Comment – Australian Constructors Association

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The Australian Construction Association (ACA) welcomes the Queensland Productivity Commission's (QPC) construction productivity interim report and commends QPC on the extent of the proposed recommendations and reform directions that it outlines. It is clear that QPC understands the opportunity that this inquiry represents to fundamentally improve the construction sector and unleash its productivity potential. What is ultimately required is to rebuild trust between stakeholders in the construction supply chain. Productivity improvement will be achieved through reforms that increase the level of collaboration and cooperation between all industry stakeholders and which remove the barriers to greater innovation and the realisation of efficiencies.

Delivering Construction Productivity

AUSTRALIAN CONSTRUCTORS ASSOCIATION RESPONSE TO – OPPORTUNITIES TO IMPORVE PRODUCTIVITY OF THE CONSTRUCTION INDUSTRY INTERIM REPORT

AUSTRALIAN CONSTRUCTORS ASSOCIATION

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Introduction

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What is ultimately required is to rebuild trust between stakeholders in the construction supply chain. Productivity improvement will be achieved through reforms that increase the level of collaboration and cooperation between all industry stakeholders and which remove the barriers to greater innovation and the realisation of efficiencies.

Key to this is the permanent removal of Better Practice Industry Conditions (BPIC) and a continuing discussion as to how its impact can be limited. The analysis undertaken by QPC to determine the impact of BPIC provides clear evidence that there is not benefit to the continuation of this policy, which reflects the experience of ACA members.

Underpinning the construction sector's ability to invest in improving productivity is its financial health. Financial regulation introduced by Queensland that was aimed at supporting financial viability has been ineffective and ACA supports the recommendation made in relation to minimum financial requirements and trust accounts. There is no evidence that either measure has been effective and both act as a barrier to constructors undertaking work in Queensland.

This inquiry represents a significant opportunity to standardise and streamline how the Queensland government procures and manages the delivery of infrastructure. This will allow the development of deep expertise and understanding that can be applied across the delivery of all infrastructure. It will allow for the development of common processes and systems that enhance efficiency across both clients and constructors.

The ACA and its members stand ready to provide any further information or feedback required to support the QPC as it develops its final report to the Queensland Government.

CONTACT

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[redacted]

Procurement

Request for information – Queensland Government Procurement Policy

The Commission would like further information on:

- How Queensland Government procurement policies:

  – impact the procurement decision of government

  – affect contractor behaviour and on-site productivity

  – provide benefits or costs not considered by the Commission and whether these justify their retention.

- How the pre-qualification system impacts contractors, building consultants and subcontractors, and the extent to which it impacts the ability of small and medium subcontractors in regional areas to compete for government tenders, and what could be done to improve matters.
- Whether there are more appropriately sized PQC thresholds and the extent to which these thresholds should vary for different stakeholders.

Procurement policies impact on contractor behaviour and on-site productivity

Existing procurement policies in Queensland have led to significant project delays and increased costs. This directly affects contractor behaviour and on-site productivity. For example:

- Contractors are becoming more selective in the projects they bid in Queensland due to high tender costs and long procurement timelines, which may result in reduced construction market capacity and competition.
- Extended tender phases and post-tender reviews force contractors to retain bid teams and external consultants longer than is usual, this adds to the cost of bidding and extends the end-to-end delivery times for projects.
- Increased procurement complexity also increases the resource requirement for constructors and adds additional cost. These costs are recovered directly through bid cost reimbursement or through overhead recovery on successfully tendered projects.

The ACA recently worked with Oxford Economics to undertake high-level analysis of the impact of halving the cost of bidding (design and construct projects) to the construction industry. This analysis suggests a potential direct benefit of $743 million, as costs are reduced and resources are re-directed towards productive activities. This opportunity is estimated to have a total economic benefit of $2.1 billion, which captures the flow on benefits to the economy of a more productive construction industry.

Procurement also impacts on on-site productivity:

- Delays in approvals, such as planning and environmental, postpone construction starts or delay activity, this not only places pressure on the project to meet planned timeframes but also increases holding costs and disrupts workforce planning.

- Local content requirements such as "Buy Queensland" can restrict supplier competition and can open the door for third party influence to push their preferred supplier. Limiting the supplier pool can limit the availability of workforce, the cost of these resources and the quality of work.

