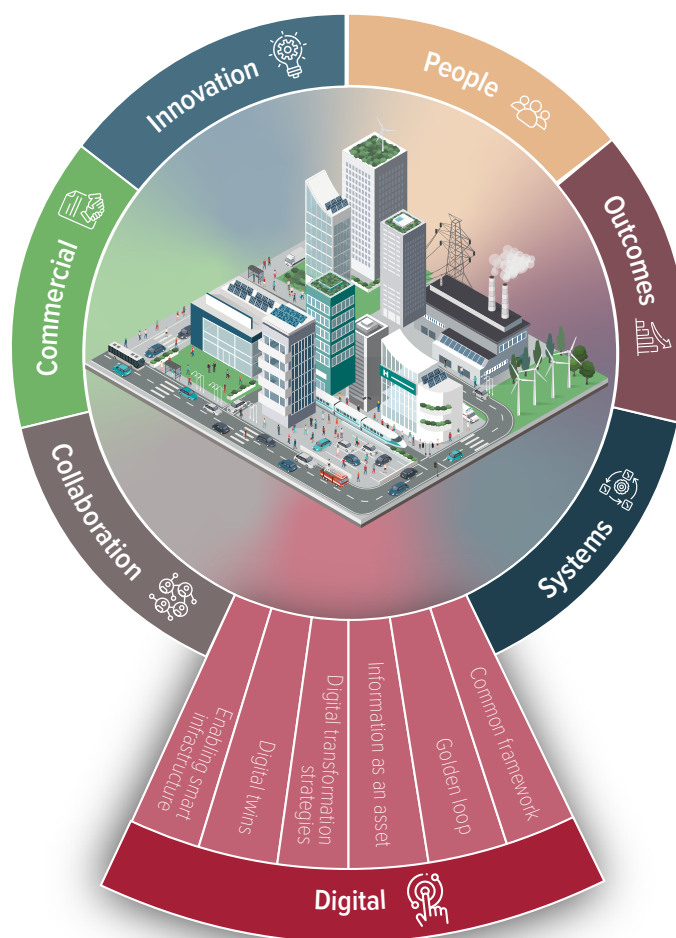
Recommendation 2.5.3

Facilitate the identification, distilling and sharing of best practices and lessons learned at a whole-of-industry level via an industry collaboration group to drive improved productivity and support higher quality, faster and cheaper infrastructure delivery.

Proposed lead: Infrastructure Australia

Supported by: Infrastructure owners and delivery agencies, and relevant industry associations and leaders

3.3 Digital transformation



3.3 Digital transformation

Digital transformation will drive productivity and innovation in infrastructure delivery.

Digital has the potential to transform the infrastructure sector and support enhanced productivity and innovation. Digital is a core enabler to achieving transformation change across the sector. Digital transformation will drive better information and knowledge sharing, a reduction in whole-life costs of infrastructure, and will play a core part of improving the future development, construction, and operation of infrastructure assets.

Through digital transformation, the value achieved by information can be bigger than the sum of its parts – enabled through a common national information framework, smart adaptable assets that can gather information, and widespread use of digital twins.

However, the potential of digital to transform all aspects of infrastructure planning and delivery and drive genuine productivity and innovation in the sector is not well recognised by many sector organisations.

This section supports the implementation of Recommendation 3.3 of the *2021 Australian Infrastructure Plan*, specifically to increase productivity and embed a culture of innovation in the infrastructure sector by adopting an evidence-based digital by default approach to infrastructure planning, delivery and operations.

3.3.1 A common national approach to information frameworks and requirements should be applied across infrastructure assets

Where do we want to get to?

A common national information framework across all infrastructure assets will improve data interoperability and information sharing to drive better decision-making and better outcomes.

- A national agency has clear ownership for defining a standardised national common framework of standards and protocols that enable secure, resilient data sharing across organisations and sectors. The framework defines a common approach to the collection, storage and exchange of data and is applied across the infrastructure sector, for all projects in all jurisdictions.
- A standardised approach enables streamlined data sharing across projects, agencies, and jurisdictions, and allows for the development of comprehensive digital libraries. It will provide a common platform for innovation and open opportunities to link digital twins.
- A common approach accelerates digital literacy in the value chain by clearly communicating to the industry the required capabilities.

“Interoperability is key to reducing friction in data sharing – you need to have data that can talk to one another to build the bigger picture.”

– Industry leader

Box 19: Defining a common information framework

What do we mean by a common information framework?

A common information framework aims to establish the building blocks that are necessary to enable effective information management across the built environment throughout its lifecycle.

A common information framework would enable secure and resilient interoperability of data and would provide a reference point to facilitate data use in line with security, legal, commercial, privacy and other relevant concerns.

The core components of a common information framework would include:

- a reference data library – a standard vocabulary to ensure the same language is used to classify and refer to the same items and characteristics
- the minimum standard – to ensure a focus on quality of information and establish security and privacy standards
- protocols for models (such as digital twins) to link and talk to one another effectively, safely, and securely.

Source: Centre for Digital Built Britain⁹²

The value of data increases exponentially as it is aggregated and shared – having access to more information fundamentally enables better decision-making and can be a key driver in delivering better outcomes. Establishing a common approach to information standards is a fundamental step in streamlining and enabling information sharing across projects, sectors, and jurisdictions by removing barriers and allowing interoperability.

Greater levels of data and information sharing enables better decision-making, leading to financial savings, improved performance and service throughout the lifecycle and drives better outcomes for business and society across the whole life of an infrastructure asset.

Establishing a standard national information framework is a fundamental pillar of enabling this. The UK National Digital Twin Programme provides an example of a national framework providing a clear, consistent structure for sharing and validating data, a common language for describing digital elements, and architecture that ensures data is interoperable.⁹³ A common framework that underpins all digital twins opens the opportunity to link these models together to get a higher system-level insight than would otherwise be possible.

Data security is a core part of sharing information. A national information framework can ensure that a comprehensive ‘secure by design’ approach is established across all jurisdictions, with any data sharing managed effectively.

A common framework, by clearly communicating the capability requirements to the industry, will help build the digital literacy across the infrastructure sector by standardising best practice and ensuring all contributors are moving in the same direction. In doing so, it enables focused investments and better transferability of skills across the sector.

Current state

Common data frameworks and data sharing are not currently enabled by consolidated IT systems across organisations or jurisdictions. Infrastructure owners often view digital transformation as a function of enterprise-wide IT solutions. Lessons from best practice show us that those who have made the most progress recognise that information processes that flow through the investment lifecycle are the real enabler of better outcomes. Clear and effective information processes must also ensure interoperability of information across IT systems.

“ There is a need to standardise data capture, asset information, and meta data across jurisdictions. ”

– State infrastructure agency

Stakeholders consulted agreed that there is a lack of systematic information and data sharing across jurisdictions. However, government stakeholders consistently expressed a strong desire to standardise meta-data across jurisdictions to enhance data sharing and the dissemination of lessons learned and better utilise the large pool of existing data to inform better decision-making.

Common data frameworks to support data being shared across the project lifecycle from planning to operations and asset management has been a focus for local government, including through the Institute of Public Works Engineers' (IPWEA) 2020 International Infrastructure Management Manual. Opportunities exist to leverage local government national reporting frameworks, such as the IPWEA State of the Assets report.

A key theme that emerged from the stakeholder engagement was the varied infrastructure capability that exists across Australia, particularly in remote areas that have very limited digital connectivity and infrastructure to the wider nation. A national information framework can help to build the capability needed to create Australia's digital backbone.

While there are some exemplars of good data governance across jurisdictions, sectors, and projects, many operate with a degree of independence, leading to inconsistency in how data is collected, managed, used, and shared. Each jurisdiction has information and data frameworks, however these do not enable data interoperability across sectors and do not allow for simple sharing across jurisdictions.

It was noted in the *2019 Audit* that there is a growing need to manage cybersecurity risks such as data security and system resilience as more Australians use digital services.⁹⁴ A secure national information framework can play an important role in managing these risks. *Australia's Cyber Security Strategy* will also play a core role in managing these risks, with the proposed national information framework aligning with this strategy.⁹⁵



Recommendation 3.1

Develop and implement a common national information framework across all infrastructure assets in all jurisdictions to drive better data interoperability and information sharing and better, more informed decision-making.

0-5

Recommendation 3.1.1

Develop an understanding of the data and information needs across asset types and lifecycle phases to establish the baseline requirements for a common information framework.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies, Infrastructure Australia

0-5

Recommendation 3.1.2

Develop and implement a common information framework, including a reference data library, protocols for security, access and information sharing and channels for assets to speak to one another for interoperability to set the foundation for better information sharing.

Proposed lead: State and territory infrastructure bodies

Supported by: Infrastructure owners and delivery agencies, Infrastructure Australia

0-5

Recommendation 3.1.3

Establish a data sharing framework between jurisdictions and a decision-making framework to drive better decisions based off better information sharing.

Proposed lead: Infrastructure Australia, state and territory infrastructure bodies

Supported by: Infrastructure owners and delivery agencies

5-10

Recommendation 3.1.4

Implement the common information framework for all new infrastructure assets in all jurisdictions and develop a roadmap for implementation across existing infrastructure assets to drive interoperability of data and information sharing across assets and jurisdictions.

Proposed lead: Department of Infrastructure, State and territory infrastructure bodies

Supported by: Infrastructure Australia, infrastructure owners and delivery agencies

3.3.2 All infrastructure programs should be founded on a visible ‘golden loop’ of high-quality digital information that flows through the end-to-end delivery process

Where do we want to get to?

Data is treated as a valuable asset and is used effectively to driver better, more informed decision-making and to improve the performance of existing assets.

- Infrastructure projects are founded on a clear understanding of the ‘golden loop’ of information that flows through the end-to-end delivery process.
- Information processes start with a focus on the information required to operate and maintain the infrastructure system, delivering an effective service to customers.
- Information processes are aligned with current and future user requirements and ‘levels of information need’ both within the project, the program, and the agency.

“The digital transformation has to be driven from the top to change the culture of the major project industry across all levels of government, project delivery and advisory and construction organisations.”

– Industry leader

The digital journey begins with a clear understanding of what information is required to deliver a service from a solution, including ongoing operation and maintenance requirements.⁹⁶ True digital transformation is enabled through a customer and user-first approach. Ensuring the right feedback loops are in place from the outset helps to develop a whole of life perspective and improve the whole-life value of assets, with clear information processes that align with and flow to the required outcomes.

Data should be the foundation of all projects to drive a step-change in infrastructure productivity. We are currently in an era of ‘digital abundance’ – collecting, communicating, processing, and storing of information is cheaper and easier than ever before.⁹⁷ Using this information effectively is key to improving the performance of existing assets and driving better decision-making for future investments – the ‘golden loop’ of information flow.

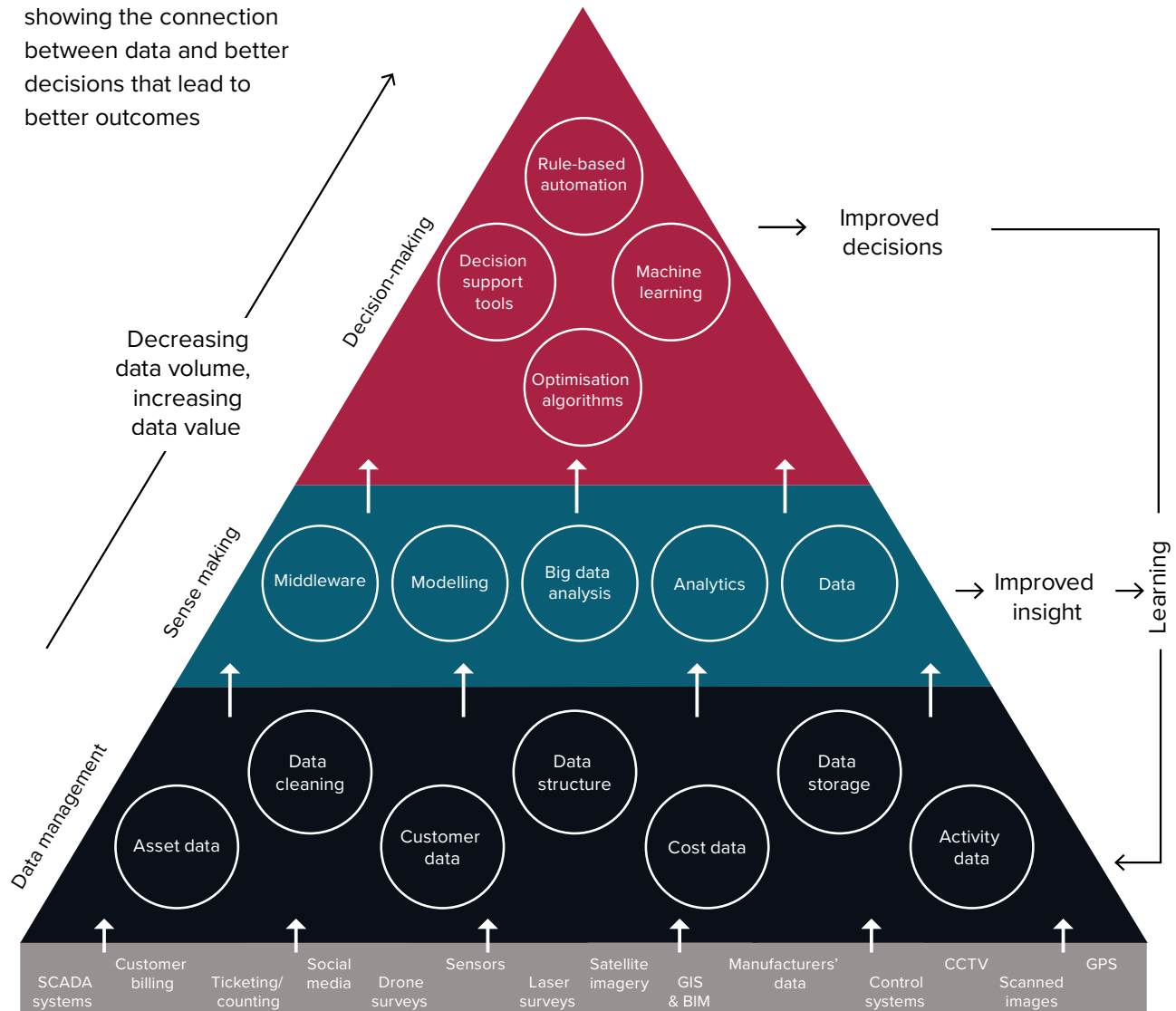
Information is the core enabler. A mindset shift is required to begin treating data as the valuable asset it is, on par with physical assets. Though the structures and processes may not be in place to make the most of this information immediately, there is immense value in capturing information that can be leveraged in the future. This information can be used to provide a historical baseline and form the basis of future analysis.

The value of different categories of data changes depending on the user, with engineers, operators, economists, and planners all placing varying levels of importance on the different categories.⁹⁸ To drive the best outcomes, it is important to bring these perspectives together to ensure that the right data is being captured at the outset.

The information value chain, presented in Figure 9, shows the connection between data and better decisions that lead to better outcomes.

Figure 9: The information value chain

The information value chain:
showing the connection
between data and better
decisions that lead to
better outcomes



Source: Centre for Digital Built Britain⁹⁹

Current state

“Government is not aware of the wealth of data that it does actually sit on. There is a need to better harvest the data it has access to and develop up a range of reference projects across all classes of assets.”

– State infrastructure department

There is varied maturity of data gathering and implementation across jurisdictions and sectors, with a general lack of reliable and user-focused information.¹⁰⁰ Transport and telecommunications are amongst the most mature sectors. The transport sector, particularly in the major cities, has invested heavily over recent years in real-time information

on congestion, transport timetables, and public transport vehicle capacity, with operators typically using this data to driver better outcomes and broader choice of services.¹⁰¹ This is particularly important in driving better outcomes at a system level for transport infrastructure.

However, across many parts of the country and most sectors, there is a lack of reliable and user-focused information.¹⁰² This can lead to difficulties in assessing the performance of assets, networks and services and impacts the ability to make informed planning decisions for new and existing infrastructure assets. Overall, this lack of information has a detrimental impact on the system-level outcomes that are being achieved.

Where asset performance data does exist, variations in the definitions and source data makes it difficult to compare between jurisdictions – highlighting the importance of a national information framework.¹⁰³

Recommendation 3.2

Infrastructure programs should integrate digital information loops throughout the lifecycle of infrastructure assets to drive better decision-making and improve the performance of existing assets.

0-5

Recommendation 3.2.1

Infrastructure projects and programs should define the information requirements of customers, users, and operators, with the information processes configured to give projects a clear focus on these requirements from project development through to operation.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies

0-5

Recommendation 3.2.2

Establish clear information processes that provide the underpinning framework for projects and programs, establishing clear information requirements at each lifecycle stage and ensuring clear information deliverables throughout the delivery process.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies

3.3.3 Projects and programs should recognise information as an asset, with provision of information an integral component of asset handover

Where do we want to get to?

Information handover is considered of equal importance with physical asset handover, with the timely handover of quality information reflected in commercial models to set operators up for success.

- Information is recognised as an integral part of the proposed solution and of the proposed operating environment, with information and physical assets given equal importance and seen as integral parts of the proposed solution.
- The handover of project information and data to the owner and operator is seen as a core component of the completion of a project and the transition of an asset into operation, with information provided and signed off by operators in advance of physical asset handover.
- Information is developed progressively through the delivery process, with information rich standard products integrated into proposed solutions.
- Commercial incentives for information handover underpin the importance of the transfer of data to the asset owner and operator.

“ The operations and maintenance space is critical to getting value out of data. ”

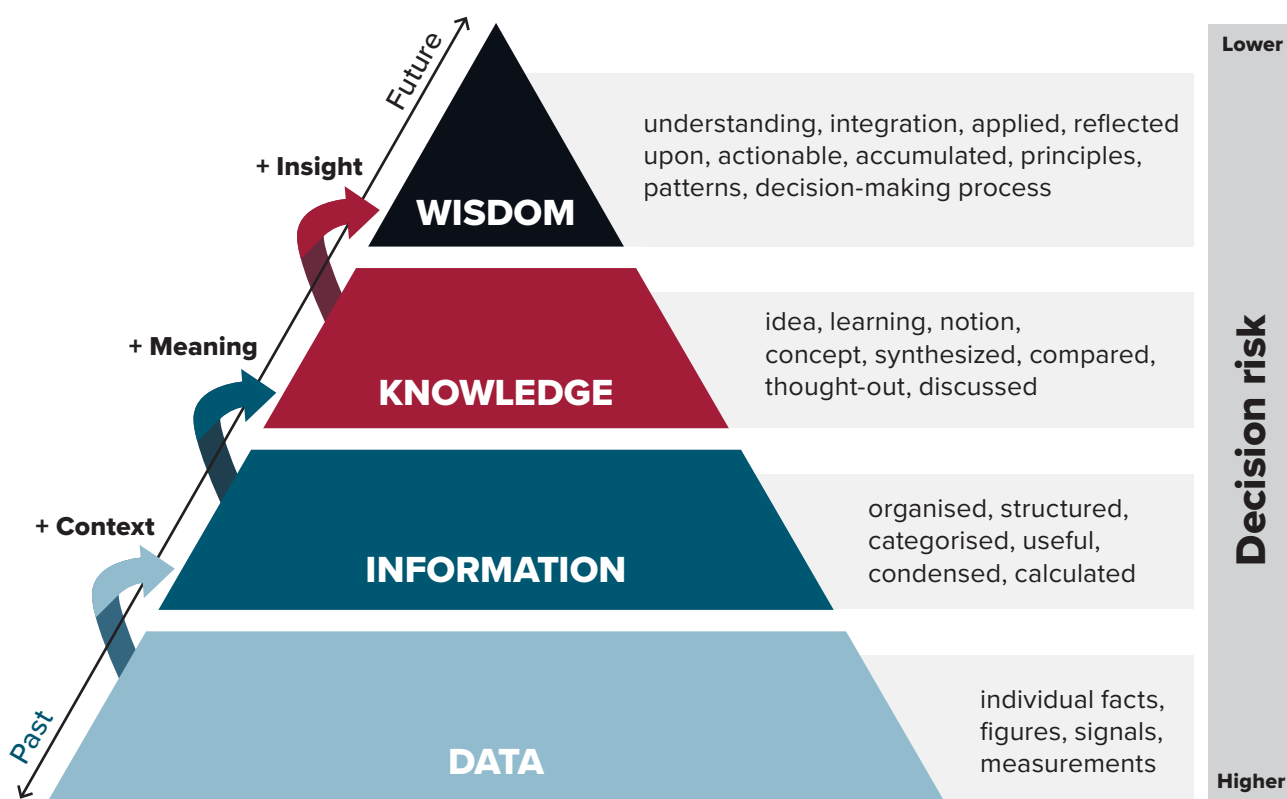
– Industry leader

The timely handover of project information is a core component of enabling the ‘golden loop’. Information has inherent value, and the loss of information represents a loss in value. The handover of project information and knowledge is often overshadowed by the handover of the physical asset during the completion phase. However, comprehensively capturing the knowledge from a project can help drive a thread of continuous improvement and support a shift away from a project-by-project mentality to a systems approach to project planning and delivery.

Information exchange has benefits for both owners and operators:

- **Owners** benefit by capturing the knowledge from the project, which can feed back into the system for the planning and delivery of future infrastructure projects and can enable a shift in the data, information, knowledge, wisdom hierarchy (see Figure 10).
- **Operators** benefit by being ‘set up for success’ by the smooth transition of key project data, such as risk management information, as-built models, and operation and maintenance manuals being in place from the beginning of asset operation, and can be used to demonstrate the as-built quality of the asset. The timely transition of information can reduce time, costs, and operational risk, particularly health and safety risks.¹⁰⁴

Commercial models should reflect the importance of information handover, as this acts to both set clear expectations for the information handover and provides incentives for it to occur in a timely manner.¹⁰⁵ This is a key building block to developing Should Cost Models and becoming an intelligent client that is able to clearly articulate cost alongside outcomes.

Figure 10: Data, information, knowledge, wisdom hierarchy

Current state

The physical asset handover is traditionally the primary focus of the project and program handover phase in Australia, with the handover of information typically an afterthought – often after a new asset is in service.

Information is typically seen as something provided at completion, with elements such as operations and maintenance manuals developed as part of the handover and close-out process. However, this process does not take into account that this information is often required long before the handover point for products and components included in the design.

This stems from a number of issues:

- operations and maintenance personnel typically are not involved until the end of the project lifecycle, prior to the asset handover. As a result, they do not have the opportunity to provide input during the project development phase about what information they require for a smooth handover and successful operation of the physical asset.
- clients generally do not have an effective process for assessing the completeness and quality of data – even where information is provided there is no immediate understanding of whether it matches requirements.
- there are generally no contractual requirements for the timely handover of quality information.
- the physical asset is valued more highly than the information and data assets. It is much more difficult for a client or operator to not accept handover due to poor or lacking information than if there is a physical defect.

There is an opportunity to shift the current mindset and introduce new processes that emphasise the value information holds, and ensures information is provided and verified in advance of handover and commissioning of the asset. Owners should make it a more explicit requirement and support it by tying the handover of information into reward models and incentives.

Recommendation 3.3

All infrastructure projects should ensure there is timely handover of quality information to set operators up for success.

0-5

Recommendation 3.3.1

Infrastructure owners and delivery agencies should involve operations and maintenance personnel during the project development phase to understand what information they require for a smooth handover and successful transition to operation of the physical asset and incorporate this into the project requirements.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

Recommendation 3.3.2

Infrastructure owners and delivery agencies should provide incentives in commercial models for the timely handover of quality information prior to the physical asset handover.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory treasuries, state and territory infrastructure bodies

0-5

Recommendation 3.3.3

In collaboration with infrastructure operators, infrastructure owners and delivery agencies should establish processes for assessing the completeness and quality of data prior to handover.

Proposed lead: Infrastructure owners and delivery agencies, infrastructure operators

Supported by: State and territory infrastructure bodies, and relevant industry associations

0-5

Recommendation 3.3.4

State and territory infrastructure bodies should require demonstrable evidence during assurance reviews that quality information is to be handed over to the owner and operator prior to the physical asset handover point.

Proposed lead: State and territory infrastructure bodies

Supported by: Infrastructure owners and delivery agencies, Infrastructure Australia

3.3.4 All major contributors to infrastructure delivery should have clear and committed Digital Transformation Strategies

Where do we want to get to?

All major contributors to infrastructure delivery begin their digital journey with Digital Transformation Strategies, with these considered in partner selection to drive digital transformation in the infrastructure sector.

- Digital Transformation of the infrastructure sector is accelerated through the aggregation of the digital commitment of all key players. All contributors to infrastructure delivery have an understanding of their existing digital capabilities and a roadmap for improvement, outlined in Digital Transformation Strategies.
- Digital capabilities are an important consideration in partner selection, along with their ongoing commitment to digital enhancement, all of which is clearly demonstrated in their Digital Transformation Strategy.
- Digital transformation will be led by governments and public delivery agencies, who will develop digital transformation strategies that outline their digital ambitions and a roadmap for how they plan to get there.