A quick Expression of Interest (EoI) process that shortlists only two parties to go through to tender, can be effective in avoiding unnecessary effort on a tender and therefore, related cost. Paradoxically, a smaller short-list may also result in greater competition – as both parties consider that they have a strong chance of success the effort devoted to the tender process is likely to be high.

Tender stipends or bid cost reimbursement provide increased opportunity for contractors to explore innovative solutions and opportunities for risk mitigation as they are not focused on keeping tender costs down to minimise head office overheads.

Impact of the prequalification scheme on contractors

The Queensland prequalification scheme adds to the already restrictive environment that is created through minimum financial requirements (MFR) and net tangible asset requirements. Queensland has the most stringent prequalification thresholds and opportunities to alleviate these requirements involve the provision of security in the form of bonds and bank guarantees, which is an additional expense.

This adds to the indirect costs of delivery and allocates resources and effort away from productive activities – that are focused on infrastructure delivery rather than satisfying a prequalification threshold deficiency. This also reduces a contractor's available facilities with their financiers to conduct further productive work.

The prequalification scheme is time consuming for teams to manage, with resources required to manage both the contractor's prequalification and subcontractor or supplier prequalification. The prequalification process is often inefficient and duplicative, requiring contractors to re-demonstrate "best practice" principles (safety training IR) in EOIs even though this has already been assessed as part of prequalification.

Compliance with the requirements of prequalification is one of the increasing indirect costs of delivering infrastructure. Similar to the work undertaken to identify the benefits of reducing the cost of bidding the ACA also recently worked with Oxford Economics to estimate the benefits of reducing indirect delivery cost by 10%. This resulted in savings to the non-residential construction industry of $5.7 billion annually. These benefits are likely to be even greater if it is assumed that a portion of the effort that is direct to the activities that make up indirect costs are devoted to delivery.

There are also issues with existing thresholds that apply within the prequalification scheme:

- They may not reflect actual market conditions or contractor capacity, especially in regional areas.
- Thresholds that are too rigid can exclude capable firms from participating in bundled or large-scale projects.

- Existing financial thresholds are binary and do not take into account any previous contractor history and success.
- Existing thresholds within the prequalification scheme essentially represent a penalty for taking on state government work – it minimises any incentive to take part in government funded works.

A better approach would be to:

- Introduce flexible thresholds that consider project complexity, location, and contractor experience.
- Use Early Contractor Involvement (ECI) to assess capability in real-time rather than relying solely on static thresholds.
- Encourage collaborative models that allow contractors to demonstrate value through innovation and partnership rather than just scale.
- Place greater emphasis on non-financial criteria, such as delivery of recent projects and recent project completion values to show financial capacity, with a review of existing project portfolio.

AUSTRALIAN CONSTRUCTORS ASSOCIATION

Contractual Arrangements

Request for information – Improving Tendering and Contracting

The Commission would like further information on:

- the key barriers to increased adoption of digital technologies, such as Building Information Modelling, and the policies or practices that would allow the opportunities for digital technologies to be fully leveraged
- the benefits and costs of collaborative contracting arrangements, and the key barriers to greater adoption of collaborative contracting (including early contractor engagement)
- how risk can be more appropriately allocated in government contracts
- the benefits and costs of adopting standardised contracts
- the extent to which there are likely to be benefits from greater bundling of projects, and the extent to which this might prevent competition by preventing smaller firms from tendering for work
- whether government procurement agencies have the capacity to undertake the types of changes noted in submissions, and what additional capabilities (public and private) are required and how these could be best achieved
- examples of successful approaches that have been used to incentivise improved risk-allocation by contracting agencies
- the pros and cons of replacing prescriptive specifications with more performance-based specifications.

Adoption of digital technologies

As part of the ACA's involvement in the development of the National Construction Strategy (NCS) we have led a workstream aimed at identifying the barriers to the adoption of modern methods of construction (MMC) and new technology as options for addressing these. To inform this work stream ACA engaged Mott MacDonald to undertake desktop research and extensive stakeholder engagement, which has result in two reports. The first identifies the range of barriers to adoption and the second provides recommended actions to improve adoption, and construction productivity.