“The starting point for organisations beginning their digital journey is to develop a Digital Transformation Strategy.”

– Industry leader

Digital transformation of our industry is best enabled by all parts of the ecosystem digitally transforming their business. This aggregated effect is the most significant contributor to digital change. While digital transformation strategies in isolation will not drive transformational change, they play an important role in developing buy-in, framing the vision, help embed digital within corporate strategy and are an important first step on the digital transformation journey for all members of the ecosystem.

Box 20: Digital Transformation Strategies:

- **Build the case for change** by defining the vision for the future and the benefits it will deliver, providing a compelling rationale, and assessing the current levels of digital maturity.
- **Outlines what and how** digital transformation will enable intelligent operation throughout the whole asset and data lifecycle and how it will be implemented to drive meaningful change.
- **Identify the change required** to achieve the vision, highlighting the importance of people and the cultural shift needed to fulfil the potential of true digital transformation, along with Board level sponsorship and clear ownership for implementation.
- **Help to build an overall picture of the progress** of digital transformation journey in Australia. Governments and public delivery agencies publishing their strategies provides a baseline to the wider industry, and means the strategies can be easily collated to build a picture of the overall maturity and progress.

When driving change at an industry level, messaging plays an important role in developing buy-in. Comprehensive overarching government strategies set the digital transformation agenda and help develop the alignment and consensus required.

The record infrastructure investment pipeline committed to by governments of all levels means government is well positioned to drive digital transformation. This can be achieved through compelling visions and strategies, and by setting digital capabilities and digital transformation strategies as important considerations in partner selection, a point echoed by multiple stakeholders consulted. This is an important lever, as it clearly signals to industry that investments into their own digital capabilities will be worthwhile.

A point raised by stakeholders was that it is important to recognise that not all owners and delivery agencies begin their digital journey at the same point. However, developing a digital transformation strategy helps organisations to understand their current level of digital maturity, articulate how they can benefit from improving their digital capability, and identify what is needed to guide them on their digital journey.

Current state

Some jurisdictions have recently implemented digital strategies, signalling a broad desire to improve digital capability and make the most of digital transformation, though these are not infrastructure focused.¹⁰⁶ However, government and industry stakeholders noted that there is currently little coordination between jurisdictions on digital priorities.

There are some excellent examples of programs driving digital change in major construction programs across Australia, such as Sydney Metro in NSW and Level Crossing Removal Program in Victoria, who are taking comprehensive digital engineering approaches to delivery.

However, to really accelerate digital transformation all parts of the ecosystem need to transform their business digitally. Stakeholders noted that digital is generally presented as an 'add-on', rather than a core offering for infrastructure projects. This is typically reflected in partner selection by public procurement agencies, where digital capability is not set as a fundamental criterion.

Recommendation 3.4

All major contributors to infrastructure delivery should have Digital Transformation Strategies to drive digital transformation in the infrastructure sector.

0-5

Recommendation 3.4.1

Infrastructure owners and delivery agencies should support digital transformation by collaborating to develop clear and committed Digital Transformation Strategies that outline their vision for digital transformation and their roadmap for improvement.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies

0-5

Recommendation 3.4.2

Digital capabilities should be considered as an important criterion in partner selection for infrastructure projects and programs by infrastructure owners and delivery agencies.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies

3.3.5 All infrastructure projects and programs should adopt digital twins

Where do we want to get to?

Digital twins are developed for all infrastructure projects and are used to simulate, model and inform future development, construction and operation to drive efficiency and productivity improvements.

- Digital twins are embraced across the industry and are developed for every new project.
- Digital twins provide the capability to simulate all aspects of delivery, including customer service, operation and construction. The industry works to a clear recognition that no aspect of operation or construction should be undertaken for the first time physically, it will have been simulated and optimised in advance digitally.
- Digital twins are used to drive a step change in efficiency and productivity. They are utilised to conduct 'digital rehearsals' of construction prior to any physical activity to identify issues and opportunities for streamlining processes and are used to engage with the supply chain throughout solution development and production management.
- A standardised approach is established to allow digital twins to be connected to each other to create an ecosystem of models that can talk to each other. This enables opportunities for strategic optimisation, including establishing standardised products and processes.

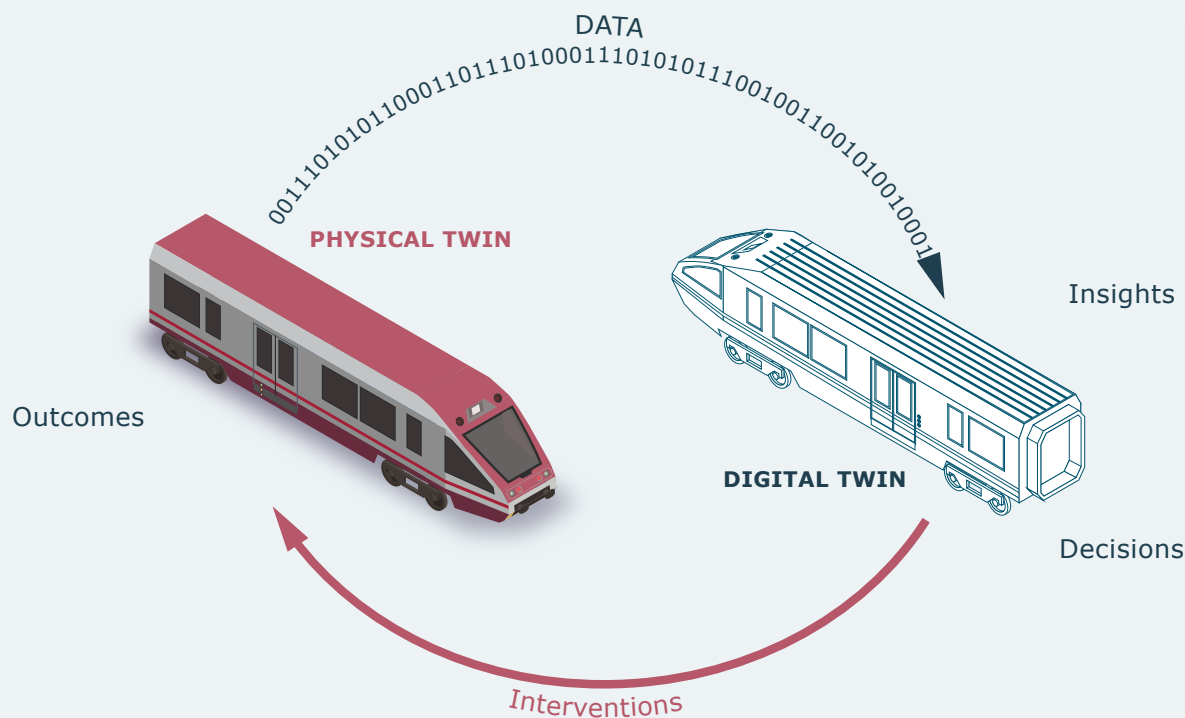
“Digital twins are an enabler and a part of the bigger picture, driving better decisions based on better information.”

– Industry leader



Box 21: Defining digital twins**What is a digital twin?**

A digital twin is a realistic representation of physical assets, processes, and systems. A digital twin differs from other digital models as it has a data-connection to the physical twin.

Figure 11: Digital twins

Source: Centre for Digital Built Britain

Digital twins, with their direct link to the physical twin, provide the opportunity to simulate and optimise every aspect of development, delivery and planning of infrastructure assets digitally – we no longer have to make a physical change to the system without having first simulated and optimised it in a digital twin. The effect the widespread adoption of digital twins will have on every aspect of performance represents one of the biggest opportunities for our industry to drive transformational change.

Source: CDBB and UK Government¹⁰⁷

Digital twins are a key part of enabling the ‘golden loop’ outlined in the principle above by providing the base for the collection and analysis of data, and the delivery of both the physical asset and its digital twin should be a critical part of the handover process. Digital twins provide immense opportunities to improve both the delivery and operation of infrastructure by driving better decisions based on better information.

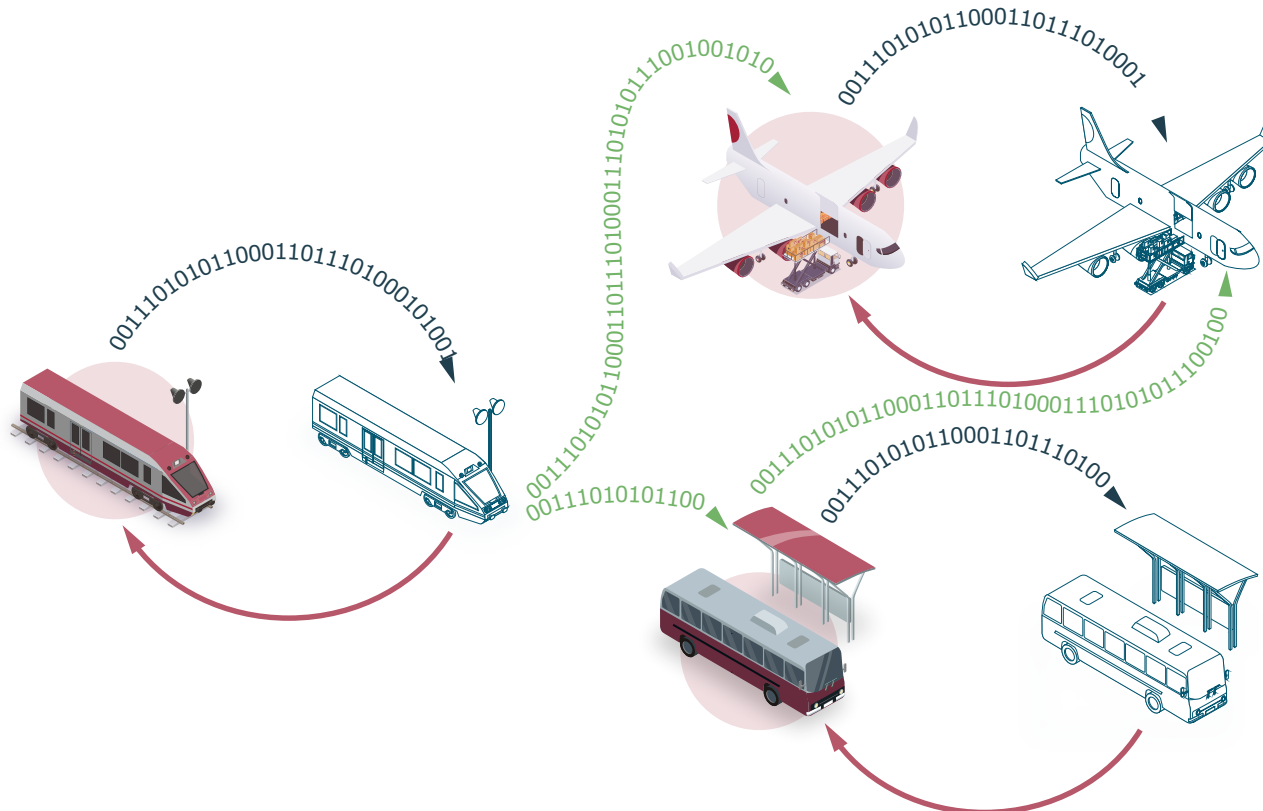
The primary value of a digital twin is the connection it has to the physical twin – as it is based on data from the physical asset, a digital twin unlocks value by supporting improved decision-making. This in turn creates the opportunity for positive feedback into the physical twin to improve performance.¹⁰⁸

By linking into the ‘golden loop’, a digital twin can provide significant value at all lifecycle stages of an asset:

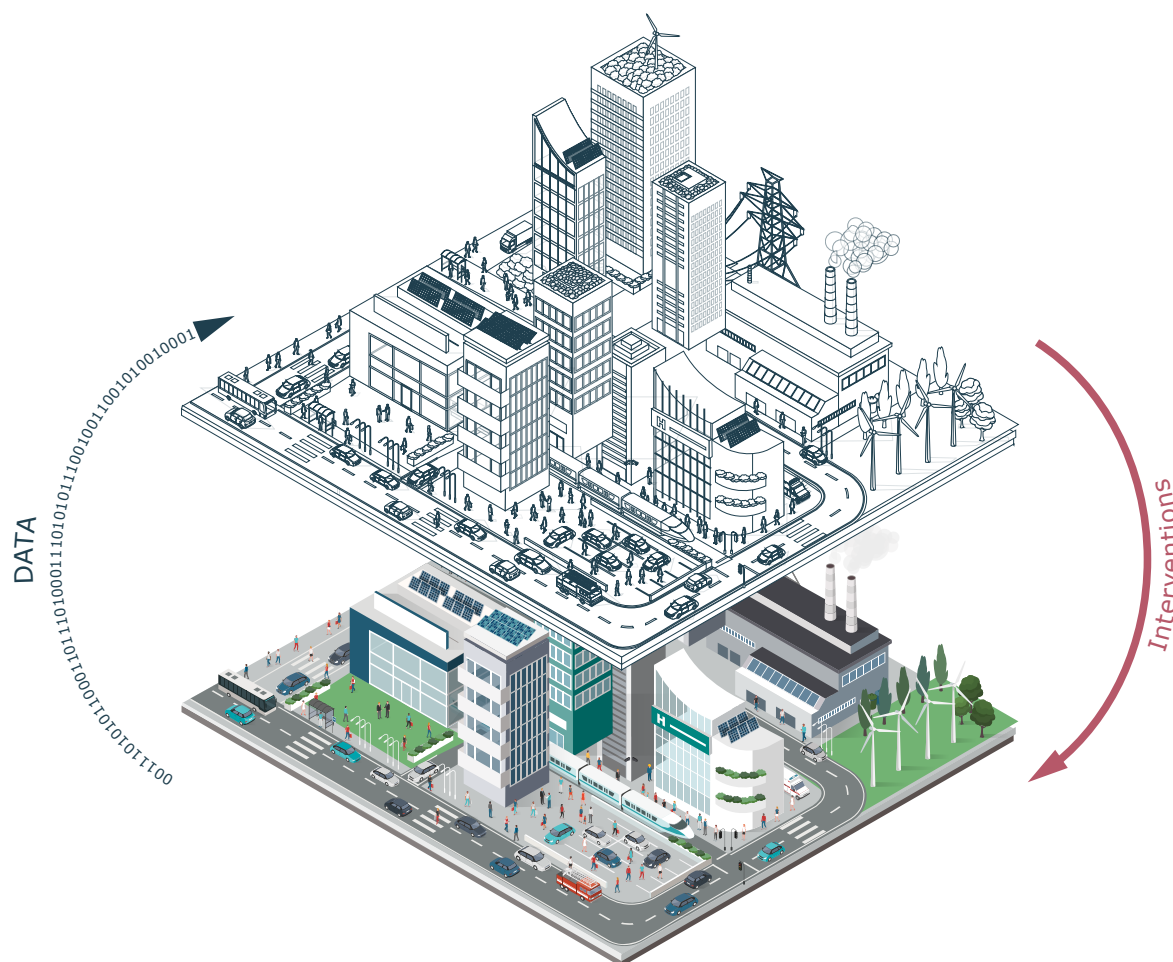
1. It can assess the **current state**, with real-time status monitoring and control, provide operation and maintenance interventions, and the ability to optimise the performance and safety of assets through diagnostics and prognostics.
2. It can inform the **future state**, where the information collected can inform the long-term strategy for the asset and support wider asset planning. Digital twins can form the basis of predictive and preventative maintenance programs, improving the performance and safety over the whole life of assets.
3. It can provide a **history** of the asset through recording keeping, allowing lessons to be learned from the past, and moves towards improved transparency and integrity of information, underpinning a focus on effective change control.
4. It can be used to **test** scenarios and fault conditions, such as climate change, the impacts of increased usage, or assess interdependencies with other assets.

Fundamentally, infrastructure exists and operates as a system – everything is interconnected and interdependent. While isolated digital twins provide significant benefits in themselves, even broader benefits can be achieved through creating networks of connected digital twins (see Figure 12). Linking digital twins allows us to understand how the system as a whole operates, rather than just the individual parts – it allows opportunities to examine the interdependencies of infrastructure assets and the broad impacts that interventions can have (see Figure 12).¹⁰⁹

Figure 12: Conceptual diagram of connected digital twins



Source: Centre for Digital Built Britain.

Figure 13: Understanding the ecosystem through connected digital twins

Source: Centre for Digital Built Britain.

For digital twins to be linked effectively, they need to be underpinned by a common information framework. A common framework forms the foundational piece in maximising the benefits from linking digital twins, ensuring interoperability of the data, future-proofing the digital assets, and streamlining information and knowledge sharing between assets, projects, and jurisdictions.

An area where digital twins can provide immense value is by allowing ‘digital rehearsals’ to be conducted prior to physical construction work. Digital workflow simulations are common-practice in other industries, such as automotive, manufacturing and aeronautics, due to the benefits that can be derived. The benefits of digital rehearsals include:

- Identification and resolution of issues prior to physical construction work, making the work on site safer, more efficient, and higher quality.
- Ability to conduct multiple iterations of the workflow to identify the most efficient and effective approach.
- Allows for ‘just in time’ scheduling of the delivery of materials and equipment to site due to a more thorough understanding of the sequence of events. ‘Just in time delivery’ is commonplace in the manufacturing industry as it maximises the efficiency of the process and reduces the need for large areas for storage of unused materials and equipment.
- Drives the production system approach to delivery, reducing variability and promotes efficient model building to achieve better outcomes.

The ultimate goal of conducting digital rehearsals is to make the work on site as uneventful as possible, as all the issues have already been identified and resolved.

Current state

Digital twins are gaining significant momentum and political backing across Australia, with a number of ambitious initiatives in progress or announced. Some of the leading initiatives are the NSW Spatial Digital Twin, Digital Twin Victoria, and QLD Spatial Digital Twin.¹¹⁰

However, while their use is becoming more widespread, creating digital twins is not standard for all infrastructure projects. Digital twins are primarily used for 'mega' projects where there is significant capital investment.

It was noted during the stakeholder engagement that there is a desire for broader use of digital rehearsals on construction projects, however a combination of thin margins for contractors and restrictive procurement processes has restricted more widespread implementation. There is a significant opportunity to leverage the learnings from the development and implementation of these digital twins to accelerate improvement across the industry.

Recommendation 3.5

All infrastructure projects and programs should create digital twins of the physical asset to drive efficiency and productivity improvements.

0-5

Recommendation 3.5.1

Digital twins should be created for all infrastructure projects and used to simulate, model and inform future development, construction and operation to drive better decision-making and optimise the performance of infrastructure assets.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

5-10

Recommendation 3.5.2

Opportunities to link digital twins should be pursued to identify and analyse interdependencies between infrastructure assets to drive more informed decision-making and optimise how the infrastructure system operates.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

3.3.6 Programs should adopt development and procurement approaches that enable smart infrastructure solutions

Where do we want to get to?

Procurement strategies and approaches enable smart infrastructure solutions to drive more financially sustainable and efficient delivery of outcomes.

- Procurement policies and commercial strategies focus on outcomes. Partners are procured and engaged at an outcomes level rather than with a predefined scope, creating the opportunity for smart infrastructure solutions to deliver outcomes from optimised existing assets.
- Procurement aligns with a systems approach, using this focus on outcomes to ensure that projects are seen as interventions on an existing system with partners engaged to develop and deliver these system interventions. There is an understanding by procurement and delivery agencies of the role that procurement plays in enabling intelligent solutions to be implemented by the supply chain.
- More widespread adoption of smart infrastructure solutions drives better, more efficient and financially sustainable outcomes and enables broader systems-level thinking.

“ There needs to be flexibility in procurement to allow for innovation. ”

– Industry leader

Smart infrastructure is the combining of physical infrastructure with digital infrastructure such as sensors, internet of things, and machine learning to provide better information to drive more informed decision-making, faster and cheaper.¹¹¹ Making infrastructure smarter can provide real-time feedback on usage and provide opportunities for optimisation.

Smart infrastructure means delivering infrastructure differently – unlocking new solutions, allowing assets to adapt to how they are being used in real-time, and can lead to non-build solutions to improve infrastructure efficiency to optimise the system.¹¹² Optimising existing assets will be inherently more environmentally sustainable and lower carbon than building new assets, as well as a being much more cost-effective.

To realise the benefits of smart infrastructure, it needs to be embedded into procurement. Procurement strategies and approaches need to be designed in a way that enable smart solutions to be implemented by the ecosystem – incentivising the ecosystem to deliver ‘best for project’ and ultimately ‘best for system’, including new technology. This requires a shift from the current procurement approach of focusing on scope to one which focuses on outcomes and a shift towards a systems-level perspective.

This shift in the procurement approach needs to be underpinned by better engagement with the supply chain to understand their capabilities and how best to implement smart solutions and selecting and empowering partners who can best help along this journey.

Current state

An important theme from the stakeholder engagement was that the current procurement policies and standards are rigid and jurisdictions are typically risk averse. This acts to encourage the same set of solutions and limits innovations, as well as locking out new players with new approaches to infrastructure delivery and providing barriers to smart infrastructure solutions. For the real benefits of digital transformation to be unlocked, there is a need for procurement policies and standards to embrace change and help drive new approaches to delivering infrastructure.

There are a range of smart infrastructure projects across Australia, in particular a growing number of smart motorways projects in NSW, Victoria, South Australia, Queensland, and Western Australia. However, approaches to implementing smart infrastructure solutions are typically conducted on a project-by-project basis and does not inherently provide platforms to cover all asset classes and sectors.

Recommendation 3.6

Procurement and program development approaches should enable and encourage smart infrastructure solutions to drive more financially sustainable and efficient delivery of outcomes.

0-5

Recommendation 3.6.1

Smart infrastructure interventions that optimise existing assets should be investigated as the first intervention over building new assets to drive more financially sustainable delivery of outcomes.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

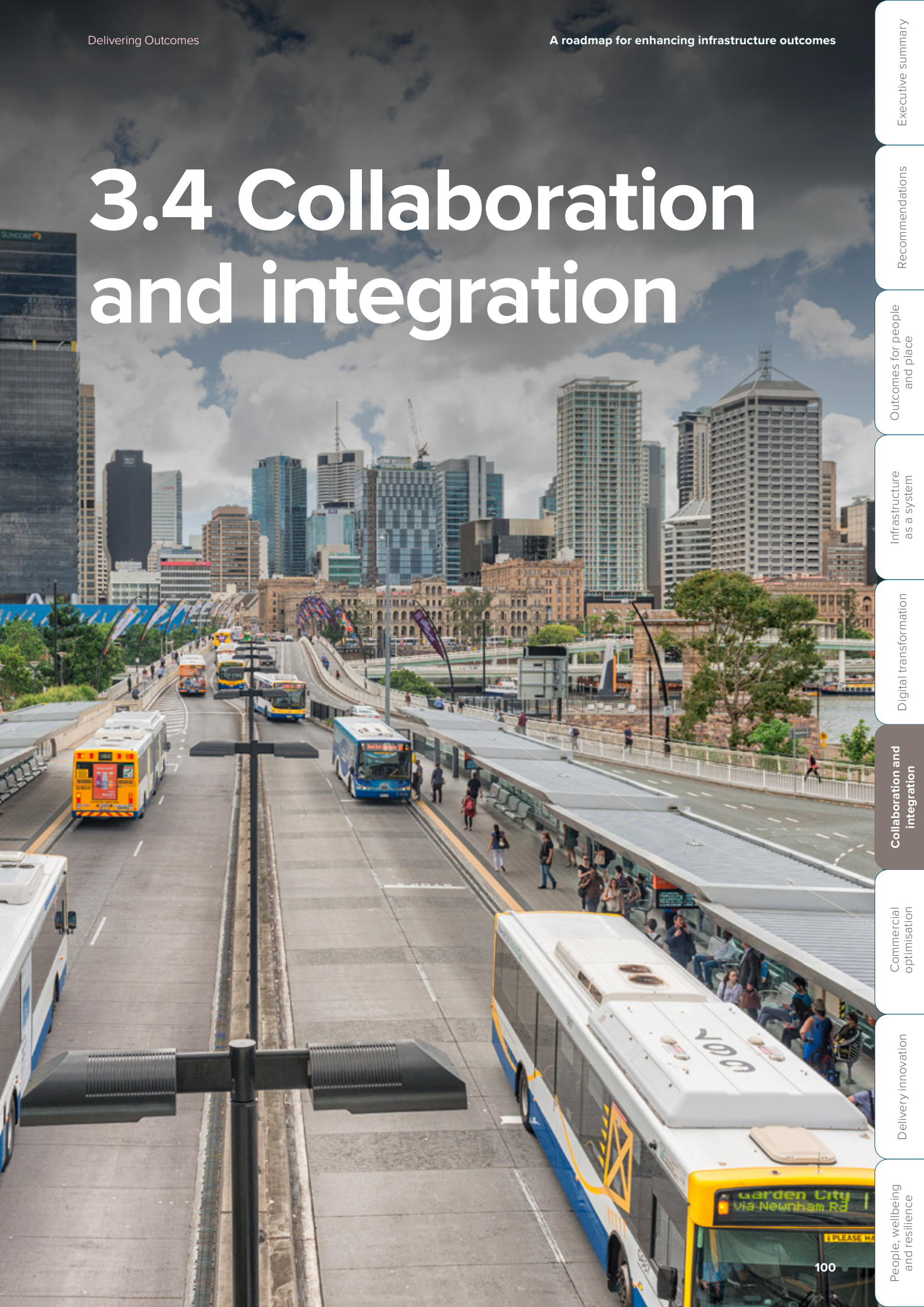
Recommendation 3.6.2

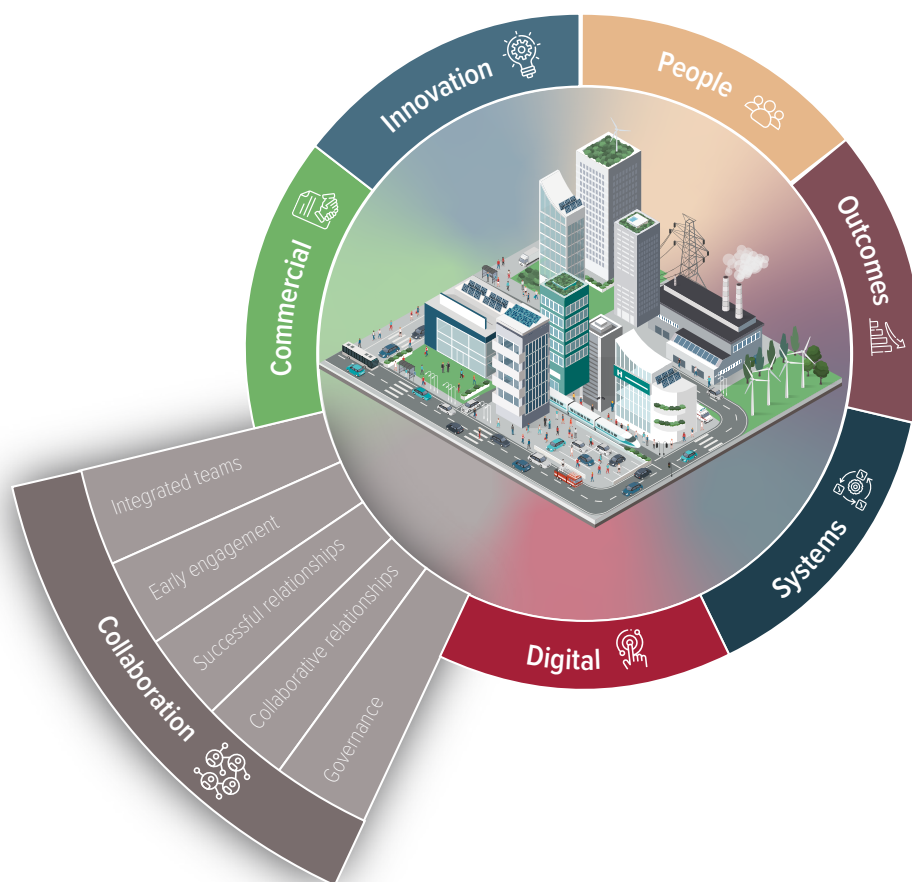
Infrastructure owners and delivery agencies should review their existing procurement policies and frameworks to ensure value-for-money, smart infrastructure solutions are enabled and encouraged, along with the early engagement of appropriate partners to develop and implement these solutions.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Australasian Procurement and Construction Council, and relevant industry association

3.4 Collaboration and integration





3.4 Collaboration and integration

Collaboration and integration across the ecosystem will drive a financially sustainable and high-performing infrastructure industry.

A new model for delivery is required to transform the infrastructure sector in Australia, one founded in long-term, collaborative, and trust-based relationships, with regular two-way dialogue between the government and industry, and delivered by high-performing integrated teams.

Effective governance is a key enabler to this, playing an important role in ensuring the focus is on the right outcomes, framing relationships for success at the outset, and driving collaborative behaviours. Such a model will represent a departure from current

practice, where transactional relationships that largely exist on a project-by-project basis, which along with unbalanced risk and commercial models, drive an adversarial culture and a financially unsustainable industry.

This section supports the implementation of recommendations of the *2021 Australian Infrastructure Plan*, including *Recommendation 3.2b*: Reduce uncertainty for industry and improve value for money by improving engagement with industry and the supply chain.

3.4.1 Owners should enable delivery through effective and visible governance

Where do we want to get to?

Effective governance ensures the focus is on the right outcomes and drives positive change in the infrastructure industry.

- More integrated, collaborative delivery approaches are underpinned by effective governance, recognising that governance should include clear and transparent decision-making, visible assurance as well as supporting culture and behaviour.
- Effective governance is underpinned by clear dependable performance data, with collective boards and management groups able to respond to real time measures of progress and productivity.
- Governance sets standards on integrity for the delivery organisation, demanding transparency, openness and honesty. Good governance is active in seeking to drive a culture of productivity, driven by communication.
- Governance is underpinned by excellence in change management. Collective delivery processes seek to identify and understand changes in circumstances or assumptions at the earliest opportunity and act positively to mitigate potential impacts and leverage available opportunity.
- Project and program governance mirrors the principles of good organisational governance, with effective separation between executive and non-executive input and thinking.
- Intelligent, adaptable owners drive commitment to collaborative behaviours with the supply chain through a shared commitment to deliver continuous improvements in performance, behaviour and culture.
- Owners take the lead in developing organisations with culture, practices, and systems appropriate to what is being delivered.

“Governance needs to ensure there is a holistic conversation around infrastructure planning, procurement and delivery.”

– Industry Peak Body

Effective governance plays a critical role in ensuring the focus is on the right outcomes and is a foundational element from which many of the principles this roadmap rely on.

International best practice, including Project 13 and the UK Construction Playbook, emphasise the importance of effective governance in driving better outcomes.¹¹³

“Companies tend to get the results their governance systems demand.”¹¹⁴

Effective governance can drive positive change by:

- **defining value for money**, not simply on the basis of lowest cost for a defined scope but in the operating performance, customer service, and sustainability outcomes (see **Section 1**)
- developing **commercial models** that support desired behaviours and culture, through incentives for collaborative working and innovative ways of working, defining fair risk allocation, and supporting long-term partnerships with financially sustainable returns for all parties
- making **data-driven decisions**, based off transparent and high-quality performance reporting, supported by the assurance process that challenges and ensures the focus is on the right outcomes.

Effective governance also plays an important role in providing public confidence that infrastructure investment decisions are data-based, transparent, and will deliver the desired outcomes for society.

Current state

Compared globally, the *2019 Audit* found that Australia's infrastructure governance is relatively strong, with well-established institutions and regulatory systems that have generally performed well.¹¹⁵

The *2019 Audit* also identified that government infrastructure agencies in particular have been a positive change and have helped drive better outcomes for users.¹¹⁶

However, recent experience on a range of high profile projects indicates that there is an opportunity to improve, particularly for major projects, as identified by the Grattan Institute and Roads Australia.¹¹⁷

Decision-making for infrastructure projects is falling short of best practice, in particular regarding:¹¹⁸

- announcing projects before a range of solutions have been analysed and a detailed assessment has been completed. Notably, NSW introduced ministerial guidance on the announcement of projects and based on stakeholder feedback has seen an improvement in this area
- transparency around decision-making can be lacking, with business cases and supporting analysis typically not made public
- post-completion reviews are rare and provide limited insight as to whether the stated benefits and outcomes have been achieved.

Regulation and governance vary greatly across jurisdictions and sectors. A common feedback during the stakeholder engagement was the inconsistency across jurisdictions and a desire for increased harmonisation of governance processes.

Recommendation 4.1

Implement visible and effective governance to enable infrastructure delivery and ensure the focus is on the right outcomes.

0-5

Recommendation 4.1.1:

Consider making major infrastructure decisions transparent for the public by publishing business cases and supporting analysis for major decisions to provide public confidence that investment decisions are data-based and will deliver the desired outcomes for society.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies, Infrastructure Australia

0-5

Recommendation 4.1.2

Review existing governance arrangements with the goal to reduce variation in governance processes and requirements across jurisdictions and sectors.

Proposed lead: State and territory infrastructure bodies

Supported by: Infrastructure Australia, infrastructure owners and delivery agencies

0-5

Recommendation 4.1.3

Governance for infrastructure projects and programs should clearly define how 'value for money' is assessed and measured, recognising that impact on the required outcomes for customers, communities and the environment is integral to value for money, alongside economic value and efficiency.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies, Infrastructure Australia, state and territory treasuries

3.4.2 Infrastructure projects and programs should enable delivery by developing and fostering long-term, collaborative relationships throughout the ecosystem

Where do we want to get to?

- Long-term, collaborative relationships are embraced across the infrastructure industry and drive better outcomes for all parties.
- Supply chain relationships are characterised by long-term, collaborative relationships that span projects and programs to build understanding of capabilities, shared ways of working, and shared investment into better outcomes.
- Owners have an in-depth understanding of the capabilities of their supply chain and know when to integrate them into their delivery team to get the best outcomes.
- Collaborative behaviours are underpinned by commercial models that allow and incentivise collaboration, positive behaviours and knowledge sharing across all parties.
- Through regular engagement with the supply chain, both owners and industry have a clear view of the future skills, capability and capacity requirements. Owner strategies take into account the need to build industry resilience with future skills and capabilities to establish a sustainable level of capacity.

“ There is a desire for genuine collaboration across clients and partners across the whole ecosystem. ”

– Industry leader

There are significant benefits to be achieved for both owners and the ecosystem by shifting towards long-term, collaborative relationships with a focus on outcomes. Implementing collaborative models with longer-term relationships is supported by international best practice such as Project 13 and the *UK Construction Playbook*, and has been used in local exemplar projects such as Level Crossing Removal Program in Victoria.¹¹⁹

By investing in a long-term relationship, owners provide certainty for the supply chain and help to establish a more financially sustainable, healthier ecosystem. Certainty is important for all levels of the supply chain, as it allows organisations to invest into their business, skill development, processes, and research and development, helping to drive improved productivity and efficiency savings.

The most significant benefits of longer-term relationships are at the overall system level, including:

- reduced outturn cost through set or fixed rates for duration of the relationship
- a greater level of trust between parties, leading to reduced time and cost through faster implementation of projects
- established knowledge of processes, preferences, and needs, meaning the ecosystem needs less guidance and clients can be leaner

- clear expectations mean that quality is consistently high
- provides the ecosystem with a clear pipeline, which is particularly valuable for smaller members of the ecosystem
- provides the ecosystem with a broader view and deeper understanding of the owner's business and goals, driving better decisions and overall outcomes
- a clear expectation can be set that when work is delivered for less that these savings are invested – helping to feed the pipeline and benefit all ecosystem members.

A consistent theme throughout the stakeholder engagement was a desire for more collaborative relationships across the ecosystem.

Collaborative relationships drive better outcomes by:

- helping to encourage knowledge exchange between members of the ecosystem
- allowing owners to develop deeper understanding of the capability of the ecosystem to drive better value and outcomes by knowing how and when it is best to integrate them into the delivery team
- building trust and communication across the ecosystem.

Collaboration needs to be supported by effective governance and underpinned by commercial models that support and drive the desired shift in behaviours through incentivising the desired collaborative behaviour and knowledge sharing.

Current state

The majority of infrastructure projects and programs in Australia are procured on a project by project basis, with few examples of long-term, collaborative partnerships.

The Australian Constructors Association has noted that the construction sector in particular has long been treated as a 'zero-sum game', reflected in unbalanced risk allocation and penalty-laden commercial models.¹²⁰ However, stakeholders expressed a consistent desire for more collaborative relationships and to move away from the current adversarial culture.

The collaborative and long-term model of the Level Crossing Removal Program in Victoria was consistently held up as an exemplar in the industry, a program of works that uses a long-term alliance contract model and a strong focus on collaboration. The focus on collaboration and the certainty provided by the long-term agreement are core parts of the industry-leading outcomes the program has achieved.

The Construction Industry Leadership Forum has also been widely acknowledged as helping to build collaboration and drive some positive outcomes, noting it is currently focused on 'mega-projects' being delivered in NSW and Victoria.¹²¹

Recommendation 4.2

Long-term and collaborative relationships that span projects and programs are used across the infrastructure industry to drive better outcomes.

0-5

Recommendation 4.2.1

Infrastructure owners and delivery agencies should actively identify opportunities to develop long-term, collaborative supplier relationships, through identifying suppliers that align with the overarching outcomes owners are seeking to achieve.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

Recommendation 4.2.2

Infrastructure owners and delivery agencies embed collaborative approaches within all contract forms. If an alternative approach is chosen, state delivery agencies should clearly demonstrate why their alternative approach is more appropriate during assurance reviews.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: State and territory infrastructure bodies, Infrastructure Australia

0-5

Recommendation 4.2.3

Infrastructure owners and delivery agencies should lead the shift towards collaborative relationships and away from an adversarial culture by implementing models that incentivise collaboration between all parties.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

3.4.3 An early statement of intent should be the basis for successful, trust-based relationships

Where do we want to get to?

Successful, positive relationships are established from the outset of infrastructure programs.

- Relationships with partners and strategic suppliers are underpinned by a clear owner statement of intent, framing the relationship, setting a clear context and expectation on how the relationship will work. This statement of intent represents a clear commitment on behalf of the owner and provides that basis for aligned business-to-business (b2b) relationships. Capable owners don't assume an effective relationship will develop through application of the contract, they underpin it through a statement of intent that becomes a shared responsibility and an ongoing aspect of governance.
- At the outset of the relationship, all participating organisations use this framing to set out required principles and behaviours. The direct alignment between outcomes, goals and behaviours is maintained throughout the life of the relationship and is visible to everyone in the program.
- Owners set the tone for the relationship with aligned behaviours throughout an organisation and the constituent team with managers held to account for driving collaborative behaviours between all parties.
- Owners drive a progressive industry culture through a clear articulation of expected behaviours and leading by example throughout the life of programs.

“It's important to establish the right behaviours early, as they will only strengthen over time.”

– Industry leader

Intelligent owners don't assume that effective relationships are the inevitable result of the procurement process and the contract. They recognise the need for ongoing relationship management and the importance of creating the right environment to drive the best outcomes. They enable this by framing the relationship they require at the outset – setting the context, having clear aims, and setting out how the relationship will work, be managed, and issues will be resolved. While this is outside the contract, it is a statement of intent of the mutual expectations that will be part of the formal relationship framework and how this will be governed.

Clearly establishing the desired behaviours for a partnership at the outset is vital in framing the nature of the relationship and setting the project or program up for success. For a truly collaborative and trusting environment between parties, behaviours must be aligned throughout the owner or delivery agency and the partner teams. A statement of intent, co-developed by all parties, can capture the 'desired state' of acceptable principles and behaviours to be followed throughout the partnership.

For there to be a fundamental shift from the typical adversarial behaviours that come from the traditional transactional approach to a more collaborative relationship, there needs to be a recognition from all sides of the changes required. A statement of intent can provide an important step on this journey by identifying the desired behaviours and create buy-in to the change required.

A key insight from international industry leaders is the role that the commercial model plays in framing the relationship and the behaviours it drives in building trusting, collaborative, and high-performing teams. It is difficult to set up a trusting environment if the contract is based on penalties, has unbalanced risk allocation, and terms that try to 'take the shirt off the back' of the other parties.

It is important for this statement of intent is carried throughout the life of the project or program, with both new personnel required to co-sign the statement and regular refresher courses for existing team members to reinforce the desired behaviours.

Current state

Relationships are generally the result of the procurement process and the contract. There is generally little emphasis on developing effective business-to-business relationships to support the delivery of the proposed infrastructure solution. Relationships in the infrastructure sector are characterised as adversarial, combative, and lacking trust across the industry.¹²² This feedback was echoed throughout the stakeholder engagement process, however there was also a strong desire for this to be improved.

With the *NSW Government Action Plan: A ten point commitment to the construction sector*, the NSW Government advocates for the fostering of partnerships and collaboration between the private and public sectors to drive innovation and productivity in the NSW construction sector.¹²³ Industry advocacy bodies, such as the Australian Constructors Association, have also recommended a similar charter be implemented at an industry level.¹²⁴

Sydney Metro in NSW and Level Crossing Removal Program in Victoria are two notable examples of projects that clearly framed desired behaviours from the outset of the programs to drive an intended approach to working with their ecosystem partners.

Recommendation 4.3

Ensure statements of intent are developed at the outset of infrastructure projects and programs, outlining the desired behaviours for all parties.

0-5

Recommendation 4.3.1

Engender trust-based relationships at the outset of infrastructure projects and programs by developing a 'statement of intent' that frames all strategic relationships. This 'statement of intent' should include the aims, measures of success, how the relationship will operate and be managed and how issues will be resolved. This framing should initially provide a clear shared expectation and become part of ongoing governance.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

3.4.4 Owner strategies should engage with partners and suppliers early in the delivery process to maximise the influence they can have on delivering the best outcomes

Where do we want to get to?

Owners engage regularly with the market and have an in-depth understanding of the capabilities of the supplier ecosystem to drive better outcomes.

- Owners have an in-depth understanding of the capabilities of all parts of the supplier ecosystem developed through regular engagement with the market.
- The ecosystem strategy for all projects is based on a clear understanding of the influence and value supply system capabilities will have on the outcomes to be delivered. Commercial and engagement strategies are directly informed by this understanding of influence and value. Engagement no longer follows a hierarchical tiered approach of traditional construction.
- Active market engagement allows owners to develop an understanding of market capacity and market appetite, which is used to shape the model and timing of the project.

“Innovation lies in diversity of thinking.”

– Industry leader

Early engagement of the supply chain can bring benefits including reducing end-to-end timescales for the delivery of infrastructure projects through identifying and mitigating risk early and accessing industry experts' knowledge early in the project lifecycle.

A capable owner does not rush to engage all parts of the supply system – they understand where the influence and value is within the ecosystem and they develop informed engagement strategies that harness capability at the right stage in the process to drive the best outcomes. For owners to be able to apply this form of early engagement effectively, they need to have a detailed knowledge and understanding of the whole ecosystem.

Early and regular engagement with the supply chain allows owners to develop this detailed understanding of the capabilities of all levels of the supply chain. This also allows owners to understand inter-dependencies of any specialist members of the ecosystem.

Regular and active engagement with the ecosystem benefits both owners and suppliers – it helps to promote upcoming procurement

opportunities and test the market appetite, and also brings diverse views to the table by providing a forum to discuss delivery challenges and risks associated with the investment. To achieve the best outcomes, the goal is to move away from the current system of engaging with the market on a project-by-project basis to one where there is regular communication and engagement with the market to help with project development and partner selection.

Throughout this process, it is important for owners and delivery agencies to have an honest understanding of their own strengths, weaknesses, and capabilities. This, combined with an in-depth knowledge of the skills and capabilities of the supply chain, allows owners to select partners that best compliment their own skillset to achieve the best outcomes.

Stakeholders during the engagement period noted the importance of getting different perspectives involved early in solution development and the value this provides.

Current state

There are two core elements of engaging with the market:

- information sharing – such as sharing the pipeline and informing the market about upcoming project opportunities
- having a two-way dialogue with the market, incorporating feedback into the project model.

Across Australia, the former is done well, with positive feedback from across jurisdictions during stakeholder engagement. The market is typically provided with plenty of notice and details of upcoming major projects and programs.

However, having a two-way dialogue with between government and the market and developing projects in a collaborative way is generally not done as well across Australia. This may have contributed to a number of single bidders on major infrastructure projects in recent years.

There are promising signs of improvement in this area, however. South Australia was praised during stakeholder consultations as typically doing a good job of engaging with the market and listening to feedback, and iterating project models based on this feedback. The *NSW Government Action Plan: A ten point commitment to the construction sector* outlines a commitment to procuring in a more collaborative way.¹²⁵

The Construction Industry Leadership Forum was also praised during the stakeholder engagement as providing a forum for industry to provide feedback on projects and has improved the two-way dialogue between industry and government.

Recommendation 4.4

Owners should engage regularly with the market to develop an understanding of the capabilities within the ecosystem to drive better outcomes.

0-5

Recommendation 4.4.1

Engage regularly with all parts of the ecosystem in order to understand capabilities, perspectives and supplier requirements.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

Recommendation 4.4.2

This understanding of ecosystem capability should be used to inform procurement and engagement strategies that leverage partners capability when it can add most value in the development of solutions. This early engagement should, where appropriate, include the engagement of strategic suppliers in the strategic planning phases of project development.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

3.4.5 Infrastructure is delivered through integrated high performing teams

Where do we want to get to?

Integrated and collaborative teams are used to deliver successful infrastructure projects and programs more efficiently and effectively.

- The industry operates on the clear recognition that successful projects require integrated and collaborative teams, where the interfaces and hand-offs of traditional delivery are superseded by 'enterprise' organisations that bring together the right organisations and right people.
- Time is invested by owners and managers at the outset and throughout the life of infrastructure delivery programs to integrate people from different organisations to develop a single high-performing team with shared behaviour, processes, and practices.
- A collaborative culture that is supported by a partnership model with integrated teams and processes and an adoption of a one-team 'win together, fail together' approach.
- Integrated teams, systems and tools support the creation of an environment which encourages the aligned behaviours necessary to deliver the outcomes. This includes access to shared data and common IT systems to build trust between all parties.
- Workforce training and development is embedded throughout the value chain.

“Partners put people in, but then they are part of the team – everyone works as one.”

– Industry leader

High-performing teams form the foundation of successful infrastructure delivery. Industry best practice is showing the importance of establishing integrated teams to drive collaboration and achieve better outcomes. This is the model adopted by exemplar projects such as Level Crossing Removal Program and Sydney Water Partnering for Success (P4S) Program.

The traditional transactional delivery model tends to place barriers between organisations, making collaboration difficult through both the commercial model and logistical constraints (such as using different IT systems and working in separate offices).

Integrated teams help to address this, encouraging collaboration and helping to soften the boundaries between the parties. Integrating their capabilities and functions produces better outcomes for all, as well as largely eliminating duplication of effort.¹²⁶

The most effective teams act as networks of collaborative relationships, encouraging the sharing of knowledge, and complimenting the capabilities of each party to drive better outcomes. These effective delivery enterprises are characterised across three key integrated streams: information, organisation and process (Table 3).¹²⁷



Table 3: An effective delivery enterprise

Stream	Description
Information	Integrated delivery teams should work within common information structure and processes. The aim should be to integrate information across the delivery process, with one version of the truth across all parts of the team. The outcomes required and the requirements of operation and maintenance provide the focus for the information structure, with clear information processes through delivery. This focus on outcomes and supporting information processes provides the 'golden loop' that enables a more integrated approach to the delivery of infrastructure.
Organisation	The integrated enterprise is aligned on the delivery of required outcomes. This enables early engagement of suppliers, partners, and enables Modern Methods of Construction. Early engagement, and engaging partners and suppliers based on ability to deliver outcomes allows for greater leverage of supplier / partner capabilities in decision-making and continuous improvement. The enterprise is good at creating and enabling effective integrated teams, minimising the inefficiencies seen in the traditional transactional approach to delivery. This requires a capable owner that owns the project and can set clear direction and objectives. This change enables innovation, research and development, as suppliers and partners benefit from and contribute to continuous learning within the current and future integrated enterprise(s).
Process integration	Integrate key delivery process such as risk management, project controls, procurement and contract management, governance, health and safety. When solutions have been developed, integrated teams should collaboratively design the process for assembly. Processes for delivery cannot be developed effectively if partially completed designs are passed to contractors who have yet to procure and develop their delivery teams. These high performing teams also drive a high-performance risk, health and safety culture that is standard across the enterprise and that ultimately improves employee health and productivity.

Owners need to lead the development of collaborative, high-performing teams to get the most out of the integrated approach. This includes setting the team culture and practices, executive sponsorship by all parties, developing joint-partnership principles, and ensuring the systems are appropriate to support the collaboration between parties from different parent organisations to drive a one-team 'win-together, fail-together' approach.

The 'hygiene aspects' are an often-overlooked part of building an integrated and collaborative team but play an important role in supporting a high-performing integrated team.¹²⁸ Collaborative contracts may be in place and teams set up in an integrated way, but this also needs to be underpinned by organisation 'basics' to fully embed collaborative behaviour. These measures include co-location of employees, common information technology and communication systems, and shared common reporting to aid transparency to enable free flow of information and build trust between all parties.

Current state

Across Australia, there is a strong trend of co-located teams for infrastructure projects. However, co-located teams are not the same as ‘integrated’ teams – personnel from different organisations may all be sitting in the same office space, but that does not mean that they share a one team ‘win-together, fail-together’ approach. The use of co-located teams is a good first step on this journey, but more can be done.

Integrated teams have driven great outcomes on a number of large infrastructure projects across Australia, including the Pacific Highway Upgrade between Woolgoolga and Ballina, Level Crossing Removal Program, and Sydney Water Partnering for Success (P4S) Program.¹²⁹ These integrated teams have minimised duplication of effort between the client and contractor and drive cost and time savings compared to more traditional models. The Partnering for Success (P4S) Program is a prime example of an Australian model that embodies enterprise delivery (see Box 22).