Both reports are attached as appendix to this submission.

Collaborative contracting arrangements

There has been a consistent call from the construction industry for greater collaboration in the procurement and delivery of projects. This is primarily driven by the belief that the delivery of infrastructure can be improved substantially if contractors are involved earlier and their skills and knowledge used to inform each phase of the project lifecycle. There are a range of different collaborative contracting models, which suit different projects and outcomes, but all generally include earlier contractor involvement and efforts to align stakeholder interests. Integrated project delivery lies at the top end of the collaborative contract scale.

An integrated project delivery approach employs a different philosophy—the project participants accept and manage design and construction risks as a team. Interests are aligned to ensure reduced disputes and improved project outcomes. All the key parties involved in the design, fabrication, and construction aspects of a project are joined together under a single agreement.

The integrated approach provides an environment conducive to the open and transparent sharing of information needed by many new productivity-enhancing digital technologies. This approach also requires far fewer people to manage the project as project roles are filled by the best person for the job, regardless of whether they are ultimately employed by the owner, designer or contractor. There is no need to supervise what the other party is doing and no need to have large commercial teams focused on claim preparation/ defence.

Efficiency is improved even further by all project personnel being located in the same office, making communication easier and allowing quicker resolution of issues. A collaborative approach is particularly beneficial the greater the level of uncertainty as it promotes information sharing and a cooperative approach to understanding the project needs and then determining how this can be achieved.

A more collaborative contract model can deliver substantial benefits. These include:

- Improved risk identification, management and mitigation through shared and transparent processes.
- Improved risk allocation – earlier and improved identification allows transparent discussion of allocation.
- Greater innovation and efficiency by allowing contractors to propose solutions early.
- Development of stronger relationships and trust between clients and constructors.
- A reduction in disputes and a less adversarial environment.
- Greater constructability and value management – early engagement an ability to influence scope/ design can lower costs and reduce design and construction time.
- Improved costing accuracy.

Case Study: Collaborative Contracting – Edmonton to Gordonvale road upgrade

A $481 million major upgrade of the Bruce Highway between Edmonton and Gordonvale, south of Cairns to make travelling safer and more reliable and to improve flood resilience in the area. This project included a 10.5km upgrade including duplication of all existing two-lane sections to four lanes, new service roads, the relocation of 4.4km of rail line, the construction of two new active level crossings and the relocation and construction of 8.8km of cane rail.

Collaborative elements that contributed to successful delivery include:

- Collaborative Partnership Agreement that enabled joint risk management
- Designer was a joint-venture partner (with contractor) and had profit tied to project success.
- Shared project charter and co-location fostered mutual respect and rapid decision-making.
- Innovations included eMesh concrete, solar hybrid systems, and early procurement.

There are costs and barriers that can prevent the use of contract models that include greater collaboration, these include.

- Tendering costs may be higher as a result of using interactive processes – although this process should result in greater efficiency in delivery and a net reduction in project costs.
- Cultural resistance within agencies to collaborative behaviours – a culture of two-way collaboration on both sides is needed.
- A lack of capability and capacity – collaborative models need the people on the project who are able and empowered to make decisions and resolve issues progressively.

Standardised contracts

There is an increasing tendency for clients to use either heavily modified standard forms or bespoke contracts for individual projects. The complexity of these modified/ bespoke forms has led to inefficiencies and disputes arising from their interpretation.

If the construction industry reverted to standard forms of contract the saving in costs for legal advice alone would be substantial, not to mention the time that all parties would save during project procurement. While not all disputes arise from differing interpretations of contract provisions, many do. In 2018, an industry survey identified that, on average, industry professionals spend nearly 5 hours a week just dealing with disputes.[1]

There are a range of benefits to be realised from the use of standard contract forms, many of which have implications for improved productivity. These benefits will be maximised the more broadly standard contract forms are adopted.

[1] Construction_Disconnected.pdf, accessed 26 August 2025

Benefits include:

- Reduced negotiation time and legal costs - Reduced upfront cost required to review and negotiate contracts between parties, reducing expenditure on indirect costs also minimises resources required and time taken.
- Consistent expectations across projects – improves decisions makings and assessment of project risks.
- Facilitates benchmarking and performance comparison.
- Increased clarity for contracting parties about risk allocation.
- Deeper skills and contracting understanding.
- Increased certainty of pricing and time contingencies and an overall more successful project.

Project Bundling

Some of the inefficiencies present within the construction industry are a result of the 'projectification' of construction. Budgets, procurement, delivery, resourcing, contracts and a range of other aspects are designed to support the delivery of a single project. There is often little consideration given to how a program or portfolio of work can best be delivered and the efficiencies that this may deliver. A programmatic approach, or the budling of projects together for the purposes of procurement and delivery, could deliver substantial productivity benefits, including:

- Economies of scale (e.g. in procurement, design, staffing) and reduced overheads (e.g. in tender costs, project overhead/indirect costs).
- Streamlines delivery and simplifies management.
- Opportunity to benefit from learnings from previous stages or projects within the bundle.
- Opportunity for greater repetition (e.g. facilitating opportunities for prefabrication or offsite manufacturing).
- Fewer / better able to manage interfaces.
- Ability to plan longer-term incentivises investment in R&D, systems and processes that enable productivity gains.
- Ability for resources to span multiple projects over linger timeframes providing greater certainty for workforce, this may even provide confidence for contractors to employ workforce rather than relying on labour hire.
- Shared preliminaries and overhead costs (such as, for example, site sheds and similar facilities) across projects reducing overall costs.

Case Study: Program Approach – Victoria Level Crossing Removal Program (LXRP)

LXRP was established by the Victorian Government to oversee one of the largest rail infrastructure projects in the state's history. It includes the elimination of 75 level crossings and the delivery of other rail network upgrades such as new train stations, track duplication and train stabling yards.

LXRP's Program Alliance framework is the primary delivery mechanism for its portfolio of works. It provides for the development and delivery of multiple work packages, on a fully allocated and staged basis, across five Program Alliances. The 'program' approach has driven a longer-term manufacturing or production mindset to development and delivery, rather than a bespoke approach to single-site projects.

The certainty created through the full allocation of work packages enables each Alliance to attract and retain large-scale, high performing teams and to drive continuous improvement. It provides the certainty needed for investment in skills development, plant, longer term supply chain agreements, workplace conditions and solution standardisation and reuse. Importantly, upfront investment is offset by efficiencies realised across subsequent packages and between Program Alliances.

Key outcomes of the program approach include:

- procurement efficiency
- realising lower overall risk profiles in proposal pricing
- delivering optimal scope and quality outcomes
- a culture of innovation and continuous improvement; with the application of lessons learnt from package to package and investment in solution standardisation and reuse
- optimal time and value-for-money outcomes
- minimising claims and disputes.

One of the arguments against bundling is that it increases the size of the program of work to be delivered and as a result precludes smaller firms from participating – limiting both their ability to grow and also the competitiveness of the tender process.

Larger packages may exceed the capacity of smaller firms not only in terms of their resource capacity but also in terms of their financial capacity. Limiting the number or size of constructors that can deliver the program may also limit the diversity of approaches to delivery and access to innovation and specialised skills from niche providers.

However, many of these risks can be overcome through the use of subcontracting, which allows efficiencies without limiting the access to capability and capacity. It also provides access to large government contracts to smaller firms, allowing them to build their expertise and develop capacity.

Further, it is not the case that all projects should be bundled. In many cases there may be no benefits from delivering projects as part of a program and clients may get the greatest value from continuing with a project base approach. Therefore, it should be the case that there will remain multiple opportunities for smaller organisation to contract directly with government clients.

Better risk allocation

Construction is a risky business; there are risks involved in the construction of every project. These risks include things like abnormally inclement weather, unforeseen ground conditions, input price volatility, material availability, equipment breakdown and much, much more. Some of these risks can be estimated, mitigated and managed by the contractor but many cannot, and it is not appropriate to expect them to do so.

The mantra of 'the party best able to manage the risk should bear the risk' is premised on the false notion that being able to manage a risk equates to being able to estimate and bear the financial cost of dealing with the risk if it eventuates. On even small projects this liability can run into many millions of dollars. Inappropriate risk allocations impact productivity in several ways. In a competitive procurement process where the lowest tender wins at the exclusion of all other criteria, contractors are essentially encouraged to risk their own businesses by pricing unquantifiable risk.