Box 22: Sydney Water Partnering for Success integrated enterprise approach

Case study: Sydney Water Partnering for Success (P4S) – integrated enterprise approach

P4S came into operation in 2020 based on a 10-year agreement to create three regional delivery consortia for the full design, construction, maintenance and operation lifecycle of Sydney Water’s \$1.3 billion annual investment program. Sydney Water is a member of each consortium and all three of them are supported by consultancy Arup and Aurecon acting as strategic planning partners. The consortia also draw on a common pool of 588 specialist suppliers.

Integration is viewed as a key capability across the enterprise and is seen as an enabler to the significant cultural shift from traditional in-series delivery. Partners are incentivised to collaborate across an integrated program to solve process and production problems that enable more effective delivery via much higher levels of replication, standardisation and continuous improvement.

Sydney Water has recognised the need to spend significant time (upwards of five years) communicating with the supply chain in adopting this enterprise approach. This included investment in its own capability in order to become a capable owner, with a particular focus on leadership, commercial expertise and project management.

Source: Institute of Civil Engineers¹³⁰



The Partnering for Success (P4S) Program model is aligned to the principles championed by the Institute of Civil Engineer's (ICE) Project 13 approach.¹³¹ This enterprise approach, developed out of research of proven exemplar projects, has led to increased levels of replication, standardisation and continuous improvement, and ultimately productivity in delivery.

However, project delivery in Australia is still predominantly characterised by delivery in traditional project teams. The individual participants of these teams are incentivised through their contractual relationships to control their own processes and

guard their own information. Sub-contractors have little to gain from working together, even if it results in better outcomes for the owners, and they have much to lose from sharing information that could be used against them if they fail to deliver on their contractual commitments.

With the current boom of infrastructure projects across Australia, there is a growing skill constraint across the industry. An increased use of integrated teams could help to alleviate some of this pressure by reducing the duplication of effort across the ecosystem.

Recommendation 4.5

Integrated and collaborative teams are used to deliver infrastructure projects and programs more efficiently and effectively.

0-5

Recommendation 4.5.1

Integrated and collaborative teams should be used to deliver infrastructure projects and programs. These teams should establish processes and capabilities that integrate individuals drawn from different organisations together in high performing delivery teams, recognising this is an essential part of developing effective delivery enterprises.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

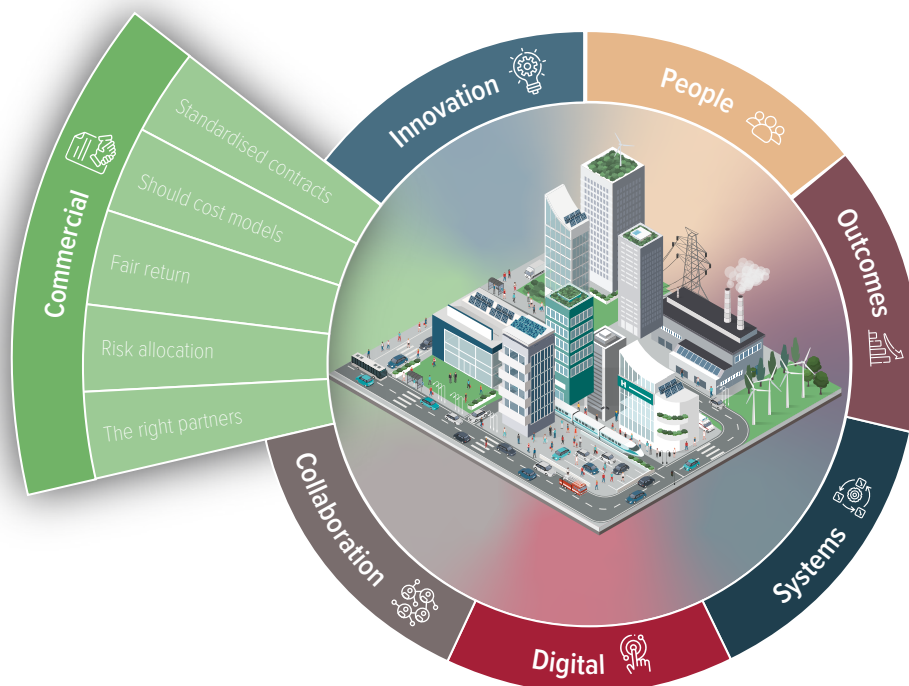
Recommendation 4.5.2

Infrastructure owners and delivery agencies should ensure co-located teams are enabled with the right systems and tools to support an integrated, high-performing team environment, including shared access to data and common IT systems.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

3.5 Commercial optimisation



3.5 Commercial optimisation

Commercial alignment and optimisation drives industry financial sustainability and enables innovation.

The predominant approach to contracting in Australia generally defaults to transferring risks to the proponent. Scope and price are used to run competitive processes, selecting proponents based on estimates founded on limited information and developed under constrained bidding timelines. While standardised contracts and approaches exist, these are usually specific to each jurisdiction and are amended for each transaction.

There is an opportunity to leverage existing good practice and build on this with international best practice in commercial alignment and optimisation. In the desired state: outcomes and Should Cost Models are understood throughout the ecosystem

and used to assess performance; relationships are framed to be mutually beneficial and fair; risks are allocated transparently and on a capability basis; innovation is incentivised and long-term relationships are fostered through good collaboration; and national standardised contracts and processes are effective and used by default with minimal amendments.

This section supports the implementation of Recommendations in the *2021 Australian Infrastructure Plan*, including Recommendation 3.2b: Reduce uncertainty for industry and improve value for money by improving engagement with industry and the supply chain.

3.5.1 Delivery model selection and procurement should place greater emphasis on selecting the right partners to deliver the required outcomes

Where do we want to get to?

Outcomes and value are the focus for delivery models and procurement, moving away from heavily weighted price criteria to enable more efficient relationships, uplift decision-making maturity and better deliver against desired outcomes.

- Outcomes and value provide the focus for procurement. Clients will consider the outcomes they are trying to achieve and how that informs a value framework for procurement. Time, cost, and quality are recognised as delivery metrics, not as investment outcomes.
- Procurement focuses on selection of the right people and organisations, with the right capability to deliver the required outcomes. Selection includes technical and cultural capabilities, alignment with required behaviours, and performance against 'should cost' metrics.
- Value is informed using Should Cost Models to provide a starting point for affordability or incentive models where partner returns are related to value, not to volume.
- Procurement (including bidding timelines and costs) and commercial arrangements are reasonable and promote collaboration and ecosystem integration.
- Procurement processes consider how to effectively work with suppliers throughout the lifecycle of projects, underpinned by a robust, multistage and interactive supplier selection process. Owners and suppliers shift to longer term relationships, which will enable continuous improvement in safety, time, cost and quality.

“ Procurement needs to be based on collaborative models of contracting that seek to put the outcome and benefit to society as most important, and allows the supply chain to make good profits where good outcomes are achieved. ”

– Industry leader

A shared focus on outcomes unlocks innovation and drives continuous improvement. Procurement processes are more equitable where an outcomes-focus ensures that appropriate time and resources are spent allocating risk and choosing delivery models and contract options. Long term relationships are built and are more effective, as up-front selection processes prefer proponents with behaviours and culture that are aligned to project and enterprise outcomes.¹³²

Articulating value in procurement will allow project and program teams to understand how their solutions will perform as part of the wider infrastructure

ecosystem. This includes physical and non-physical (i.e. data) interdependencies, as well as Governments' social, economic and environmental priorities.

The use of Should Cost Models ensures cost and schedule related performance are baselined against realistic goals.¹³³

This outcome focus also enables increased levels of standardisation, reducing the need for unnecessary bespoke solutions and supporting the move to adopting platform approaches.¹³⁴

Current state

Australian infrastructure construction procurement has, in some cases, begun the transition from measuring value predominantly through 'lowest price' to giving at least equal weighting to achieving project outcomes.¹³⁵

For example, in 2019 the Queensland Department of Housing and Public Works released a guide to *Using an outcome-based procurement approach*.¹³⁶ The guide outlines benefits of an outcomes based approach (e.g. innovation), risks involved and situations where the approach is suitable.

However, the predominant approach to procurement in Australia remains price focused.¹³⁷ Scope and price are used to run competitive processes, selecting proponents based on estimates founded on limited information. Specifications are typically technically or functionally based, restricting opportunity for external parties to innovate the requirement. Generally, government direction for the adoption of outcomes-based procurement is limited, which inhibits both motivation for jurisdictions and private sector confidence to adopt these approaches.

“There is heavy reliance in delivery agencies on prescriptive specifications, for example, the use of performance specifications that don't accept alternative designs – we can't support and achieve innovation under such arrangements.”

– Industry leader

This price focus, particularly in rushed tendering processes, is a contributor to the regular overrun of outturn versus tendered cost in Australia (estimated by Grattan Institute to be more than 60% of road and rail projects over \$20 million in cost between 2001–20).¹³⁸

Constrained bidding timelines, high bidding costs and poor government capacity and capability were recognised by industry and government during engagements as barriers to collaboration and better articulation of outcomes.¹³⁹ These barriers also limit competition, driving poor behaviours in price estimating.

As stated in the *2019 Audit*:¹⁴⁰

“This inhibits the ability for new market entrants to compile compelling offers and increases risks for both successful proponents and client agencies.”

Picking the right partner to deliver required outcomes takes time – further restricting or streamlining the bidding process can have negative consequences to the selection of an appropriate partner. Australia's culture of developing bespoke solutions to problems will continue to drive the need to run a new selection process for each solution.

“You need a mission requirement that everyone can agree to. This requires technical authorities (technically competent people) that know how to say 'yes' to a good idea, rather than just defaulting to a 'no' where an idea pushes the boundaries of existing constraints.”

– Industry leader, commenting on outcomes-based procurement and barriers to achieving this

Overall procurement and delivery timelines could be reduced by considering programmatic approaches, where long term partners are selected (reducing the number of bespoke procurements) to deliver required outcomes of a repeatable or standardised program of work.

Recommendation 5.1

Enable more efficient delivery of value and outcomes, and uplift decision-making maturity, by focusing delivery model selection and procurement on choosing the right partners to deliver required outcomes.

0-5

Recommendation 5.1.1

Improve the delivery of desired outcomes by framing procurement to focus on outcomes and value (moving away from heavily weighted price criteria), with the long-term view of all procurements being outcome-focused in line with the principles set out in this roadmap. This necessitates establishing outcomes at the enterprise level and cascading these through procurement decision-making.

Proposed lead: State and territory treasuries

Supported by: Infrastructure owners and delivery agencies, and the Australasian Procurement and Construction Council

0-5

Recommendation 5.1.2

Foster more productive, longer-term relationships and improve alignment to desired outcomes by ensuring procurement criteria place at least equal weighting on supplier capability and behaviour. These criteria should be aligned with the desired outcomes.

Proposed lead: State and territory treasuries

Supported by: Infrastructure owners and delivery agencies, and the Australasian Procurement and Construction Council

Recommendation 5.1.3

Support the transition to outcomes-based procurement by building internal capability and capacity of procurement professionals to effectively deliver outcomes-based procurement. Ensure training and guidance incorporates lessons learnt and feedback from industry and other jurisdictions.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Australasian Procurement and Construction Council, and relevant industry associations

5-10

Recommendation 5.1.4

Support the transition to a more financially sustainable, productive and innovative industry by co-developing procurement best practice guidance. This should include, at a minimum, the principles of:

- outcomes-based procurement
- transparent, collaborative, and equitable allocation of risk
- fair return for partner and supplier contribution
- transition to Should Cost Models
- contract and process standardisation

Proposed lead: Australasian Procurement and Construction Council

Supported by: Infrastructure Australia, state and territory treasuries, and relevant industry associations

3.5.2 Supplier relationships should be founded on the identification and transparent allocation of risk to the party (or parties) best placed to manage them

Where do we want to get to?

Risks are allocated collaboratively and appropriately, enabling collaboration and more productive delivery.

- Visible risk processes allocate – not transfer – risk, with allocation based on the capability required to manage identified risks. Collaboratively ensuring that risks are owned or jointly owned by the party or parties best able to manage and bear them, and understanding how they intend to handle them, is key to delivering value and successful outcomes.
- Owners apply appropriate focus during commercial strategy development to test risk treatment approaches with the market and explore the balance of risk between the supplier, the ecosystem they will rely on, and the owner.
- Risk allocation should be supported by good, collaborative risk management aligned to the project and program strategic outcomes set out in the Project Scorecard. Projects compile a risk allocation matrix that considers which organisations in the supply chain are best placed to manage and bear each risk (i.e. whether it is a supplier, partner, owner or joint risk), the extent to which they can assume responsibility for each risk, or where joint risk ownership is appropriate (risk sharing).
- Through project delivery, aligned, common risk processes provide ongoing visibility of risk allocation, mitigation and status.

“ Procurement needs to be based on collaboration, managing and mitigating risk appropriately rather than pushing [risk] down the supply chain. ”

– Industry leader

Ensuring risk is allocated to the party best able to manage or bear that risk is key to successfully delivering value and outcomes. This needs to be underpinned by best practice risk management processes that are aligned to desired outcomes. Poor risk allocation leads to risk treatment and management placed on parties that are ineffective at or unable to manage that risk. This drives poor behaviour in attempting to mitigate risk, and causes owners to eventually bear the cost of poor risk allocation. Allocation differs from risk transfer in that allocation implies a shared or collaborative approach, whereas risk transfer attempts to mitigate risk for one party (the client) by requiring the other party (supplier or contractor) to estimate and price-in these transferred risks.¹⁴¹

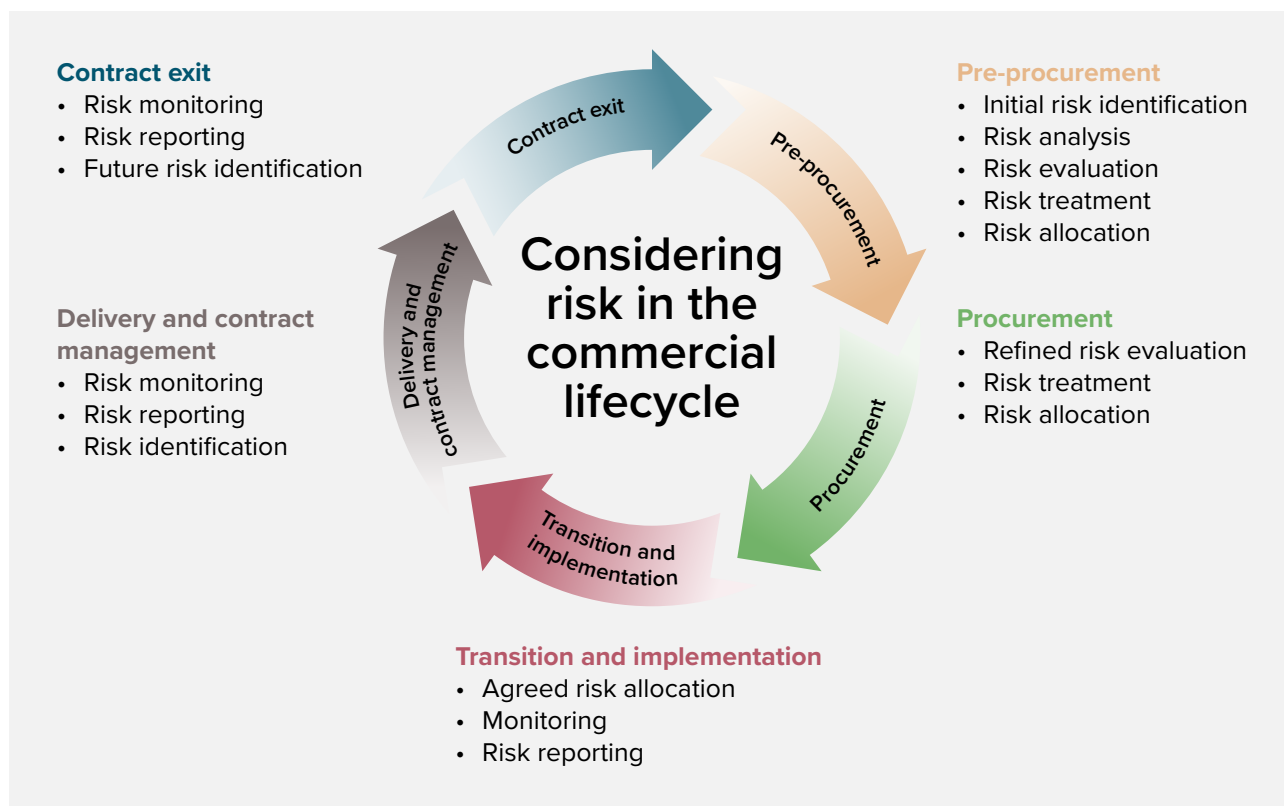
Inappropriate allocation of risk is a key blocker to competition in construction delivery procurement. Risk allocation should consider both labour capability and capacity, as well as the financial capacity to manage and absorb risk. Addressing this early and transparently with suppliers and contractors will allow clients to leverage industry expertise in informing the parties best suited to each risk.¹⁴² Not only does this foster a productive relationship long term, it also

increases the confidence that industry will make profit, and ultimately clients will achieve their desired outcomes (within proposed cost and schedule).

These benefits are also enabled by engaging the market throughout the development of commercial strategy. Clients can explore different risk approaches, and scenario test risk allocation across owners, contractors and suppliers, thus fostering and encouraging innovative solutions.

Risk management should not stop at the end of procurement. Continuous engagement throughout the life of projects (through the good risk management principles mentioned above) enables proactive response to any material change and maintains the risk allocation status quo. When risks materialise as issues through delivery, integrated teams should focus on addressing the issue in line with enterprise outcomes rather than attempting to lay blame (and therefore cost). Again, these benefits are enabled through the initial transparent allocation of risk at contract outset.

Figure 14: Risks should be considered early and often in the project lifecycle.



Source: Construction Playbook.¹⁴³

Current state

The default approach in Australian delivery procurement is to transfer risk to the private sector, in an attempt to increase certainty in outturn cost for the Government. This is due to focus on price, rather than outcomes, and an expectation that the private sector will price risk up-front with limited information. This is a poor approach to achieving outcomes and often leads to increased cost to the government (the very risk attempting to be mitigated in the first place).¹⁴⁴ Industry and governments stakeholders consulted agreed that risk allocation is a key challenge for the infrastructure sector.

“Government are extremely risk averse. This leads to procurement models that are imbalanced, making contractors hold most of the risk.”

– State Treasury

Two of the first ten commitments by the NSW Government to the construction sector in 2018 were ‘Procure and manage projects in a more collaborative way’ and ‘Adopt partnership-based approaches to risk allocation’, indicating a clear recognition of these barriers in the NSW procurement market and a positive step toward addressing them.¹⁴⁵

Constrained bidding timelines exacerbate the issue, with public pressure to deliver on political announcements (that are often too early) and reduce procurement timeframes are a constant tension on the selection process.¹⁴⁶ These time pressures and lack of collaboration lead to inadequate understanding of risk (or risks being missed altogether), reducing the likelihood of good risk allocation and ultimately poor outcomes. The ‘rush to fail’ phenomenon was quoted regularly during stakeholder engagements.

This same issue is highlighted in the *2019 Audit*.¹⁴⁷

“ This results in higher levels of risk and uncertainty being priced into tenders. These costs are ultimately carried by the users through poor quality services or additional costs, or met through government reimbursements. ”

Adopting delivery and commercial models that consider a more equitable approach to risk provides greater certainty that desired outcomes (including outturn cost and on-time completion) will be achieved.

Mistrust between delivery agencies and contractors stifles early involvement and collaboration opportunities. Commercial strategy and risk allocation often happens in isolation. Bringing in expertise early could ensure that robust assessment is applied to choosing a model that best mitigates risks and achieves outcomes. Bespoke solutions also drive transactional or ‘linear’ commercial arrangements, pushing risk further down to sub-contractors, who have limited integration into the delivery team and are less informed to manage these risks effectively.¹⁴⁸

“ A lot of these litigious situations are a result of procurement mechanisms. [We need] fairer risk sharing, and more collaboration. ”

– State Government

Good outcomes have been achieved in the Australian market where early collaboration, and a more open and transparent approach to risk has been adopted. For example, the Level Crossing Removal Program divided mega-projects into smaller, more manageable scopes of work which enabled increased front-end engineering and assessment of risk prior to delivery procurement.¹⁴⁹ Newcastle Light Rail’s 18-week target cost development phase engendered collaboration and leveraged private sector insight in understanding target cost.¹⁵⁰ The Snowy Hydro 2.0 project used a geotechnical baseline report to transparently allocate complex geotechnical risk – see Box 23.

Box 23: Snowy Hydro 2.0 risk allocation

Case study: Allocation of geotechnical risk in the Snowy Hydro 2.0 (Snowy 2.0) project

The Snowy 2.0 project is located within a complex geological and hydrogeological area, presenting significant geotechnical uncertainties for construction. To address this issue, Snowy 2.0 adopted a geotechnical baseline report (GBR) approach, as proposed under International Federation of Consulting Engineers (FIDIC) Emerald book standardised contract form.

The Emerald book and GBR are based on the premise that risks must be transparently and equitably allocated to the party that is best positioned to manage them. The GBR defines geotechnical baselines agreed by both parties, and acts as a mechanism to adjust risk throughout construction as both parties gain greater clarity of geotechnical conditions.

This approach presents an equitable approach to delivery of highly complex and uncertain infrastructure solutions, ultimately enabling a more productive delivery environment and better delivery of outcomes. While the use of a GBR is not an end in itself (for example, good risk management throughout delivery is a key aspect of ensuring this approach is effective), collaborative approaches to risk allocation present an enormous opportunity for the Australian construction sector.

Source: Gomes et al¹⁵¹

Recommendation 5.2

Risks should be allocated (not transferred) to the party or parties best placed to manage them, enabling collaboration and more productive delivery.

0-5

Recommendation 5.2.1

Leverage industry expertise to uplift risk quantification and allocation maturity through increased early supply chain engagement during the procurement strategy and pre-selection phases. This should include all relevant tiers of suppliers.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** Australasian Procurement and Construction Council, and relevant industry associations*

0-5

Recommendation 5.2.2

Improve transparency and collaboration by developing a risk allocation matrix that contemplates which suppliers are best placed to bear (and manage) each risk in the ecosystem. This should be developed and shared with prospective bidders, iterated proactively and collaboratively through the selection process, and transparently communicated throughout the life of the contract.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** Australasian Procurement and Construction Council, and relevant industry associations*

5-10

Recommendation 5.2.3

Support the long-term transition to more mature risk allocation and supplier engagement by adopting collaborative and transparent risk allocation principles as standard practice. Deviation from this approach should require justification during business case development and in procurement strategy documentation.

***Proposed lead:** State treasuries*

***Supported by:** Australasian Procurement and Construction Council, infrastructure owners and delivery agencies*

3.5.3 Contracts and commercial models should recognise the requirement for a fair return for partner and supplier contribution

Where do we want to get to?

Relationships are founded on the fundamental principle that contracts should be profitable and mutually beneficial, supporting a more financially sustainable and innovative industry.

- Contracting arrangements recognise the fundamental principle that contracts should be profitable and be mutually beneficial. Fair returns and expectations need to be reasonable for suppliers to remain interested and for the market to be financially sustainable.
- Long term, sustainable relationships are built off the back of these equitable arrangements. Innovation in technology and capability is enabled through trust and profitability, which will deliver safer, quicker and more environmentally sustainable infrastructure solutions.
- Payment terms are aligned to the Security of Payments Act and linked to the delivery of agreed outcomes, which are consistent across the delivery enterprise. Costing will be fit for purpose, relevant to the risk associated with delivery (and the party owning that risk).

“ We need to accept and celebrate an industry where organisations can make good profits by providing good outcomes – our procurement approach should not seek to minimise financial success for the supply chain; but to maximise it. ”

– Industry leader

Ineffective payment terms, terms and conditions, and low pricing of tenders drive a bias towards poor quality and can ultimately lead to increased probability of contract failure. This short-term thinking reduces value and can affect the financial sustainability of markets, to the point where some suppliers may exit the market altogether.¹⁵²

Longer term thinking, that considers a transaction should be mutually beneficial to both parties, will ultimately lead to increases in quality, reduction in contract failures and maintain healthy market competition. Applying the fundamental principle of ‘contracts should be profitable’ fosters constructive relationships between industry and owners.

Profitable and mutually beneficial transactions enable innovation and trust – suppliers have the confidence to invest in research and development, owners and delivery agencies benefit from improvements in productivity, and the community ultimately benefits from the delivery of desired outcomes.