A casualty of poor risk allocation has been transparency and the sharing of project information. Information is unlikely to be shared if it can be used to prepare or defend claims for additional cost related to the realisation of inappropriately transferred project risk. Ideally, risks that cannot be quantified and priced should be dealt with openly and transparently, encouraging collaboration and innovative thinking rather than adversarial behaviour and disputes.

There are a range of opportunities to improve the allocation of risk in government contracts, they include:

- Early engagement and transparency to identify and understand the project risks, how they need to be managed and mitigated and who is accountable when risks are realised – this can be achieved through the use of collaborative models like Early Contractor Involvement (ECI), TMR's collaborative form of contract (CPDA), Alliances and Incentivised Target Cost contracts.
- Acceptance by government delivery agencies that there are risks that must be shared or that should be the responsibility of the delivery agency. This not only ensures risk allocation is optimal but also that the client is an active participant in the understanding of and management of risk.
- Accuracy of reliance information – tenderers should be able to rely on the information provided by clients at tender and have access to relief where the information is inaccurate. During the project development phase, project owners will normally undertake preliminary investigation work, and this information is typically provided to tenderers. However, tenderers are typically required to assume risks for the accuracy of this information.

Case Study: Risk Allocation – Sydney Gateway

Sydney Gateway was contracted on a hard dollar D&C that allowed this project to be delivered ahead of time and to budget. Some of the aspects which underpinned the successful delivery and management of risk included:

- An equitable risk allocation, in particular with respect to Utilities and Contamination risk
- The project was run on a highly collaborative basis, almost like an Alliance. Both Client, IC, and Contractor collocated in an open plan office. There were no entry barriers between the teams.
- Note that the Contract was still administered to the full extent by both parties, that is the" Contract was not put in the draw".
- The Leadership from the Client and Contractor walked the talk with respect to collaboration and best for project outcomes, the project was run as one team.
- Collaboration workshops helped with the formation of the right culture plus held regularly to keep the momentum and to onboard new staff during the life cycle of the project.
- The Project PCG's (monthly) consisted of top 5 issues presentations from Client and Contractor leads, this emphasised collective ownership. Matters included Safety, Enviro, Time, Traffic, Commercial, Community, Quality etc. Traditionally the Client team would use these sessions to challenge the Contractor in a critical sense, rather than having ownership and being part of the solution

Commercial issues trackers were also presented to the respective PD's (TfNSW & JV) by their commercial leads at the above PCG's. The goal was to have a clean slate commercially every six months. This created a culture of prompt issues resolution and accountability. This worked brilliantly as evidenced by the fact that there was not a single commercial dispute on the project over four years of delivery.

Using performance-based specifications

Clients use specification documents to define what a contractor must deliver and the people required to deliver it. On large projects these specifications can run into multiple volumes and thousands of pages. This is because they tend to be highly prescriptive, detailing not only what must be done but how it must be down – this includes specific materials and components as well as the experience required for key project personnel.

Detailed specifications may seem to eliminate risk and guarantee a uniform product, but they are also part of the reason that we have failed to innovate and why contractors are required to chase project management unicorns in a constrained labour market – limiting the diversity of the sector and the ability to acquire experience.

An alternative approach is to move to performance-based specifications, which define how the constructed asset must perform. Constructors can then compete based on their solution to meet the performance requirement – this allows for greater flexibility in how performance can be delivered, and the associate cost. This would also allow for the development of agile and diverse projects teams to deliver the project rather than having to find people with the specified experience. In summary, the benefits of adopting performance-based specification include:

- Encourages innovation and tailored solutions – fully leveraging the skills and experience of the market in delivering a broad range of infrastructure.
- Allows flexibility to adapt to changing conditions, technologies and materials.
- Opportunity to fundamentally change how to construct something – new technology and materials may not have as much reliable historical data (but may be appropriate especially if the cost of failure is low)
- Opportunity to increase the competition amongst suppliers – overly prescriptive technical specifications often create an oligopoly amongst the suppliers whose product/service meet the specification.
- Can reduce costs and improve delivery timelines.
- Contractor still carries the risk of ensuring the works are fit for purpose / compliant.