“ [we] like working with collaborative clients and collaborative contracting models as they provide the leeway to try new things in a safe and supportive environment – [we] aren’t going to be punished if something doesn’t work out. ”

– Industry leader

Linking payment to the delivery of outcomes at both the organisation and project level gives clear line of sight to clients on supplier performance. These mechanisms incentivise behaviour towards achieving the mutually agreed outcomes.¹⁵³

Current state

Risk and reward in infrastructure procurement in Australia is unbalanced.¹⁵⁴ Despite record levels of investment in recent years, industry stakeholders described a range of factors that contributed to a low or declining profit margin, including (but not limited to):

- a thin Tier 1 contractor market to support the range of mega projects (>\$500 million) currently in delivery or planned in the near term, where in some cases aggressively low pricing has been used to win work.¹⁵⁵ This approach can drive out competition, further reducing the financial sustainability of the market
- erosion of tendered profit margin and higher likelihood of risk events occurring due to inadequate up-front risk assessment and inequitable allocation of risk¹⁵⁶
- a price-based approach to tendering focusses contract option and delivery model on achieving price-based outcomes (not necessarily best for project outcomes)¹⁵⁷
- procurement evaluation criteria that is too focused on direct experience in the state or sector, which can be an inhibitor to innovation and attracting new players to the market. This issue is exacerbated by constrained procurement timelines.¹⁵⁸

In recognition of these issues, advocacy for good practice in equitable returns was observed from a majority of industry and government stakeholders.

Price-based tendering also means payment mechanisms are attached to delivery of milestones, which are generally attributed to upfront estimates with limited (or too late) industry involvement. Payment terms could instead be linked to achieving desired outcomes, which drives contractors to innovate and collaborate in solutions development.¹⁵⁹

“ There is a ‘screw them down’ type culture. We should be driving genuine fair value, fair price. ”

– State government

Financial sustainability at the sub-contractor tier is impacted when payment cashflow is not transparently or accurately distributed. The Australian *Security of Payments Act* is in place aiming to protect against this, however stakeholders noted that competitive tension and inappropriate risk allocation is in some cases enabling poor behaviour in honouring timely payment.¹⁶⁰ This means the ecosystem relies on negative cashflows and works ‘out of pocket’ which ultimately raises prices to cover associated risk.



Recommendation 5.3

Contracting arrangements and commercial models should be founded on the principle of fair return, supporting a more financially sustainable and innovative industry.

0-5

Recommendation 5.3.1

Support the financial sustainability of the infrastructure industry by reviewing payment terms and risk allocation against a collective aspiration of fair return, and the fundamental principle that contracts should be profitable and expectations reasonable.

Proposed lead: State and territory treasuries

Supported by: Infrastructure owners and delivery agencies

0-5

Recommendation 5.3.2

Enable a more equitable assessment of performance by ensuring supplier selection and performance criteria is linked (where data is available) to 'should cost' expectations. Where outcomes-based procurement has been used, payment mechanisms should be linked to performance against achieving these outcomes.

Proposed lead: State and territory treasuries

Supported by: Infrastructure owners and delivery agencies

0-5

Recommendation 5.3.3

Support lower-tier suppliers in receiving a transparent and fair return by extending the principles of fair return to all tiers of suppliers in the ecosystem, in line with the Security of Payments Act.

Proposed lead: State and territory treasuries

Supported by: Infrastructure owners and delivery agencies, and relevant industry associations

3.5.4 Capable owners should inform value through Should Cost Models, with partners incentivised to deliver value relative to these established baselines

Where do we want to get to?

Should Cost Models provide realistic baselines, improving decision-making maturity and assessment of performance against delivery of outcomes.

- Capable owners should use intelligence from previous program and project performance, combined with wider benchmark data, to develop baselines that provide a more realistic definition of value and the starting point for any procurement process.
- The use of benchmarking data will drive consistency and the overall robustness of commercial baselines. Benchmarking can generate the inputs required for Should Cost Models, provide the building blocks for whole of life cost evaluation, provide a comparator for project and program performance and where possible provide the commercial thresholds against which partners are incentivised.
- Projects and programs undertake benchmarking of key project deliverables including cost, schedule, emissions and agreed outcomes at each stage of business case development – this enables good decision-making in procurement through a firm understanding of value and outperformance targets.
- Capable owners engage early with capable suppliers and advisors to leverage expertise in ensuring baselines are appropriate, realistic and demonstrate value.

“ The procurement process of accepting the lowest price needs to stop. Quality is abandoned as a result of producing something for the cheapest price and shortest timeframe. ”

– Industry leader

When delivering complex engineering projects, traditional competition against delivering a pre-defined scope should not be seen as the most effective method of defining value. The low correlation between tendered cost and outturn cost highlights the difficulty in using traditional competition as a measure of value or efficiency.¹⁶¹ The in-series approach to procurement that requires scope to be defined to a sufficient level to enable price-based tendering can preclude early engagement with suppliers and be a real barrier to innovation. Should Cost Models instead enable owners to focus on outcomes-based selection criteria and delivery performance – creating alternative forms of competitive tension by, for example, competing against the most effective (or innovative) solution to deliver required outcomes.

“ The cheapest price seldom delivers the best outcome. ”

– Industry leader

A firm understanding of cost and performance is critical to good decision-making and successful project and program delivery. Inaccurate estimates may lead

to unrealistic expectations, which can derail a project's chances of success. Informed estimates drive delivery of desired outcomes closer to their actual value, and performance measured against this is closer to a true estimate of over or under-performance. This gives owners higher confidence in the ongoing performance of delivery against baseline and gives clear line of sight of expectations to the delivery team.¹⁶²

Adopting a Should Cost Model also enables continuous improvement in risk quantification and allocation. It drives an increased understanding of the whole of life costs and risks associated with different options and scenarios. This differs from the current price-based model in that much of the performance intellectual property is kept by the supply base even though it has been paid for by the client. Adopting a price-based approach does not easily enable an improvement culture to develop.

Should Cost Models will inform engagement with bidders and the appropriate commercial strategy including methods to incentivise the supply chain to focus on whole of life cost. Suppliers are enabled to innovate and value-engineer solutions, while still maintaining a focus on the overall outcome being achieved (and their performance against the outcome baseline).¹⁶³

Current state

Stakeholders agreed that generally, procurement in Australia is price-based. This places emphasis on prices that are based on partially completed designs and actual construction activity is therefore based on high level programs with activities defined and organised on an ongoing basis.¹⁶⁴

During stakeholder engagement, participants suggested Australia is viewed internationally as a high-cost investment geography – attributed to a range of factors including risk aversion, limited benchmarking and declining profit margins.

“Traditionally overseas players view Australia as risk averse commercially... not many people are making money, despite the boom. It is an undesirable market.”

– State delivery agency

Early contractor involvement is limited, meaning industry expertise is only leveraged late in the decision-making process. Bidding timelines imposed by clients further diminish the amount of time given to industry to effectively assess risks and associated costs, and (where prescriptive specifications allow) provide innovative solutions.¹⁶⁵

Australia has limited benchmarking for infrastructure delivery. This creates limited opportunities for owners to become informed on what delivery ‘should cost’. This results in a continuous loop of proponents selected on unrealistic prices and lessons not being adequately captured to inform future projects.

Recommendation 5.4

Owners should adopt Should Cost Models to improve decision-making maturity, transparency, and assessment of performance against delivery of outcomes and value.

0-5

Recommendation 5.4.1

Uplift decision-making maturity and assessment of performance by drawing upon available benchmarking data to develop and use Should Cost Models. Where insufficient data is available to inform an adequate Should Cost Model, international benchmarks, local proxies, and early supplier engagement should be used to inform cost as accurately and transparently as possible.

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure owners and delivery agencies, and relevant industry associations

0-5

Recommendation 5.4.2

Support the transition to greater adoption of Should Cost Models by building internal capability such that owners and delivery agencies are able to develop, maintain, and apply Should Cost Models. Ensure any training and guidance incorporates lessons learnt and feedback from industry and other jurisdictions.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Department of Infrastructure, Transport, Regional Development and Communication, and the Australian Institute of Quantity Surveyors

3.5.5 Infrastructure should adopt a standardised contract approach for all aspects of solutions delivery, enabling more consistent industry expectation and response

Where do we want to get to?

The adoption of standardised contracts and approaches improves procurement efficiency, reduces risk and fosters continuous improvement.

- Owners agree a standard contract form at the enterprise level, including a suite of options for both construction and professional services. During delivery strategy development, project teams draw from the enterprise level agreement to determine the most appropriate contract option to achieve desired outcomes.
- Owners will have the capability and capacity to effectively execute and manage these standard approaches, including differentiating between when a bespoke solution is or is not required. Owners and contractors will benefit from continuous improvements and lessons learnt across the public sector. For longer term arrangements, owners will appropriately use clear contractual obligations and break points.
- Early involvement of contractor entities will facilitate informed decision-making on the most effective contract option choice. Both owners and contractor entities will be capable enough to identify when a bespoke solution is required – be it an adaptation of an existing standard approach or a truly bespoke solution – and will have appropriate processes and governance in place to manage.

“ A standardised approach [to contracts] presents an opportunity to divert effort and money away from disputes and towards better delivery of outcomes. ”

– Industry leader

Contract standardisation has myriad benefits, including:¹⁶⁶

- reducing bidding timelines and costs by streamlining contract review and focussing on (if any) variations to the standard form
- enabling continuous improvement and cross-sector learnings as experience is gained using the standard approaches, and opportunities / risks are addressed in future projects
- simplifying training requirements for contract management and transaction resources, and reduced resource intensity overall due to the streamlined bidding process
- improving risk allocation as both parties are more informed in the mechanisms of the contract and how best to use these to achieve desired outcomes

- supporting capability development of client-side staff and the possibility of enabling people movement and development between asset classes and jurisdictions to enable capacity growth
- enabling the deployment of standardised systems that can be deployed across large agencies, supporting the collation of data and information on contracts.

Applying a standardised approach also allows more time to be focused on early engagement with contractors in commercial strategy, enabling robust assessment of risk allocation. Capable owners and suppliers will make informed decisions on whether existing contract options or a bespoke solution is required for the project.

Current state

As reported throughout this roadmap, Australia's default position is generally to apply bespoke solutions to major contracts. Some standard forms exist and are in use across several sectors (for example: NSW General Conditions of Contract (GC21) and the Federation of International Consulting Engineers 'FIDIC' conditions of contract), exemplar sectors being residential, commercial and process engineering.¹⁶⁷ However, a majority of these are significantly amended, particularly for larger contracts (>\$50M), which diminishes the intended benefit of these standard forms.¹⁶⁸

“ [Standardisation would enable] planning and procurement and delivery to focus more on the outcome. This would improve opportunities for more partnering within the industry, rather than just more master contractor, subcontractor projects. ”

– Industry stakeholder

Infrastructure Australia's 2016 *Australian Infrastructure Plan* highlighted the need for standardising procurement practices and standards across jurisdictions in Australia, and recommended Australia should only deviate from internationally accepted standards if there was a compelling rationale for the development of a non-conforming Australian and jurisdictional standard.¹⁶⁹ Standardisation could

address the key challenge of increasingly complex processes and constrained resources, as highlighted by stakeholders and described in the *2019 Audit*.¹⁷⁰

“ The public sector is inadequately skilled and resourced to undertake a high volume of sophisticated procurement activity... [which] can result in the taxpayer being exposed to inappropriate risks or costs, and compromising the capability of projects to achieve user outcomes. ”

The *NSW Government Action Plan: A ten point commitment to the construction sector* specifically calls out standardisation of contracts and procurement methods.¹⁷¹ This includes engagement with industry on key terms for greatest benefit, a review of contracts against international standards, development of guidance materials and minimising sector specific variations to standard terms.

Stakeholders engaged agreed that a presumption in favour of standardised approaches is desirable. Particularly in addressing jurisdictional differences and streamlining procurement across Australia to reduce tender timing and costs, improve competition, and foster innovation and long-term relationships. In recognition of the benefits of standardisation, Sydney Water's P4S project has adopted the NEC4 suite of contracts to deliver its nearly \$4 billion program of works (see Box 24).

Box 24: Sydney Water adoption of NEC4

Case Study: Sydney Water – Adoption of NEC4 suite of standardised contracts

Sydney Water's P4S program has embraced the NEC model, adopting the NEC4 suite of contracts to deliver its \$1.3 billion annual investment program. Refer to Box 18 for more on Sydney Water's integrated enterprise delivery model.

P4S's portfolio procurement manager Pouya Razavi said: 'we selected NEC4 contracts because they are global best practice. They have been used for three decades internationally and are endorsed by the governments of the UK, South Africa and Hong Kong. They bring plain English and a collaborative way of working upfront in relationships with the supply chain, and the simple contract structure reduces disputes between parties and enhances project outcomes.'

Utilising a standard suite of contracts has allowed Sydney Water to promote collaboration and upfront relationships, reduce disputes through plain English and simple structures, utilise pain/gain mechanisms to promote innovation, proactively and collaboratively review risk, optimise tendering processes, and establish common performance benchmarks among other benefits.

Source: Institute of Civil Engineers¹⁷²

“Government clients negotiate one on one with private sector suppliers for every contract, often using bespoke contracts or modified ‘standard’ contracts that often repeat the same problematic terms.”

– Consult Australia¹⁷³

Along with broad support, there was also consensus among stakeholders on the challenges related to adopting standardised contracting practices:

- Australia’s federated system is perceived to be an impediment to cross-jurisdiction standardisation, despite calls for standardisation in various Infrastructure Australia, industry, and state government publications
- Australia’s culture of bespoke solution development can inhibit perceptions of the effectiveness of standard forms and is generally a difficult behaviour to change
- early contractor involvement in commercial strategy development is limited, with contractors typically engaged after contract options and delivery models are decided (or majority drafted)
- industry engagement continually highlighted deficiencies in Government capability and capacity to effectively strategise and manage procurements, in some cases choosing a procurement model purely because it was used previously.

Governments have developed some guidance and commitments to addressing greater use of standard forms, however more can be done to better realise the benefits this approach can have on construction delivery.



Recommendation 5.5

Owners should adopt a standardised contract approach to infrastructure delivery, minimising bespoke contracts and clauses, to improve procurement efficiency, reduce risk and foster continuous improvement.

0-5

Recommendation 5.5.1

Enable immediate-term procurement efficiency gains by looking for opportunities to simplify existing contracts and (or) leverage existing standard forms. Owners should liaise with other jurisdictions and look to Australasian Procurement and Construction Council advice for opportunities to standardise approaches to procurement.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Australasian Procurement and Construction Council, and state and territory treasuries

0-5

Recommendation 5.5.2

Support the transition to a more standardised approach to procurement by increasing the capability of procurement resources and introducing new approaches that avoid bespoke contracts or amendments to existing standard forms. Owners and suppliers should be capable and informed enough to adequately assess the need for a bespoke solution, only where a standardised solution cannot achieve (or is less effective at achieving) desired outcomes.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Australasian Procurement and Construction Council

0-5

Recommendation 5.5.3

Engender continuous improvement by capturing lessons-learnt and ensure these are fed back into the procurement process. Continue to liaise with suppliers and other jurisdictions (early and often) throughout the transition to encourage greater adoption of standardised approaches.

Proposed lead: Australasian Procurement and Construction Council

Supported by: Infrastructure owners and delivery agencies

0-5

Recommendation 5.5.4

Enable the consistent and effective adoption of standardised approaches and contracts, by coordinating the collective review and development of a workable national solution. This should involve extensive industry and Government engagement, assessment of international best practice examples (e.g. NEC and FIDIC contract suites), and lessons learnt from international jurisdictions.

Proposed lead: Australasian Procurement and Construction Council

Supported by: Infrastructure Australia, state and territory treasuries, and relevant industry associations

5-10

Recommendation 5.5.5

Enable more efficient and effective procurement by transitioning to a preference for the use of the national standard contract form and approaches (identified in Recommendation 5.5.4). Where a national standard has not yet been developed, the principles of being easy to read, simple, fair, and facilitate good management should be adopted. Deviation from this approach should require justification during business case and procurement strategy development.

Proposed lead: State and territory treasuries

Supported by: State and territory owners and delivery agencies

3.6 Delivery innovation

Executive summary

Recommendations

Outcomes for people and place

Infrastructure as a system

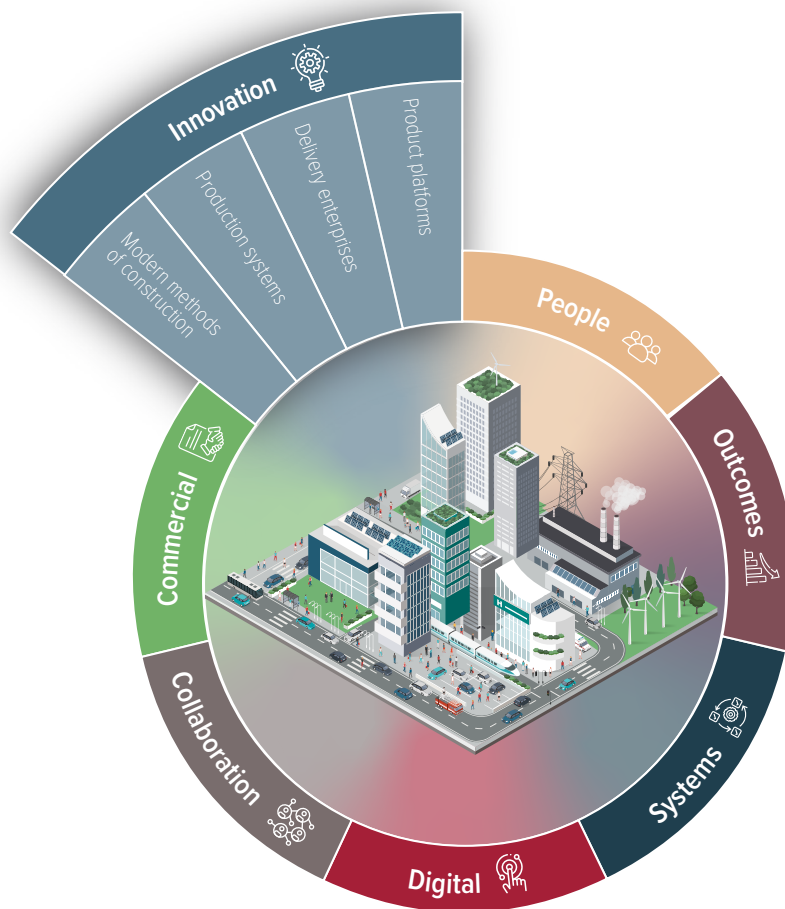
Digital transformation

Collaboration and integration

Commercial optimisation

Delivery innovation

People, wellbeing and resilience



3.6 Delivery innovation

Delivery integration and innovative techniques enable increased productivity.

Infrastructure planning and delivery in Australia generally utilises traditional construction methodologies that have struggled to innovate over the past two decades.

A new approach to delivery presents an opportunity to integrate across the infrastructure lifecycle, creating an ecosystem that delivers on desired outcomes. From a delivery perspective, this ecosystem is productive, reliable and predictable,

utilising Modern Methods of Construction (including platform approaches) underpinned by efficient production systems.

This section supports the implementation of recommendations in the *2021 Australian Infrastructure Plan*, including Recommendation 3.2b: *Reduce uncertainty for industry and improve value for money by improving engagement with industry and the supply chain.*

3.6.1 Owners should set a clear presumption in favour of Modern Methods of Construction, including off-site construction

Where do we want to get to?

Modern Methods of Construction are standard practice, enabling improvements in productivity, quality and safety.

- Owners have a clear and comprehensive strategy at an organisational level, outlining the expectation for the use of Modern Methods of Construction in delivery. This should run through their portfolios and down to individual projects and programs.
- This strategy should include a clear presumption in favour of off-site construction, shifting labour and capital intensity to the design and manufacturing stages of delivery.
- Implementing Modern Methods of Construction is not an end in itself. Owners should set a framework to consider whether, how and to what extent the use of Modern Methods of Construction can drive wider value and achieve project or program outcomes.
- A common set of metrics should be developed to better understand construction performance across government and support organisations in improving delivery performance.

“ 80% of infrastructure construction problems are not unique, but are delivered as such. ”

—State treasury

Modern Methods of Construction provide alternatives to traditional construction methods and have the potential to deliver significant improvements in productivity, efficiency and quality for both the construction industry and public sector.¹⁷⁴



Box 25: Modern Methods of Construction**Modern Methods of Construction**

Modern Methods of Construction refers to a broad range of innovative construction processes, including (but not limited to) volumetric construction whereby manufactured parts are assembled offsite in controlled factory settings and transported to the construction site as a fully or majority furnished product, or offsite frame construction where a product's frame is built in a controlled setting and transported to a site where it is assembled completed using traditional methods.

In 2019 the UK Government, in consultation with the 'MMC Working Group', developed a Modern Methods of Construction definition framework that splits the various techniques and technologies into seven categories that span offsite, near site pre-manufacturing and site-based process improvements. Early adopters and pioneers have been the modularised built environment industries (such as housing, schools or jails), meaning these definitions are more akin to the housing sector than other linear infrastructure. However, the benefits of these principles have been recognised, and are being applied more broadly across the infrastructure construction sector (for example, the UK Construction Playbook sets a clear presumption in favour of Modern Methods of Construction).¹⁷⁵

Source: MMC Working Group¹⁷⁶

Off-site assembly and an increased focus on designing solutions for manufacture and assembly provide an opportunity to improve productivity, reduce labour requirements, and improve the safety and environmental sustainability of construction.

Faster and more efficient quality inspections reduces the likelihood of re-work (and therefore waste), improves the quality of the prefabricated components, and reduces the likelihood of human error and inconsistency. Health and safety are improved through the more controlled and effective working environment.¹⁷⁷

“Modern delivery methods are good for productivity, but are even better for the people working on the projects in terms of safety and wellbeing.”

– State Government

Moving construction operations off-site also moves activity away from the construction site. This provides the opportunity for geographic logistics or manufacturing hubs to be set up in areas where the employment opportunities would provide a regional benefit.

Infrastructure has historically tended to create opportunities in dense urban areas where employment is higher and where travelling to and from site adds to congestion. Moving construction away from the site potentially shifts activity to where it can provide more employment opportunity and reduces the issues associated with travel in urban areas.¹⁷⁸

Government taking leadership in these principles will drive confidence in industry to invest in building the capability and capacity to use Modern Methods of Construction, further catalysing a culture of innovation and collaboration across the sector. Common metrics across governments, supported by enabling digital technologies, will foster continuous improvement in delivery and streamline lessons learnt across the sectors.¹⁷⁹

Current state

Design and construction in Australia is characterised largely by bespoke solution development. Unique designs, components and labour are brought to site and are subsequently required to be planned and managed with precise alignment to avoid cost or schedule blow-outs.¹⁸⁰ A large amount of capital and labour intensity is spent constructing infrastructure on site, from scratch.

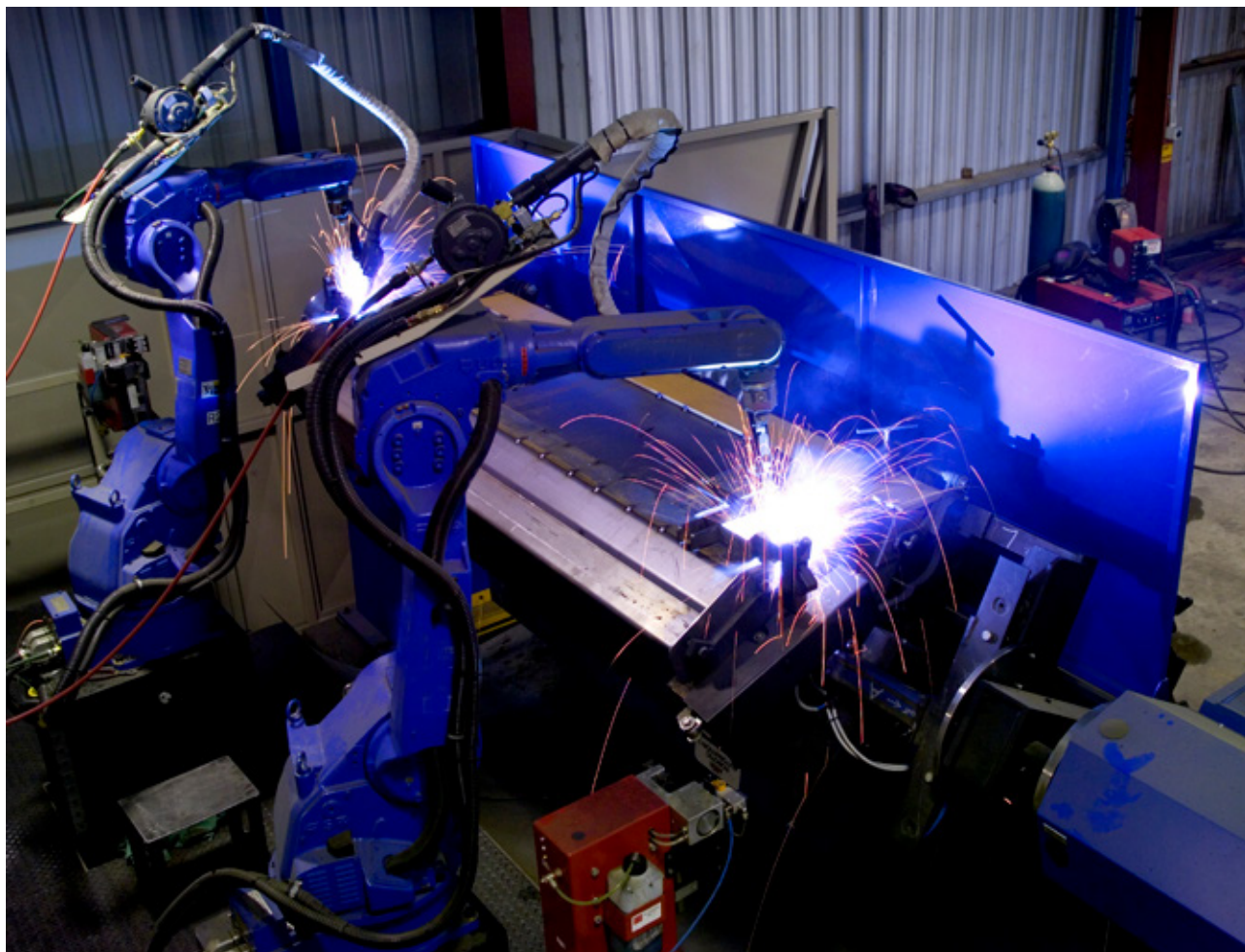
“Australia is heavily lagging other developed economies, such as China, in innovating delivery through manufacturing approaches.”

– Industry leader

Construction industry multifactor productivity in Australia has remained relatively stagnant over the past 30 years.¹⁸¹ Many of the Productivity Commission's 2014 considerations for improving productivity in the infrastructure sector are still applicable today. For example:

“The expanded use of prefabricated elements ... and other off site techniques is seen by many construction industry commentators as having further potential to deliver significant productivity improvements.”¹⁸²

There have been recent advances towards modern construction across a range of public infrastructure in Australia. Notable and significant examples include School Infrastructure NSW's clear prioritisation of DfMA (including the construction of the Jordan Springs Public School using DfMA methods – see Box 26) and Level Crossing Removal Program's production approach to delivery.¹⁸³ The potential of prefabrication and modularisation to support improved productivity has been recognised by Infrastructure NSW, stating 'Industry and government need to foster innovation to ensure that inefficient construction practices are reformed and new productivity-enhancing technologies are adopted'.¹⁸⁴



Box 26: School Infrastructure NSW and DfMA**Case Study: School Infrastructure NSW – ‘Why DfMA is part of our future’**

School Infrastructure NSW's 2020 Delivery Strategy outlines a clear presumption in favour of DfMA techniques. School Infrastructure NSW recently completed their first school using these techniques, the Jordan Springs Public School. For more on School Infrastructure NSW's Delivery Strategy, refer to Box 12.

Completed in July 2020, Jordan Springs Public School supports up to 600 students, featuring 27 new flexible learning spaces, a new hall, two covered outdoor learning areas and modern core facilities design to allow additional classrooms in the future. Up to 95% of the school was constructed off-site.

Some of the success attributed to the use DfMA for the Jordan Springs Public School include:

- Early investment in the design and engineering of the kit of parts enabled onsite time savings
- Manufacturing of building parts created jobs in safe environments and onsite assembly required less interfaces
- DfMA manufacturing and assembly reduced CO2 emissions, material and water use
- Offsite manufacturing and on-site assembly required less trades on site and generated less noise, dust, traffic and disruption
- This method of manufacturing facilitated new jobs, training and upskilling
- The DfMA design and construction process reduced the cost of construction.

Acknowledging the benefits of DfMA approaches, School Infrastructure NSW has now nominated 20 candidate projects for future DfMA-style delivery.

Source: School Infrastructure NSW¹⁸⁵

Widespread uptake of Modern Methods of Construction is currently hindered by a range of factors, including:

- the lack of a comprehensive, consistent and long-term infrastructure investment pipeline, which stifles confidence to invest in innovative technologies.¹⁸⁶ Most jurisdictions are yet to fully adopt these technologies, which adds further uncertainty across the ecosystem
- an embedded culture of traditional construction, and preference for ‘bespoke’ solutions, limits the repeatability of any production process
- inconsistent standards, contracting arrangements, and a lack of integration across the ecosystem means products are unlikely to be re-used or easily integrated into different projects.



Recommendation 6.1

Owners should set a clear presumption in favour of Modern Methods of Construction, enabling improvements in productivity, quality and safety.

0-5

Recommendation 6.1.1

Facilitate the transition to greater use of Modern Methods of Construction by developing a Modern Methods of Construction Strategy. The strategy should provide industry greater confidence to invest in innovative technologies and techniques, foster collaboration, and set clear targets for adoption of the principles set out in this roadmap: Modern Methods of Construction, production systems, delivery integration, and product platforms. Regularly assess progress against the targets set in this strategy and publicly update the strategy to reflect progress, changes, and innovations.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Infrastructure Australia, and relevant industry associations

0-5

Recommendation 6.1.2

Enable the adoption of standardised products by establishing a clear presumption in favour of delivering through portfolios or programs, and adopting standardised and interoperable components. This necessitates the use of delivery models, contract forms and technical specifications that are outcomes-focused and therefore do not stifle innovative proposals that utilise these standardised and interoperable components.

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure owners and delivery agencies, and relevant industry associations

0-5

Recommendation 6.1.3

Assist Governments and industry by developing best practice guidance (based on the principles in this roadmap) for the adoption of Modern Methods of Construction. This should leverage existing local examples and lessons learnt from other jurisdictions, and include at a minimum the principles of:

- adopting Modern Methods of Construction
- delivery through production systems
- delivery integration
- digital platform approaches.

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure Australia and relevant industry associations

5-10

Recommendation 6.1.4

Maintain momentum in the transition to innovative delivery approaches by regularly conducting maturity assessments of projects against best practice guidance, including (but not limited to) adoption of off-site techniques, production system methodologies, delivery integration and the adoption of standardised and interoperable components.

Proposed lead: Infrastructure delivery agencies

Supported by: Department of Infrastructure, Transport, Regional Development and Communications, Infrastructure Australia and relevant industry associations

3.6.2 Delivery should be founded on a production system approach that underpins reliable, effective delivery

Where do we want to get to?

Infrastructure solutions are delivered through production systems, improving task reliability and enabling continuous improvement.

- Delivery moves from a traditional construction approach undermined by low levels of task reliability to delivery through production systems that are underpinned by pre-planned and optimised processes.
- Integrated teams are brought together in advance of construction, with the opportunity to develop and optimise the process of delivery. These teams (including both key partners and suppliers that have an influence on delivery) can digitally rehearse and optimise construction activity, so that when delivery takes place it is through a planned and optimised production system underpinned by logistics and continuous improvement.
- Capital and labour intensity shifts to the front end of the project lifecycle, where greater emphasis is placed on designing for manufacture, and designing for high degrees of off-site assembly. Mobilisation is carefully planned, and relationships are built early and often with the supply chain to plan for logistics.

“ A production style approach has many benefits – improved safety, less waste, low barriers to market for product suppliers, improved quality, increased profitability – the list goes on. ”

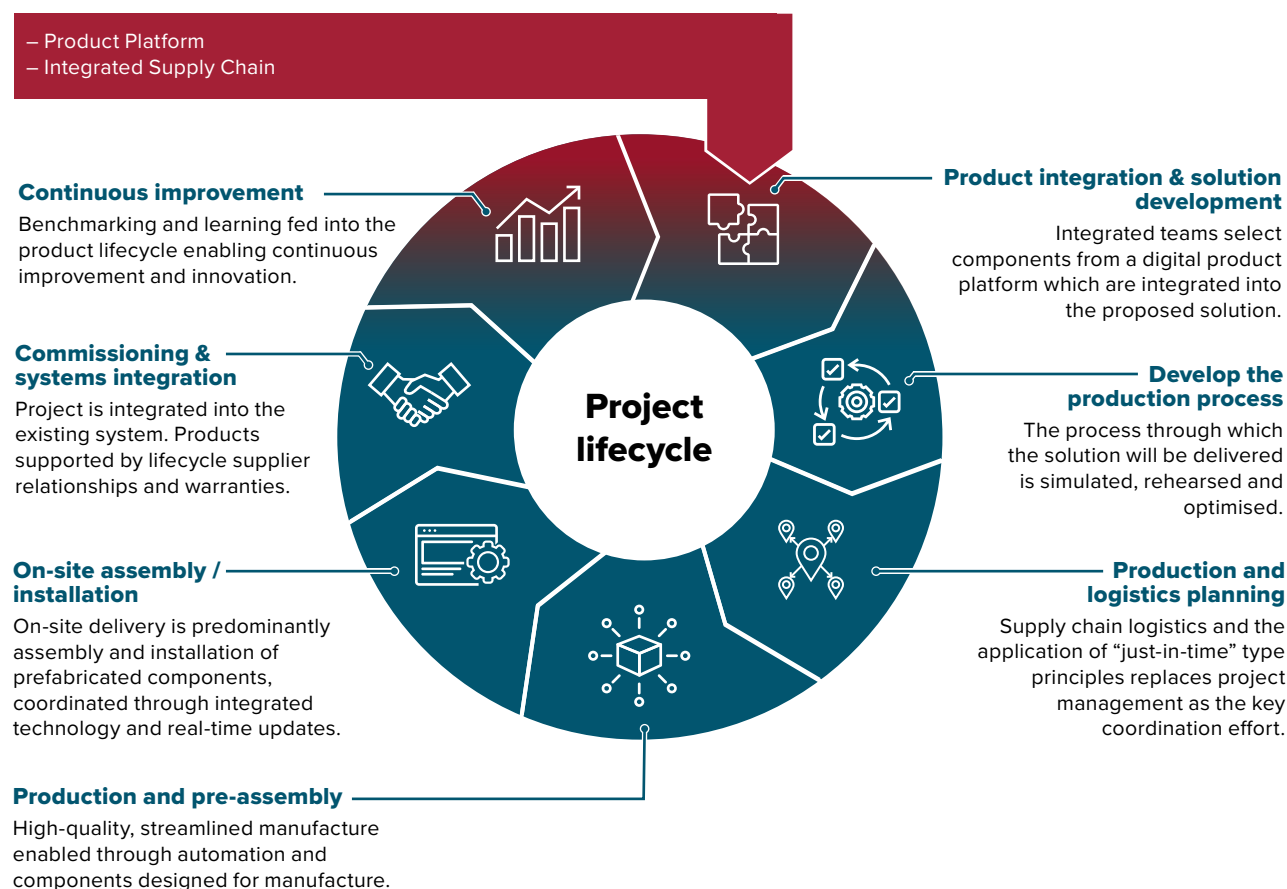
– State government

A production-system approach in which work processes are more defined and standardised, material inventories are optimised and better controlled, and labour is more effectively allocated is key to enhancing the productivity of infrastructure delivery. This approach is analogous to production systems in other industries, such as manufacturing, that have been utilised successfully for decades.¹⁸⁷

Adopting this integrated approach requires a complete shift in behaviour and pre-conceptions of lean construction delivery. A large portion of capital and labour intensity is diverted to the ‘front end’ of the

project lifecycle to plan (including early engagement with suppliers), design (for manufacture and assembly) and manufacture of components ahead of delivery and assembly on site. Managing schedule and cost is streamlined through the application of standard processes, rules and measurements for planning activities and allows for real time assessment of progress. Mobilisation and on-site construction start are pushed to relatively later dates in the project lifecycle, as greater planning and pre-assembly is completed off-site.¹⁸⁸

Figure 15: Hypothetical production system: construction delivered through a production system where products and projects are integrated.



Project delivery (cost and schedule) is optimised and streamlined through collective pre-planning, the application of standard processes and the adoption of rules and measurements that allow for real time assessment of progress. Continuous improvement becomes standard, removing waste and variability in the production cycle as processes are standardised and teams empowered to find improvements.

For this production system to be truly effective, it must be underpinned by many of the wider principles identified in this roadmap, for example: integrated governance, innovative technologies, capable owners and teams, engaged and integrated supply chains, commercial arrangements and incentives that align to desired outcomes, and portfolio system planning transparency and consistency.¹⁸⁹

Establishing a production system approach could have profound benefits for the Australian infrastructure sector. Many of the enabling technologies and innovations required to drive this change are available and can be immediately implemented.

Current state

Construction delivery remains one of the least innovated sectors in Australia.¹⁹⁰ Shifting to a production mindset requires a different approach to how we procure and develop teams, bringing together the right organisations and individuals to plan the systems and processes of delivery before pre-construction. Procurement, delivery gateways and mindsets all need to change to achieve this production shift.

“We need significant investment in digital, collaboration and processes like lean construction. Particularly a switch to manufacturing and off-site prefabrication, that are strongly supported by government.”

– Industry leader

The current approach to procurement places an emphasis on price-based competition with prices submitted against partially completed designs. Actual construction activity is therefore based on high level programs with activities defined and organised on an ongoing basis, as design is finalised and the supply chain is engaged. This inevitably produces low levels of reliability, with construction task reliability generally running at about 50%.¹⁹¹

Digital innovation is weaving its way into construction delivery through tools such as BIM or digital twins. These technologies represent an opportunity for the Australian construction sector to adopt open-source production systems that are integrated with BIM protocols, used across organisations in integrated teams.¹⁹² Such systems would enable digital rehearsal and simulation, and rehearsal of production and subsequent design decision-making and tracking of delivery components.

“Existing exemplar projects in [production systems] should be used as examples of innovation and improvement – we should use these to put pressure on other agencies to act.”

– State government leader

Despite this burning platform for delivery innovation, the dominant leadership and delivery model for infrastructure projects has not evolved significantly. Construction delivery maintains its traditional approach, using long-established construction industry methods. This conservatism has contributed to Australia's continued delivery of bespoke projects that often fail to meet performance targets or the expectations of the public.¹⁹³

The *2016 Australian Infrastructure Plan's* Recommendation 1.4 is directly relevant in this case:

“Innovation in infrastructure service delivery should be encouraged through positive, flexible regulatory frameworks. Where emerging technologies and delivery models disrupt infrastructure markets, governments should respond quickly to ensure regulatory settings maximise productivity growth and reflect the long term interests of customers.”

While this has occurred in some areas, for example in the case of the increasing mandates for BIM across Australia, more can be done to move towards a production system approach to delivery.

Recommendation 6.2

Delivery should shift from traditional construction to delivery through production systems, improving task reliability and enabling continuous improvement.

0-5

Recommendation 6.2.1

Uplift reliability and predictability in delivery by actively promoting the production systems approaches, including delivery rehearsal and production system planning. Apply these principles across the portfolio and engage early with suppliers to plan and optimise delivery.

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure owners and delivery agencies, and relevant industry associations

0-5

Recommendation 6.2.2

Optimise construction delivery by using digital rehearsal on all projects where the technology and capability is available. Rehearsals should include all aspects of construction and be used to inform interactions through the ecosystem. Owners and suppliers should plan for developing digital rehearsal capability, and advocate for its use in procurement and in existing programs.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Department of Infrastructure, Transport, Regional Development and Communications, and relevant industry associations

3.6.3 Delivery models should provide effective integration of information, process and organisation, enabling more Modern Methods of Construction

Where do we want to get to?

Delivery through ‘enterprises’ becomes the norm, allowing integrated teams to better utilise production systems, improving productivity and delivery of enterprise outcomes.

- Delivery through enterprises, rather than traditional tiered construction delivery arrangements, becomes the norm. Systems thinking approaches are used and interfaces are replaced by integration to create a common understanding of value, coordinate activities, and focus all participants on achieving a successful outcome through the entire project lifecycle.
- These enterprises adopt production systems, platform approaches and Modern Methods of Construction into a wholistic and efficient delivery approach.
- Commercial arrangements, incentives or rewards facilitate a continued focus on outcomes, and are structured to support the performance and delivery of the enterprise.

Production systems in construction function most efficiently using an ‘enterprise’ or integrated team delivery model.¹⁹⁴ Time and effort spent creating effective organisations, establishing an environment that enables high performance, with the right cultures pays dividends when the time comes to deliver a project. Emerging production processes should influence engineering, particularly in the details of components and in the arrangements for transporting them to site and fixing them in place. Efficient production systems rely on effective supply and logistics to get materials, plant and labour to the places where they are needed at the time they are needed. This requires early involvement and the development of integrated teams.¹⁹⁵

Ultimately, this enterprise approach to delivery enables higher levels of productivity and paves the way for adopting a platform approach to delivery.

Current state

A key component of an effective enterprise delivery model is a capable owner.¹⁹⁶ Both industry and Government stakeholders engaged throughout this review conceded that current Government capability is lacking both in delivery and commercial disciplines. For delivery integration to be effective in the Australian context, owner’s will need to be capable and willing to:

- accurately define outcomes
- articulate and own technical requirements
- manage stakeholders and build effective integrated teams
- put infrastructure into operation
- work collaboratively and constructively across the entire delivery team and throughout project lifecycle.

Despite these challenges, there are leading examples of enterprise delivery models in Australia such as Box 18 Sydney Water’s Partnering for Success (P4S) program. Alliance contracting has strived to achieve (and in some cases achieved) the benefits of meaningful integration. However many cases have fallen short where the alliance model has been used for a project where a more appropriate delivery model should have been deployed, and where some alliances have failed to sufficiently demonstrate value.

The Anglian Water @one Alliance is an example of an alliance delivery model that has evolved into an integrated, highly functional, and collaborative enterprise.¹⁹⁷ @one is made up of people from all member organisations, with long term relationships formed with all key suppliers.

Recommendation 6.3

Delivery models should shift to greater integration and delivery through enterprise models, improving productivity and delivery of outcomes.

0-5 **Recommendation 6.3.1**

Enable enterprise delivery by progressively moving to more integration of information, process and organisation, recognising that integration at system and project level is a feature of best practice.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** Department of Infrastructure, Transport, Regional Development and Communications, and relevant industry associations*

0-5 **Recommendation 6.3.2**

Improve productivity by designing delivery models to bring partners and suppliers together within delivery enterprises, supported by an appropriate level of common information structure, common delivery processes and as part of integrated teams.

***Proposed lead:** Infrastructure owners and delivery agencies*

***Supported by:** Department of Infrastructure, Transport, Regional Development and Communications, and relevant industry associations*

3.6.4 Owners should adopt portfolio and procurement approaches that enable projects to be delivered as digital product platforms

Where do we want to get to?

Delivery through product platforms, with solutions comprising standardised and interoperable components and assemblies, enables economies of scale and a step-change in procurement and delivery productivity.

- Owners adopt a platform approach, procuring projects based on standardised and interoperable components and assemblies, the requirements for which will be part of a digital component catalogue. The standardised and interoperable nature of the components would mean they can be used across different types of built asset and across different sectors. These components are widely accessible across the industry for manufacture and use.
- Future procurement and delivery frameworks should support this with the development of a market and supply chain that can develop and deliver designs based on these platform approaches, manufacture and supply components, and innovate to improve and develop these over time.
- The approach is enabled through procurement methods and a portfolio approach, providing visibility of 'products', and integrating delivery in a production system. Digital simulation is used to rehearse delivery, with early involvement of suppliers and contractors in the delivery design and planning phases.
- This approach necessitates the adoption of Modern Methods of Construction in delivery, principally design for manufacture and assembly (DfMA).

“ [We should focus on] DfMA, production systems and platform approaches, standardise components and requirements, and limit the number of bespoke builds. ”

– State government leader

Modern Methods of Construction, production systems and enterprise delivery (integration) are key drivers to enable a true platform approach.¹⁹⁸ Adopting a platform approach improves procurement and delivery productivity, reduces greenhouse gas emissions, and enables greater innovation and integration in the infrastructure ecosystem.¹⁹⁹ Figure 16 Sharing requirements and standards in industry will encourage continued investment in the supply chain into these components and technologies, continually improving components and their design processes to drive faster delivery. Similarly, using these repeatable cross-sector components creates economies of scale that will continue to drive down cost, and increase

safety, quality and productivity.²⁰⁰ Consistent, repeatable components also streamline automated computational design processes allowing for digital twins and enhanced simulations.

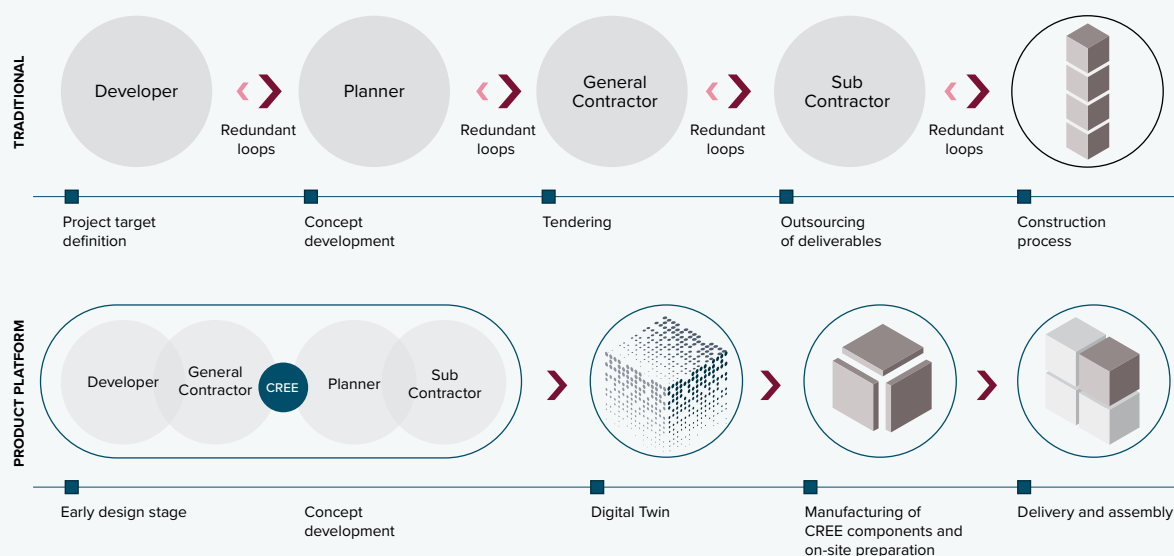
Procurement would be fast-tracked, allowing owners to choose from designs or specific components from a suite of online digital marketplaces. Owners and delivery agencies could potentially create long-term contracts with solutions providers that connect contracting and manufacturing work, prefabricating repeatable modules in a manufacturing facility before assembling on-site.²⁰¹ This reduces procurement complexity, costs and timing.

Box 27: CREE platform approach**Case study: CREE platform approach – ‘a holistic, natural, and simplified way of building for those who are sick of the old way of doing things.’**

CREE are a European technology and consultancy firm that develop sustainable buildings using prefabricated timber-based components. CREE have developed their self-titled ‘CREE System’, with materials and prefabricated components available on a digital product platform.

Their platform approach allows for replacement and upgrade of interiors and facades, and high customisability within the standardised component design. CREE combine their product platform and production system into an integrated delivery process, which they claim has improved speed, quality, certainty of cost and schedule, and other operational benefits (see Figure 16).

Figure 16: Comparison of traditional in-series design compared to an integrated team delivering using a production system, with components and designs based on a digital product platform.



CREE have leveraged their product platform and integrated approach to deliver real benefits to the vertical built environment industry. In doing so, they have created a prime example for other industries of the potential benefits of innovating infrastructure delivery through product platforms.

Source: CREE²⁰²

Adopting platform approaches is enabled by many of the other principles discussed in this roadmap, including integration, delivery through production systems and digital innovation. Platform approaches are the direction industry will take as the adoption of enterprise models and exploitation of digital technology become more common.

Current state

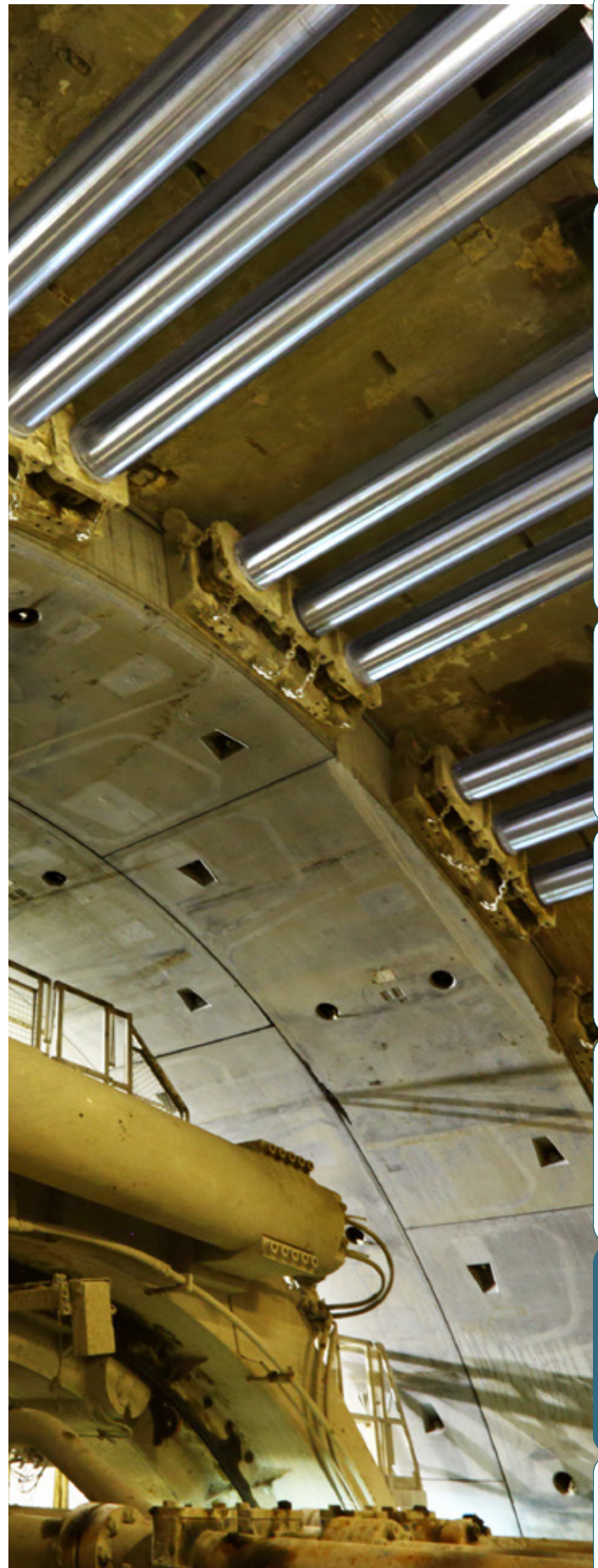
Utilising product platforms to increase infrastructure construction productivity (among the other benefits described above) has been recognised internationally as contemporary best practice. For example, in 2020 the UK Government announced its preference for a 'new approach' to building to be adopted across all government departments, titled a Platform approach to Design for Manufacture and Assembly (P-DfMA) (see Box 28).²⁰³

School Infrastructure NSW's DfMA strategy and approach (see Box 12) is a leading example of Australian innovation and is paving the way for what could be true P-DfMA. However, P-DfMA has otherwise not been widely adopted in infrastructure construction delivery.