Capacity of Queensland Government procurement agencies

It is anticipated that there will need to be an uplift in the capability and capacity within delivery agencies to successfully implement the reforms proposed within the QPC's interim report. In a recent internal survey of ACA members feedback was received that Queensland delivery agencies currently having a lack of internal capability and capacity to manage tender processes.

Procurement teams will need to develop the capacity to undertake early industry engagement and to participate in a transparent discussion. They will need the ability to engage in an open process that shapes realistic scopes and budgets and that seek to identify and understand risk early. Early engagement is key to achieving improved risk allocation between constructors and clients and procurement teams must be able to not only have informed discussions about risk but also the authority to make decisions about risk allocation.

A shift towards performance specifications has the potential to require a significant change in the approach to procurement and the assurance processes employed during delivery. This will have implications for the capability and capacity of procurement and deliver teams within Queensland delivery agencies.

Agencies will need to develop the ability to sufficiently define the performance or outcome that must be delivered as well as evaluation processes that can rigorously assess the extent to which solutions proposed this. It is anticipated that delivery teams will need to adjust their approach to assurance, these frameworks will need to be less focused on compliance with and be designed to provide assurance the desired performance will be delivered.

These changes are not limited to processes and systems used to procure and deliver infrastructure but, possibly more significantly, it will require cultural change. There is a need across the construction industry to move towards a more collaborative, open and transparent way of working. This ultimately requires an increase in trust between constructors and clients. A program of work will need to be undertaken to identify the cultural change that is required and how this can be achieved. This will require commitment from delivery agencies and constructors.

Implementation of changes and uplift in capability and capacity will be supported by a high level of consistency and standardisation of the approach to procurement and delivery. Standardisation will enable a uniform model of engagement and procurement to be employed across all delivery agencies and for the deployment of a single program across agencies designed to deliver the required changes. A common approach will also increase the pool of resources across the Queensland Government with the skills and knowledge needed to procure and deliver infrastructure. It enables the development of deep skills and expertise as the workforce repeatedly applies a uniform approach.

A high level of consistency across agencies will also deliver benefits for the construction industry which will improve efficiency and productivity. The use of a standard approach will also allow the development of deep understanding and expertise within the construction sector. Constructors will no longer need to understand and manage the different requirements of multiple agencies. Greater certainty allows constructors to plan and to design their own processes to align with needs of clients, this includes investing in capability and innovation that will deliver benefits across to all Queensland clients.

Financial Regulations

Request for information – Minimum Financial Requirements

The Commission is seeking evidence on:

- stakeholders' experience of complying with minimum financial requirements in Queensland and the time and resources involved
- whether minimum financial requirements remain well-targeted following the recent removal of reporting requirements for the majority of licensees
- whether minimum financial requirements provide benefits not considered by the Commission and whether these benefits justify their retention.

Request for information – Trust Account Framework

The Commission would like to test its understanding of the costs and benefits associated with trust account obligations in Queensland, in particular:

- stakeholders' experience of complying with trust account obligations in Queensland and the time and resources involved
- how impacts differ across projects of different sizes (for example, contracts valued above/below $10 million)
- whether stakeholders have observed reductions in contract pricing that could be attributed to the presence of trust accounts and a lower risk of delayed or non-payment
- whether trust account regulation is a significant impediment to undertaking construction projects in Queensland (including case studies or examples).