This is despite a clear case for change (stagnating productivity and innovation, calls for increased integration and collaborative commercial environments) and a wide range of enabling behaviours and technology, for example:

- a drive by the Australian Government, in consultation with industry, to mandate the use of productive digital technologies such as BIM in infrastructure construction²⁰⁴
- private industry that is motivated to stay relevant and competitive in the global market
- international examples of platform approach adoption, including strategies and pathways for implementation, as well as local proxies in the manufacturing and agricultural industries.

Key barriers to the adoption of platform approaches identified during stakeholder engagements were jurisdictional and supply chain fragmentation, inconsistent standards and inconsistent investment pipelines. As outlined in the *2016 Australian Infrastructure Plan*, differing standards across jurisdictions can be detrimental to industry efficiency and value.²⁰⁵



Box 28: UK Government's platform approach to manufacture and assembly**Case study: A 'new approach' called the Platform approach to Design for Manufacture and Assembly (P-DfMA)**

Recognising a strong case for change in the construction industry, the Infrastructure and Projects Authority (IPA) in 2018 released a 'call for evidence' for its proposed new approach to building. Issues cited in the construction sector were low productivity, poor predictability, an impending skills shortage to deliver the infrastructure pipeline, and low investment in innovation.

The proposed 'Platform approach to Design for Manufacture and Assembly' (P-DfMA) sought to address some of these issues by revitalising construction productivity and innovation. Benefits included: increases in repeatability, quality, economies of scale and safety through manufacturing techniques; supporting the Zero Carbon Building policy in the UK; improved benchmarking through repeatability and consistency; and greater emphasis on planning and design phases would play to the UK's relative strength in these fields.

The proposal contained three principles:

1. **Design for Manufacture and Assembly:** the design, procurement and construction of built assets use a defined set of standardised and interoperable components. These components should be designed to be manufactured efficiently at scale using repeatable processes
2. **Use a platform approach:** use of the same components across different types of infrastructure is maximised by adopting a platform approach. The standardised and interoperable nature of the components would mean they can be used across different types of built asset and across different sectors.
3. **Open for Manufacture, Use and Procurement:** anyone should be able to make, use and buy the components, for legitimate purposes consistent with our overall objectives.

The IPA has since collated responses and international best practice. In recognition of the potential benefits of these modern approaches, P-DfMA has been incorporated as an integral principle of the *Construction Playbook* and *National Infrastructure Strategy*.

Source: Infrastructure and Projects Authority²⁰⁶



There is a long-instituted approach to delivery in Australia that relies on bespoke solutions for delivery of construction projects, and as captured during stakeholder engagement, a perception of reduced quality from 'off the shelf' solutions.

This approach fragments and silos the supply chain into individual transactions across the myriad services required to deliver a construction project.

Inconsistencies in investment pipeline communication also inhibits private sector confidence to invest in the capability and technological enablers of a platform approach.

As stated in the *2019 Audit*:²⁰⁷

“Construction is currently one of the least digitised sectors.”

Coupled with limited direction set by owners and delivery agencies in favour of the use of platform approaches and Modern Methods of Construction, the private industry currently has limited incentive to innovate in the short to medium term.

Recommendation 6.4

Owners should adopt platform approaches to delivery, utilising standardised components and assemblies to enable economies of scale and a step-change in procurement and delivery productivity.

0-5

Recommendation 6.4.1

Look for opportunities to accelerate the development and use of product platforms to support building a market and demand for products. Look to existing local examples that could be early adopters and test the development of a true product platform.

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure owners and delivery agencies, and relevant industry associations

0-5

Recommendation 6.4.2

Support the transition to platform approaches by adopting enabling procurement and delivery approaches, including:

- **procurement approaches that support early supplier engagement during product development**
- **delivery through integrated teams that can collectively develop assembly processes in advance of construction start.**

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure owners and delivery agencies, and state and territory treasuries

3.7 People wellbeing and resilience

Executive summary

Recommendations

Outcomes for people and place

Infrastructure as a system

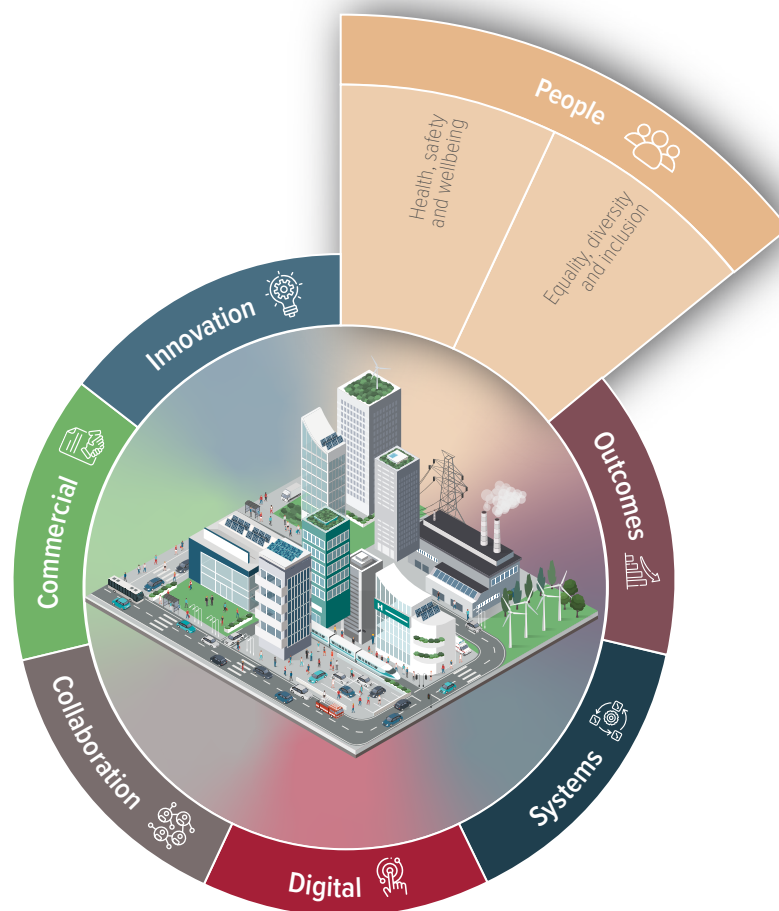
Digital transformation

Collaboration and integration

Commercial optimisation

Delivery innovation

People, wellbeing and resilience



3.7 People wellbeing and resilience

People wellbeing and resilience is the foundation of a flourishing infrastructure sector.

People are the foundation of the Australian infrastructure sector. For the sector to truly flourish, all members of the ecosystem should be provided with the opportunity to pursue jobs and careers within a safe, and inclusive environment. Getting the best out of the current workforce and attracting diverse and talented people to the sector will be key to enabling a more productive, innovative and financially sustainable infrastructure sector.

The roadmap recognises the importance of protecting and nurturing both the physical and mental health of the workforce and the role leadership plays in enabling this across the sector. The roadmap also promotes the pursuit of workforce diversity and

inclusivity, both because it's the right thing to do and because it will unlock a more resilient ecosystem capable of delivering our infrastructure needs. These are distinct but interrelated principles that in combination underpin people wellbeing and resilience and promote a positive and enabling culture across the sector.

This section supports the implementation of recommendation 3.1 of the *2021 Australian Infrastructure Plan*, and in particular Recommendation 3.1.3: *Ensure the industry is a sector of choice for employees and can meet current and future workforce demands by introducing cultural reform that embraces diversity and inclusion.*

3.7.1 Health, safety and wellbeing is driven by, and accountability owned by, industry leaders

Where do we want to get to?

A proactive and systemic approach to achieving health, safety and wellbeing outcomes is adopted across the sector enabling a more sustainable and productive infrastructure sector.

- Industry leaders are prominent and outspoken champions for health, safety and wellbeing awareness throughout the sector.
- Health, safety and wellbeing are prioritised as key matters of importance across the sector and are recognised and resourced to drive continual improvement.
- Our workplaces and ways of working are designed to protect and nurture our mental and physical health by integrating our health, safety and wellbeing objectives throughout organisation processes and practices.
- Organisations and service providers are encouraged and rewarded for positive actions taken to ensure workplaces and worksites protect and promote health, safety and wellbeing of the workforce.

“Despite working on some of the most exciting projects in the world – our workers suffer from cultural issues: bullying and unrealistic deadlines driving poor health, safety and wellbeing. We should not walk past behaviours that do not align with overall goals and this should be led from the very top.”

– Industry leader

Box 29: Defining health, safety and wellbeing

What do we mean by health, safety and wellbeing?

Health and safety broadly refers to the ‘laws, rules, and principles that are intended to keep people safe from injury or disease at work and in public places’.²⁰⁸ The *2011 Work Health and Safety Act* further defines health as encompassing ‘physical and psychological health’.²⁰⁹

Traditional approaches to health and safety, however, have focused on avoiding or mitigating the potential for harm – placing emphasis on implementing controls and practices to avoid or mitigate risks to our *physical* health.

Over time our approach to health and safety has evolved to addressing psychosocial (mental health) risks and subsequently to health *promotion* – both job and lifestyle related. For example, workplace campaigns that challenge workers to be more physically active. Some organisations have extended this further to involvement in the community, such as dedicated volunteer days, working to address broader social and environmental determinants of worker health.²¹⁰

Wellbeing refers to the state of feeling healthy and happy and brings into consideration a complex combination of factors including physical, mental, emotional, and social aspects.²¹¹ As such, the traditional definition of work health and safety can be considered a subset of wellbeing. The shift to focus on wellbeing has been synonymous with the adoption of more proactive approaches to the pursuit of worker health outcomes (as opposed to risk mitigation) as well as an increased emphasis on mental health and mental wellbeing. Example initiatives include Mental Health First Aid, developed in Australia, and Queensland Health’s ‘Dear Mind’ initiative.²¹² In the work context, when we refer to ‘health, safety and wellbeing’ we mean our physical safety, physical health, mental health and our overall sense of satisfaction.

People are at the heart of infrastructure – infrastructure exists for and because of people. The health, safety and wellbeing of our people is therefore both an outcome and a critical enabler of a successful and financially sustainable infrastructure sector.

“[The desired state] will identify and deliver infrastructure with a focus on equity and addressing social issues of importance to the health and wellbeing of people and the environment.”

– Industry leader

For decades, workplace safety has been recognised as a paramount key performance indicator (KPI) in infrastructure construction and an essential component of operating effectively and sustainably within the sector. Worker health and wellbeing are becoming accepted as equal tenets of a financially sustainable infrastructure ecosystem, with mental wellbeing being given increasing focus in recent years.

Adopting a broader approach to ‘health and wellbeing’ as well as ‘health and safety’, with an emphasis on primary intervention, is consistent with leading health advice and is advocated by leading agencies such as the World Health Organization (WHO).²¹³ Wellbeing is a natural development of health and safety, with leading organisations consistently implementing strategies that address all three elements.

Creating an infrastructure sector that protects and promotes the health, safety and wellbeing of our workforce is an ethical and, for many aspects, a legal obligation. It is also an underpinning facet of productivity, performance, and innovation.

As an industry, the legal framework should provide us with a baseline. We should aspire to continually exceed this baseline. Key benefits of this include:

- **improved health outcomes** for our workers through reductions in workplace stress and injury, and greater job satisfaction
- **promoting personal growth** by eliminating more elemental concerns about safety and health, unlocking the collective energy to create and innovate
- **increased sector productivity** and profitability through improved energy and concentration levels, reduced absenteeism, reduced workers’ compensation costs and greater levels of attraction and retention
- **enhanced social outcomes** through increased solidarity and equity.

Through our stakeholder engagement, the following have been highlighted as key success factors in achieving optimal health, safety and wellbeing outcomes:

- **leading from the top** – senior leaders need to understand their role in sponsoring health, safety and wellbeing outcomes and take responsibility for these functions and their performance
- **investment** – adequate funding is required to get proper traction across health, safety and wellbeing initiatives. This includes funding for specialist roles, in addition to generalists, who are experienced, trained and focused specifically on health, safety and wellbeing
- **collaboration and consultation** – consult widely amongst workers and stakeholders, collaborate with the supply chain, and be visible. Establish committees and working groups (to develop, test and champion initiatives and engender ownership), publish strategies, report on performance, and capture and apply lessons learned.



Box 30: Sydney Metro health and safety model**Case study: Sydney Metro health and safety model**

In NSW, Sydney Metro has developed a model for health and safety that has been founded on:

- best practice from across industry
- informed by the learnings from the results of risk-based systems
- applied research.

In developing the model, Sydney Metro has engaged extensively with stakeholders and the supply chain – publishing the approach and embedding it throughout its procurement and delivery systems and practices. A central tenet is that ‘health’ (including physical, social and mental health and wellbeing) is treated equally to ‘safety’. The model has yielded positive results for key indicators over successive years.

Sydney Metro states ‘Safety leadership is a key part of our governance framework where leaders understand their role and their accountabilities. We consider strong health and safety performance is more than complying with health and safety legislation. Our health and safety principles include:

- strong direction and governance
- systematic application of health and safety
- engagement, collaboration and consultation
- evidence based decision-making.’

Source: NSW Government²¹⁴



Current state

“Internationally, Australia has a reputation as a hard place to work.”

– Industry leader

Whilst there have been some significant strides forward in recent times, there is room for improvement across the sector in how we manage worker health, safety and wellbeing.

The physical and complex nature of constructing infrastructure creates a potentially high-risk environment for workers. Statistics published by Safe Work Australia, show that the construction sector had the third highest rate of fatalities across all sectors, recording 24 fatalities in 2018 (a rate of 2 fatalities per 100,000 workers).²¹⁵ This compares unfavourably with the UK for example, where recent data for construction has reported a rate of 1.67 fatalities per 100,000 (annual average 2015/16–2019/20).²¹⁶ Since 2006–07, the Construction industry has also been in the bottom quartile of all industries for rates of serious claims.²¹⁷

This poor record persists despite a mature and systemic approach to the identification and management of hazards and physical health (underpinned by the legal obligations), combined with other initiatives which are considered to have engendered a ‘safety culture’ across the sector. Stakeholder feedback along with industry best practice suggests a range of related delivery initiatives could be the key to unlocking further improvements in safety:

- the development of longer-term relationships across the ecosystem that allow safety knowledge and practices to be honed – more mature organisations are able to share their experience and capability with their supplier system, working much more closely to identify and share best practice
- adopting digital design techniques including the development of digital twins that are used to simulate and rehearse all aspects of construction allowing hazards to be identified, activities planned in advance and capability and training to be aligned with construction requirement – all greatly reducing risk
- adoption of Modern Methods of Construction including designing solutions for manufacture and assembly. Risks are significantly reduced by taking construction away from variable and potentially hazardous onsite environments into purpose-built facilities. The timely transition of key project information, including risk management information, as-built models, operating and maintenance manuals, from delivery to operations ensure asset operators are ‘set up for success’.

In recent years, greater emphasis is rightly being given to the mental wellbeing of infrastructure workers. Anecdotal evidence has been supplemented by a weight of quantitative research that points to a prevalence of mental ill-health amongst workers across the infrastructure life-cycle. Stakeholder feedback has reinforced that this problem is ubiquitous and is impacted by numerous factors but not least the adversarial nature of our commercial contracting environment.

In Australia, suicides rather than workplace accidents are the leading cause of death for people aged 25 to 44 and construction workers are 70% more likely to take their own lives than employees in other industries.²¹⁸ This is a stark and unacceptable reality.

As highlighted in the *2019 Audit*:²¹⁹

“Workforce wellbeing is also impacted by long-hours and limited opportunities for advancement or the development of skills. Threats to workforce physical and mental health also persist. In particular, high rates of male suicide present a key risk to the sector.”

There is some emerging evidence on the prevalence and root causes of mental ill-health in the Australian infrastructure sector but further investment and research is required to fully understand the issue. We do know that demands on our colleagues to work long and inflexible hours, particularly by comparison to other sectors, is considered a critical contributing factor.²²⁰ Measures targeting wellbeing are often secondary or tertiary levels of intervention, such as employee assistance programs, and fail to directly address the risk factors that result in mental ill-health. More recent ‘primary’ interventions include trialling of the five-day work week by Roberts Pizzaroti and NSW Health on several health construction projects. Anecdotally, the trial is yielding positive outcomes for worker wellbeing and a more holistic assessment of its impact is awaited.

It is acknowledged that as an industry we need to do more and there is a growing movement amongst industry associations, owners, delivery agencies and suppliers to elevate the issue and bring about positive change. However, amongst our industry survey respondents, matters relating to people resilience and wellbeing were still deemed less critical in supporting a productive, innovative and financially sustainable industry.

Box 31: Statistics on worker mental wellbeing**Case study: Statistics on worker mental wellbeing**

Work-related stress cost the Australian economy an estimated \$14.81 billion every year. A survey conducted by Swinburne University in 2018 of over 685 respondents working in the infrastructure construction sector found: average levels of depression, anxiety and stress within our sector exceed population norms by 40% for depression, 38% for anxiety and 37% for stress; physical complaints were observed to be 50% higher than the normal population; and 75% of respondents were suffering moderate to high levels of stress.

Source: Swinburne University²²¹



Some of the barriers we need to overcome in achieving our health, safety and wellbeing outcomes include:

- reputed low profitability across the sector (the so-called 'profitless boom') is placing increased strain on our workforce, including pressure to work long hours, which is adversely affecting our mental and physical wellbeing.
- an emphasis of safety, or health and safety, with a failure to recognise the interconnection with wellbeing. Wellbeing matters are inadequately captured in risk assessments and fail to achieve the same levels of focus and funding.
- health and wellbeing responsibilities are often a 'bolt on' to other functional roles with limited dedicated resources for work in this space. Traditionally, these responsibilities have been absorbed within the Human Resources function, which dilutes opportunities for it to be well resourced and funded.
- the lack of a long-term programmatic approach to delivery results in temporary facilities and operations which are often less safe and the movement of workers from project to projects means relevant knowledge and learnings are diminished.

Recommendation 7.1

Apply a proactive and systemic approach to achieving health, safety and wellbeing outcomes across the sector.

0-5

Recommendation 7.1.1

Drive a focus on health, safety and wellbeing outcomes by ensuring senior leaders are responsible for wellbeing as well as health and safety performance in their organisations. This should include establishing, and subsequent monitoring and reporting of, objectives and benchmarks and pursuing a 'zero appetite' position for health, safety and wellbeing risk.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Industry and relevant industry associations

0-5

Recommendation 7.1.2

Embed health, safety and wellbeing objectives and targets through each infrastructure investment as part of a holistic and consistent approach to achieving health, safety and wellbeing outcomes.

Health, safety and wellbeing objectives and targets should be captured and integrated within each business case, and progressively refined and monitored through design and into delivery. Procurement processes and contracts should clearly define expectations, including KPIs, regarding health, safety and wellbeing so that delivery partners understand expectations from the outset.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Industry and relevant industry associations

5-10

Recommendation 7.1.3

Review and optimise work patterns to reflect and support the health, safety and wellbeing outcomes to ensure workplaces and worksites protect and promote workforce health, safety and wellbeing. For example, this may include implementation of a 5-day working week. Organisations should accurately track all hours worked by employees and implement measures to mitigate the potential for overwork.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

Recommendation 7.1.4

Work with and support industry to understand the underlying causes of, and best practice solutions to, poor levels of mental wellbeing in the infrastructure sector. This could include working with the Construction Industry Culture Taskforce to finalise and promote adoption of the industry Culture Standard.

Proposed lead: Relevant industry associations.

Supported by: Infrastructure owners and delivery agencies, Infrastructure Australia

3.7.2 Equality, diversity and inclusion outcomes are incorporated in all infrastructure development and delivery arrangements

Where do we want to get to?

The industry attracts and nurtures a diverse and inclusive workforce by establishing and systematically pursuing objectives and targets for equality, diversity and inclusion.

- The Australian infrastructure sector is an ‘industry of choice’ for workers.
- Our industry leaders have a deep and current understanding of the challenges faced by disadvantaged and underrepresented groups and the benefits of creating a diverse and inclusive workforce; they are advocates for equality, diversity, and inclusion across the sector.
- People are supported to contribute fully in safe workplaces that value inclusion and diversity.
- Our industry recognises and addresses the personal and structural barriers faced by disadvantaged and underrepresented groups in attaining and retaining employment in the sector.
- Opportunities for participation by a variety of groups are supported including through the availability of multiple entry points to the industry.
- Workforce development pathways are designed and implemented to cater to a diversity of people.
- A diverse and high-performing industry is developed through strategies that motivate the workforce and adopt lead indicators to drive maturity.

“ [The desired state is] a sustainable industry with the adequate skills, capability and capacity to deliver Australia's future infrastructure demands and aspirations. The industry would be built on an inclusive culture where each and every person could reach their full potential in contributing to more user-centred community infrastructure outcomes. Success would result in the infrastructure industry being the place where people opted to work – through a strong purpose, impact and becoming the employer of choice for people seeking great careers. ”

– Industry leader



Box 32: Defining diversity and inclusion**What do we mean by diversity and inclusion?**

The Diversity Council Australia explains Diversity and Inclusion as follows:

Diversity refers to the mix of people in an organisation – that is, all the differences between people in how they identify in relation to their:

- **social identity**, for example Aboriginal and/or Torres Strait Islander background, age, caring responsibilities, cultural background, disability status, gender, religious affiliation, sexual orientation, gender identity, intersex status, and socio-economic background
- **professional identity**, for example profession, education, work experiences, organisational level, functional area, division/ department, and location.

These aspects come together in a unique way for each individual and shape the way they view and perceive their world and workplace – as well as how others view and treat them.

Inclusion refers to getting the mix of people in an organisation to work together to improve performance and wellbeing. Inclusion in a workplace is achieved when a diversity of people (for example ages, cultural backgrounds, genders, or perspectives) feel that they are:

- **respected** for who they are and able to be themselves
- **connected** their colleagues and feel they belong
- **contributing** their perspectives and talents to the workplace
- **progressing** in their career at work (such as have equal access to opportunities and resources).

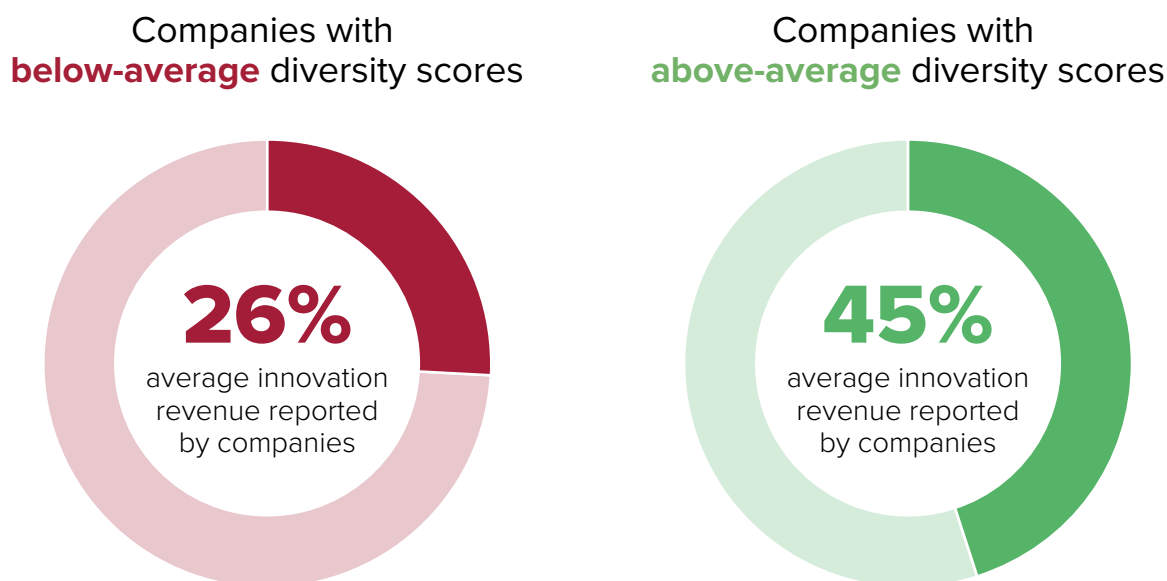
It is only through inclusion that organisations can make the most out of diversity.

Source: Diversity Council Australia²²²

Creating a working environment and culture that appeals to the breadth of society and allows individuals to thrive is paramount. It is the right thing to do and it is necessary to achieve our aspirations for a flourishing infrastructure sector. A positive and effective industry culture is led from the top and creates the conditions that ensures the working environment caters to the broadest range of talent – this is particularly pertinent at a time when our sector is reputedly moving toward peak capacity.

By taking deliberate and meaningful action to understand and address the working needs of women and other underrepresented groups we unlock the potential to foster a more resilient ecosystem, one that is capable of delivering the future infrastructure needs of the people of Australia. It is also appropriate that our strategic outcomes for people and places flow through into the outcomes we seek for the infrastructure workforce.

Genuinely diverse and inclusive workplaces consistently report higher people engagement, resilience, productivity and performance, all of which lead to better business and societal outcomes. Diverse teams provide different perspectives, approaches and experiences, and these diverse views lead to better decision-making. Reports show that when employees are confident there is a commitment to equality, diversity and inclusion they feel more included and the drive to innovate increases.²²³

Figure 17: Companies with more diverse leadership teams report higher revenueSource: Boston Consulting Group.²²⁴

There is an increasing weight of evidence to support the argument that industry homogeneity and a lack of equity impedes financial growth potential. The Workplace Gender Equality Agency has stated that 'Increased gender diversity on boards and in senior executive positions is associated with better financial performance'.²²⁵ The World Economic Forum has further noted that 'companies with more diverse management teams have been found to have 19% higher revenues due to innovation' and 'closing the gender gap has been estimated to add \$28 trillion to the value of the global economy by 2025 – a 26% increase'.²²⁶

“The business case for diversity in the workplace is now overwhelming.”

– World Economic Forum²²⁷

An effective and functional infrastructure sector flourishes through an inclusive and diverse culture by:

- fostering a collaborative and inclusive commercial environment
- attracting and retaining talent and making the sector an appealing employment option
- providing the scope of workforce required to match infrastructure programs
- delivering education and training to meet evolving industry and project requirements.

Through consultation with industry experts, several key best practice elements to succeed in achieving diversity and inclusion outcomes were identified:

- **leadership commitment and communication**, which requires deep understanding of benefits, barriers, and best practice. Diversity and inclusion should be identified as a strategic business priority
- **enabling policies and programs** to attract, retain and advance women and other underrepresented groups. This should include training to raise awareness and share knowledge across the organisation
- **measurement and accountability** to provide focus, achieve progress and incentivise the right behaviours. Establish a baseline, set targets, and continuously measure and report.

Current state

“The industry must be an industry of choice – the industry has a growing problem attracting and retaining people to meet the current and future needs of the industry. Attracting people is a problem across the entire value chain (from constructors through to designers).”

– Industry leader

The case for diversity and inclusivity in the workplace is clear. However, it is evident that the infrastructure sector continues to lack diversity across a range of diversity groups and there is recognition from stakeholders that there is much more we can do to effect positive change.²²⁸ It was also noted that efforts to date appear to have been focused on gender diversity and First Nations participation.

The need for improvement is particularly evident in respect of gender diversity.²²⁹ The infrastructure sector is highly male dominated and in construction women make up only 12% of the workforce (with over three quarters of this cohort engaged in clerical or administrative roles).²³⁰ Whilst this number reflects a 34% increase in the number of women employed in construction roles over the 5-year period from 2015 to 2020, it is clear there is much room for improvement, particularly when noting that women make up 47% of all people employed in Australia.²³¹ A dearth of women in leadership in the sector perpetuates the problem by failing to provide visible role models for others to aspire to.

As noted in the *2019 Audit*:²³²

“The construction sector is Australia’s third largest employer, yet it has the lowest levels of female workplace participation of any industry.”

Increasing the participation rates of Aboriginal and Torres Strait Islander peoples is also a strategic priority for government and a noted area for improvement within the sector. Strategies to improve First Nations people participation are already quite advanced in some jurisdictions, with various state governments embedding First Nations people participation into procurement processes and contract arrangements, such as the NSW Aboriginal Participation Policy, Queensland Indigenous (Aboriginal and Torres Strait Islander) Procurement Policy and WA Aboriginal Procurement Policy.²³³

Strong commitments to clear objectives supported by numerical targets is important to drive change to diversify workforces and build resilience. Ongoing investment to understand the effectiveness of these and other tools to drive change is needed to ensure continuous improvement.

The industry has begun to acknowledge the problem and effort is being put into pursuing improvements in diversity and inclusion. While some progress has been made, the industry lacks an integrated approach and a unifying position on equality, diversity and inclusion outcomes. This is compounded by negative perceptions of workplace culture that make the infrastructure sector a less appealing place to work. Action is needed to align the outcomes sought for people and places to ensure these cascade through all aspects of the infrastructure ecosystem.

“Our infrastructure industry is not currently sustainable – it is not a place that people are attracted to come and be part of which is evidenced by low levels of diversity and high rates of suicide and attrition.”

– Industry leader

The *NSW Government Action Plan: A ten point commitment to the construction sector* has specifically called out the need to identify, measure and report on the diversity of the workforce in the construction sector and related trades.²³⁴ This includes a commitment to increase female representation and First Nation people participation and targeting younger age (less than 25 years) people for recruitment into the industry. Stakeholders have commended these laudable aspirations, but the feedback indicates that industry has been slow to implement.

The Australian Constructors Association (ACA), Consult Australia and Roads Australia are some of the organisations lending their voice to support the need for a step change in our culture and increased diversity across the sector. The ACA’s Construction Industry Culture Taskforce for example, has identified improvements in diversity as a key ingredient for addressing industry culture.²³⁵ They are working with industry to develop a ‘Culture Standard’ that aims to tackle the interrelated issues of excessive work hours and fatigue, poor mental health, and failure to attract a diverse workforce.

Stakeholders also highlighted the need to drive a new agenda for how young people are attracted to the sector – place greater emphasis on marketing the sector as one that is about complex problem solving and having a positive impact on people

and communities. Others cited the perceived low levels of innovation and poor environmental sustainability as drags on the attractiveness of the industry, particularly to younger workers.

“Our industry is responsible for creating Australia's future – driving around our communities there isn't much that our industry isn't able to impact. We should easily be the employer of choice – an industry young people strive to be part of. That should be our goal.”

– Industry leader

The barriers to achieving our equality, diversity and inclusion outcomes are myriad and there is no quick fix. To achieve progress we need to fully understand the systemic nature of the problem. Research and stakeholder feedback has highlighted the following as being critical to overcome:

- a general lack of understanding on diversity and inclusion issues, particularly those specific to the infrastructure sector, and the business case for change
- plans and initiatives that lack ‘targets with teeth’ resulting in a lack of ownership and accountability for bringing about meaningful change
- recruitment practices that are too ambiguous or informal and a reliance on recruiting within our network which perpetuates the issue
- long working hours and other working practices that introduce barriers to productivity
- limited diversity in the employee pipeline. For example, a limited pipeline of women graduating from STEM disciplines
- poor perception of the workplace culture.



Recommendation 7.2

Establish objectives and targets for equality, diversity and inclusion and ensure these are systematically pursued to foster a resilient, diverse and inclusive workforce.

0-5

Recommendation 7.2.1

Foster a resilient, diverse and inclusive infrastructure sector by ensuring senior leaders are responsible for establishing equality, diversity and inclusion objectives and for demonstrating continuous improvement against stated targets:

- Senior leaders should be trained to fully appreciate the challenges and benefits equality, diversity and inclusion, and understand good practice methods for achieving effective outcomes.
- Senior leaders to become advocates for equality, diversity and inclusion and across industry more broadly.
- Develop diversity and inclusion policies, strategies and plans, and address matters such as parental leave and flexible working arrangements.
- Embed equality, diversity and inclusion KPIs, including recruitment, development and promotion targets, in reporting.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

Recommendation 7.2.2

Establish and embed equality, diversity and inclusion objectives through each infrastructure investment as part of a holistic and consistent approach to achieving outcomes. Equality, diversity and inclusion objectives should be captured and integrated within each business case, and progressively refined and monitored through design and into delivery. Procurement processes and contracts should clearly define expectations, including KPIs, regarding equality, diversity and inclusion so that delivery partners understand expectations from the outset.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

0-5

Recommendation 7.2.3

Industry should work collaboratively to develop and implement an industry survey to develop a deeper understanding of the relative experiences and challenges across all groups working in the infrastructure sector so that targeted measures can be implemented to achieve equality, diversity and inclusion outcomes.

Proposed lead: Relevant industry associations

Supported by: Infrastructure Australia

0-5

Recommendation 7.2.4

Champion equality, diversity, and inclusion across the infrastructure sector, and publish metrics and performance against benchmarks on an annual basis, building on the framework developed by the Workplace Gender Equality Agency.

Proposed lead: Department of Infrastructure, Transport, Regional Development and Communications

Supported by: Infrastructure Australia, Workplace Gender Equality Agency and industry associations

5-10

Recommendation 7.2.5

Uplift industry knowledge and understanding by adopting transparent reporting on the performance of equality, diversity and inclusion strategies to enable sharing of good practice and lessons learned.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

5-10

Recommendation 7.2.6

Implement measures, such as more gender equitable approaches to recruitment and promotion, to reduce the gender pay gap. Increase pay transparency and implement reporting on gender pay gaps.

Proposed lead: Infrastructure owners and delivery agencies

Supported by: Relevant industry associations

4. Implementing the roadmap

4.1 Who is this roadmap for?

This roadmap is aimed at policy, strategy, procurement, delivery and operations professionals across public infrastructure owners and delivery agencies who are responsible for the planning, procurement, and delivery of public infrastructure solutions. The best practice framework presented in this roadmap can be embedded within an owner's or delivery agency's structure from governance through to individual project or program delivery.

This roadmap is supported by the detailed analysis undertaken by Infrastructure Australia in the *2019 Australian Infrastructure Audit*, the *2021 Australian Infrastructure Plan* and the *2021 Infrastructure Market Capacity Report* and outlines a comprehensive action plan for the industry.

While the *2019 Australian Infrastructure Audit* identifies a wide range of issues across the Australian infrastructure industry, and the *2021 Australian Infrastructure Plan* provides a series of policy recommendations targeted at addressing those issues, this *Delivering Outcomes* roadmap presents a practical, pragmatic and implementable series of actions for adoption by delivery agencies, infrastructure owners and industry. This is a comprehensive action plan, that will require dedicated and sustained contribution across all industry participants.

Successful project delivery requires cross-functional integration and bringing together different areas of professional expertise. Critical to achieving the transformation change required is ensuring integrated teams have input from the right functions at the right time. To ensure effective implementation of the recommendations in this document, it will be important for States and Territories to work closely with the Commonwealth as well as industry bodies and to identify the key sponsors within their structure who will be responsible for driving the reform agenda within their jurisdictions.

Commitment, collaboration and leadership are critical in delivering the roadmap. As identified through the roadmap, industry representative groups themselves are critical in galvanising support across industry, providing opportunities for collaboration with government, and driving change through their membership.

Infrastructure Australia welcomes the ongoing contribution of a wide range of industry bodies, both in terms of supporting the development of this document, and in anticipation of support in the implementation of the roadmap. In particular, Infrastructure Australia would like to recognise the leadership demonstrated by industry representative groups including the Australian Constructors Association, Australian Owned Contractors, Australasian Railway Association, Civil Contractors Federation, Consult Australia, Engineers Australia, Infrastructure Association of Queensland, Infrastructure Partnerships Australia, Infrastructure Sustainability Council of Australia, Internet of Things Alliance, Institute of Public Works Engineering Australasia and Queensland Major Contractors Association, Roads Australia, and the Smart Cities Council Australia New Zealand. As identified through the roadmap, industry representative groups themselves are critical in galvanising support across industry, providing opportunities for collaboration with government, and driving change through their membership.

Figure 18 provides an analysis of the 30 key principles presented in the roadmap mapped against core functional groups. This should be considered a guide to support owners and delivery agencies in implementing the roadmap. It is recognised that functional ownership may vary across different owners and delivery agencies depending on their respective structure. Roles and responsibilities include:

- **Proposed lead:** deliver specific activities or lead related outcomes
- **Support:** share ownership, contributions or knowledge to enable the reform process.

It is expected that all members of each functional group are adequately informed for all activities.

Figure 18: Functional ownership across the roadmap principles

Focus area	Principle	Policy	Strategy	Procurement	Delivery	Operations
Outcomes	3.2.1 Outcomes	Own	Own			
	3.2.2 Outcomes focused delivery models		Own	Support	Support	
	3.2.3 Project scorecards		Own	Support	Support	
Systems	3.3.1 Infrastructure as a system		Own	Support	Support	
	3.3.2 Investment pipelines	Own				
	3.3.3 Portfolio approaches		Own	Own		
	3.3.4 Benchmarking	Own	Support			
	3.3.5 Continuous improvement	Own	Support	Support	Support	Support
Digital	3.4.1 Common framework	Support	Own	Support	Own	Own
	3.4.2 Golden loop	Support	Own			
	3.4.3 Information as an asset	Own			Support	Own
	3.4.4 Digital transformation strategies	Own	Own		Own	Own
	3.4.5 Digital twins		Own		Support	
	3.4.6 Enabling smart infrastructure		Own	Support	Support	Support
Ecosystem	3.5.1 Governance		Own			
	3.5.2 Collaborative relationships	Support	Own	Support	Support	
	3.5.3 Successful relationships		Own		Support	
	3.5.4 Early engagement		Own	Support	Support	
	3.5.5 Integrated teams		Own	Support	Support	Support
Commercial	3.6.1 The right partners		Own	Own	Support	
	3.6.2 Risk allocation	Own	Own	Support	Support	
	3.6.3 Fair return	Own	Own	Support	Support	
	3.6.4 Should cost models		Own		Support	
	3.6.5 Standardised contracts	Own	Support	Own	Support	
Innovation	3.7.1 Modern methods of construction		Own		Own	
	3.7.2 Production systems		Support	Support	Own	
	3.7.3 Delivery enterprises		Own		Own	
	3.7.4 Product platforms		Own	Support	Own	
People	3.1.1 Health, safety and wellbeing	Own	Own	Own	Own	Own
	3.1.2 Equality, diversity and inclusion	Support	Own	Own	Support	Support

4.2 Implementing the roadmap

The following table sets out what owners and delivery agencies and Infrastructure Australia should do to support the adoption and implementation of the roadmap.

The recommendations to support the transformation of the sector include proposed leaders and supporting bodies that can enable the adoption of reform. In addition to the role of these organisations on specific reforms there is an enduring role for delivery agencies, and Infrastructure Australia, in supporting industry reform and optimising project delivery.

Table 4: Actions to support the implementation of the roadmap

Actions	
What should owners and delivery agencies do?	• Undertake a maturity assessment against the roadmap principles and develop a strategy to progressively move towards achieving best practice against each principle. • Nominate a senior representative and team to be accountable for supporting industry reform, including implementing actions against the roadmap. Progress on some actions may require additional funding or be reliant on support from government. • Undertake a capability assessment of the skills and expertise required to achieve the roadmap best practice principles and implement appropriate training to support capability uplift. • Develop mechanisms and processes for identifying best practice and disseminating lessons learned to support internal the uplift of internal processes.
What should Infrastructure Australia do?	• Develop a process to monitor owners' and delivery agencies' progress against the roadmap. • Nominate a senior representative and team to be accountable for supporting industry reform, including implementing actions against the roadmap. Progress on some actions may require additional funding or be reliant on agreement with the Australian Government. • Develop a collaboration forum for government and industry leaders seeking to share best practice. • Work with owners and delivery agencies to develop exemplar projects that will be the source of future best practice across a specific infrastructure class and disseminate the learnings across the infrastructure sector.
What should industry groups do?	• Partner with government to identify priority areas for reform and to support adoption. • Develop dedicated membership committees tasked with supporting reform.

4.3 The Transport National Cabinet Reform Committee

On 9 July 2021, National Cabinet met and endorsed work to be progressed through the Transport National Cabinet Reform Committee under the title of *Expediting planning and approval processes for major infrastructure and optimising job opportunities*.

Infrastructure Australia is collaborating with the Department of Infrastructure Transport, Regional Development and Communications (DITRDC) to progress this work. The *2021 Australian Infrastructure Plan* and the findings from *Delivering Outcomes* are helping inform the scope as it is further developed with state and territory officials through the newly established Streamlining and Optimising Working Group (SOWG).

Glossary

The following glossary describes key terms as they are used in this roadmap.

Key term	Description
Asset	ISO 55000:2014 defines an asset as an ‘item, thing or entity that has potential or actual value to an organization’.
Asset management plan	ISO 55000:2014 defines an asset management plan as ‘documented information that specifies the activities, resources and timescales required for an individual asset, or a grouping of assets, to achieve the organization’s asset management objectives’.
Benefits	Benefits are the measurable improvements resulting from infrastructure investment or reform.
Building information modelling (BIM)	The digital representation of physical and functional characteristics of physical infrastructure or the built environment. ²³⁶
Contract form	A legal framework between two or more parties that may be standardised in nature and layout. For example, NEC4 suite of contracts is a form of contract, or a contract form. ²³⁷
Contract option	A set of commercial arrangements for different types of services, sectors or risk allocation. For example, NEC4 Alliance Contract is a contract option. ²³⁸
Contractor	Delivery service providers primarily for construction.
Delivery agency	A government-funded organisation typically tasked with planning, development and delivery of public infrastructure. In some cases, responsibility for operating the asset is also managed by a delivery agency with expanded functions.
Delivery integration	Integration of the various parties and activities involved in the delivery of infrastructure planning, design and construction.
Delivery model	A commercial and governance structure that defines how a project or program will be delivered.
Design for manufacture and assembly (DfMA)	A process by which building products, spaces or components are designed that enables a more seamless transition to manufacturing or assembly. ²³⁹
Digital delivery	A collaborative way of working using digital processes and systems throughout the lifecycle of a project and/or asset. It is a convergence of technologies such as Building Information Modelling (BIM), Geographic Information Systems (GIS), and other related information management systems. ²⁴⁰
Digital engineering	A branch of engineering knowledge and practice that deals with the creation and practical use of data or computerised devices, methods, systems and processes. ²⁴¹
Digital product platform	A digital catalogue of products (i.e. individual or pre-assembled components) used in construction (also known as a ‘kit of parts’).
Digital transformation	Wholesale changes in how the industry designs, operates, maintains and decommissions assets. It also refers to transformation of how we value data, and the impacts upon processes and systems and decision-making. ²⁴²
Digital twin	A highly accurate digital representation of physical assets, processes and systems that have a data-connection with the real world. ²⁴³

Key term	Description
Ecosystem	A network of parties responsible for or involved in planning, procurement, delivery and operation of infrastructure. The subset of the industry relevant to a project or sub-sector.
Enterprise approach	An enterprise approach brings together owners, partners, advisers and suppliers into a formal network, an 'Enterprise', working in integrated and collaborative arrangements, underpinned by long term relationships. Participating organisations are incentivised to deliver better outcomes. ²⁴⁴
Environmental sustainability	The responsible interaction with the environment with the aim of avoiding unnatural negative impacts and creating a positive feedback cycle.
Financial sustainability	The commercial health (i.e. profitability) of participants in the delivery of infrastructure solutions. An entity is financially sustainable when its infrastructure capital and financial capital is able to be maintained over the long-term. It does this by being able to manage likely developments and unexpected financial shocks in future periods without having at some time to introduce substantial and economically significant or socially destabilising revenue or expenditure adjustments.
Focus area	This report sets out seven overarching focus areas of reform as the framework for this roadmap.
Golden loop	A connection between information gathered during asset operations and information required in planning, design and delivery phases. This 'feedback' loop is a key part of a continuous improvement cycle.
Hand-off	Typically refers to a party transferring ownership or responsibility to another party between different phases of an infrastructure project (for example, the handover between delivery and operations teams).
Industry 4.0	A contemporary industrial revolution concept affecting almost every industry globally. Industry 4.0 considers transformative technologies to connect the physical world with the digital world. Current trends include advanced automation and robotics, machine-to-machine and human-to-machine communication, artificial intelligence (AI) and machine learning, sensor technology and data analytics. ²⁴⁵
Infrastructure	The physical and non-physical economic and social assets and associated services that enable society to function. Includes transport, water, energy, telecommunications and social infrastructure sectors.
Infrastructure solution	The broad range of infrastructure related interventions, including assets, markets or reform, that are available to solve an identified societal need.
Modern Methods of Construction	Modern Methods of Construction refers to the broad range of innovative construction approaches, ranging from design for manufactured assembly, offsite construction, pre-fabrication, modularisation, and digital supply-chain integration.
New Engineering Contract (NEC)	NEC is a suite of standardised contracts developed by the UK Institution of Civil Engineers for use in a variety of works, services and supply. ²⁴⁶
Outcomes	The desired change experienced by users or the environment that arises from infrastructure solutions (e.g. improved life expectancy as the result of increased health services, or reduced travel delays as a result of more road capacity). Inputs are combined or influenced to directly form outputs. These outputs can indirectly influence outcomes.

Key term	Description
Outputs	A direct product that is created as a result of the combination or influence of inputs. For instance the behaviour of an asset or the environment (i.e., lane-kilometres, number of floors in a new hospital). When effectively integrated, outputs enable desired outcomes to be achieved. ²⁴⁷
Owner	Typically refers to the ultimate custodian responsible for the infrastructure, usually the government. The government sometimes functionally manage the asset through delivery agencies (see 'delivery agency') and through private-sector partners.
Partner	A provider of strategic services such as advisory or design, often engaged over a long period of time or for a relatively large program of work.
Platform approach	A term commonly used in manufacturing referring to a set of components or assemblies that can be put together in a multitude of different ways to create multiple different products or serve several different use cases. ²⁴⁸
Price-based model	A model for estimating cost based on estimated prices, usually provided by a supplier in response to a request for tender for services.
Prime contractor	The principle counter-party to the client in an arrangement or contract to provide as service or good.
Principle	An action orientated statement that is a sub-set of a focus area, that together make up the frame of this report.
Production system	A system used to deliver a service or product that integrates planning, design, manufacturing, logistics, assembly, testing and commissioning, and post-commissioning.
Program	A suite of related initiatives (typically projects) to be delivered in a coordinated manner to obtain benefits not achievable from delivering them individually.
Project 13	A concept introduced by the UK Institute of Civil Engineers that proposes a new 'Enterprise' approach to infrastructure delivery should be implemented over the traditional transactional approach. ²⁴⁹
Project scorecard	A tool that supports a client in identifying and communicating its priority themes and the underlying critical success factors that will support delivery. Underpinning each critical success factor, there is a set of key performance indicators which are measured and which enable the client to manage performance during the delivery phase. ²⁵⁰
Proponent	Parties interested in promoting or providing a good or service.
Risk allocation	An exercise in collaboratively apportioning risk. A risk allocation process appropriately considers risk in the context of affected parties and those that are best suited to manage a particular risk(s).
Risk appetite	The amount of risk the organisation, or subset of it, is willing to accept. Often this term is used in a qualitative manner.
Risk transfer	An approach to minimise exposure through reassignment of risk ownership.
Selection criteria	Criteria used to assess the veracity of a proposal or bid to provide goods or services.
Should Cost Model	A model for estimating cost based on historical benchmarks of previous actual outturn and operational costs.

Key term	Description
Smart infrastructure	The result of combining physical infrastructure with digital infrastructure, such as sensors, internet of things, networks, or BIM/GIS, to provide improved information to drive better decision-making. ²⁵¹
Sub-contractor	A provider of a specific product or service within to a prime contractor.
Supplier	A party that provides goods or services.
Supply chain	The various network of suppliers of goods and services involved in delivery of an infrastructure solution.
Sustainability	The balance of economic, social, environment and government outcomes.
User	Any person, business or organisation that uses, or desires to use, infrastructure.
Value for money	The concept of receiving appropriate amenity or function from an investment unbounded by time (i.e. now or future) or source (capital, resources, or environment). It differs to the concept of lowest cost. Delivering value-for-money requires an understanding of all benefits compared to benchmark costs. The approach should be to maximise the benefits within the bounds of the reference/benchmark cost.

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It leads reform on key issues including the means of financing, delivering and operating infrastructure and how to better plan and utilise infrastructure networks. Infrastructure Australia has responsibility to strategically audit Australia's nationally significant infrastructure, and develop 15-year rolling infrastructure plans that specify national and state-level priorities.

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