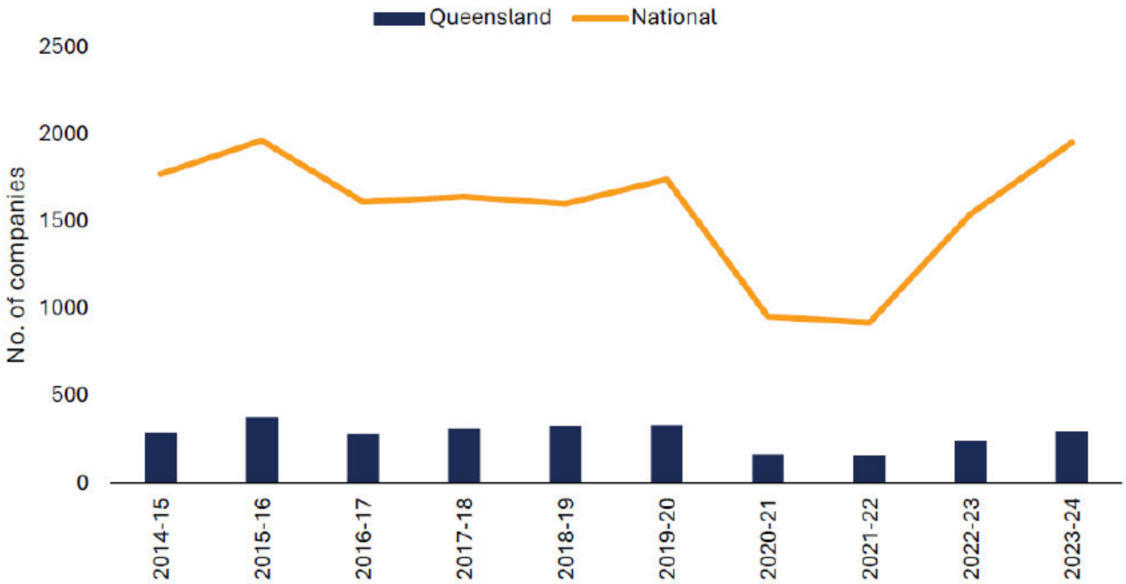
The Commission is seeking further information on:

- whether trust accounts have been effective in reducing cases of non-payment in the Queensland construction industry
- how trust accounts affect the way stakeholders operate and manage their finances (for example, cash flow)
- the adequacy of existing alternatives available under the security of payment framework

ACA supports the removal of minimum financial requirements (MFR) and trust accounts as mechanisms to improve the financial stability of the construction industry. As outlined in our Trust Deficit report it has not been established that there is a significant problem with 'on-time' payment in the construction industry or the extent to which payment timeframes are actually related to insolvency or financial instability.[2] In fact, there has been no improvement in Queensland insolvency rates since the introduction of these measures, as demonstrated in Figure 1.

[2] Trust Deficit - Australian Constructors Association

Figure 1: Construction company insolvencies, National and Queensland, 2014-15 to 2023-24



Source: ASIC Insolvency data

Note: Fall in insolvencies over the period 202 – 2022 is largely attributable to industry support during the COVID pandemic.

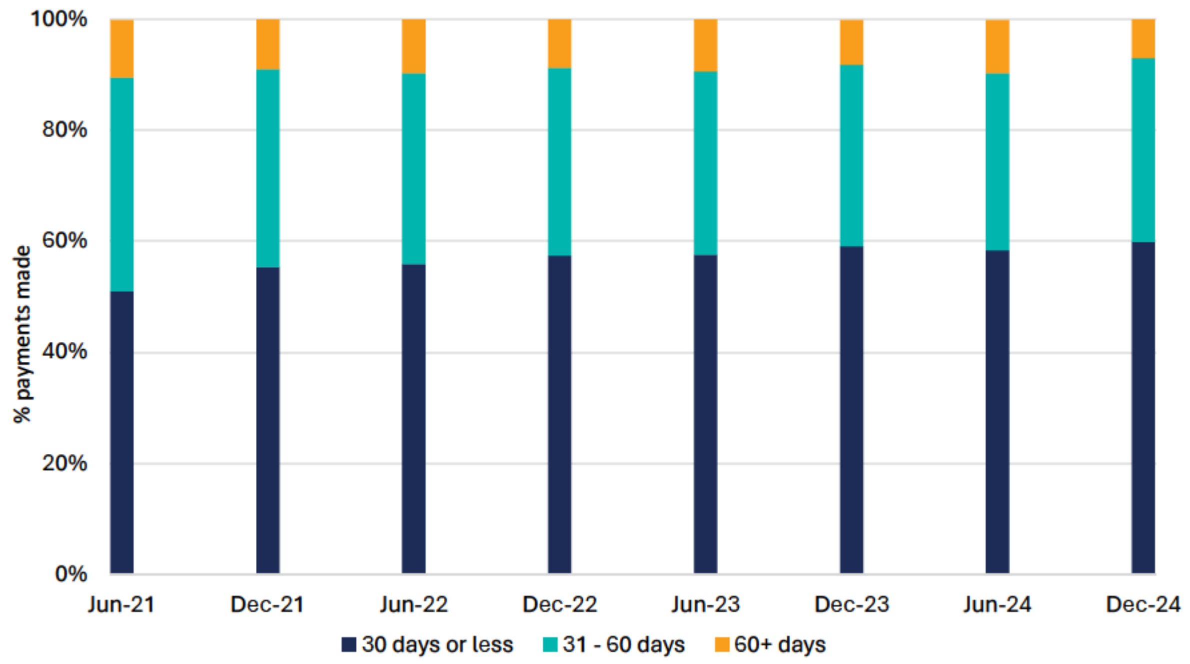
Data from the Australian Government's Payment Times Reporting Regulator for the period 2021 – 2024 indicates that for the construction industry:[3]

- Average payment terms is 34 days
- Average payment time is 32 days – with a median of 30 days and 95 per cent of payments made within 62 days
- 68.5% of small business invoices are paid within the required payment terms.
- 60% of payments are made within 30 days – compared to 69% across all industries

There has also been very little change in average industry payment times over this period, as demonstrated in Figure 2. This figure suggests that to the extent there was or is an issue with the timeframes in which payments are made, the impact of regulation aimed at improving payment timeframes has not been effective.

[3] Payment Times Reports Register | Payment Times Reporting Scheme, accessed 25 August 2025

Figure 2: Average payment timeframes, Construction, 2021 - 2024



Source: Australian Government's Payment Times Reporting

The impact of MFR and trust accounts

It is not considered that there has been any demonstrable benefit from Queensland's MFR or the use of trust accounts. Recent liquidations in Queensland have highlighted the ineffectiveness of these regulations to protect creditors when a business goes into liquidation. Trust accounts are not considered to be effective in reducing delayed or non-payment. This is in part because the frameworks do not consider the role of the principal/ client in the payment chain.

And far from reducing prices, MFR and trust accounts add cost that are ultimately passed through to clients in the form of higher prices. There are a range of ways in which MFR and trust accounts increase costs, this includes:

- Reducing flexibility to achieve optimal financial management – constructors are prevented from using the revenue generated by one activity to fund another. This is standard practice across many industries and allows organisations to smooth cash flows, manage risk and undertake investment. This can curtail growth and innovation and increase financial instability.
- Cost of compliance – constructors incur considerable cost to modify systems and processes to comply with the regulatory requirements of MFR and trust accounts. In fact, when trust account legislation came into effect there was no accounting software available that complied with the specific requirements of the legislation, which was acknowledged by the QBCC. Constructors were ultimately required to develop their own, bespoke software.
- Increases cost of financing – accounting rules related to project trust and retention trust accounts do not allow these assets to be included within net assets. External financiers view a company as a 'higher risk' when the balance sheet has a lower net

asset value, after excluding all this restricted cash. This in turn, increases interest rates that financiers are willing to offer contractors and increases the costs of raising performance security in bonds and bank guarantees.

- Loss of income – the trust account framework stipulates which banks can be used to open a project trust account and there are only seven to choose from. This not only limits a constructor's ability to select the financial institution that best meets their needs but has enabled financial institutions to take advantage of the lack of competition. Constructors can withdraw interest income from the trust account, but all seven banks have implemented processes that do not allow interest income to be accumulated on these accounts. This is a significant opportunity cost to contractors as they are denied to opportunity to earn a return on these assets.
- Reduced competition – MFR's and trust account requirements actively deter new market entrants. Queensland is now considered the most expensive and uncompetitive for construction costs since these regulations were introduced. Constructors do consider the profit and cashflow implications of the Queensland financial regulation framework and resources are directed to the projects and regions where the margins, cashflow and indirect costs are the most favourable.

The different size and value of a project does not significantly impact the resources and effort required to administer trust accounts. Complexity does arise when a constructor's project portfolio has deviations in standard contract payment terms. For example, a payment calendar of expected receipts for progress claims sent to principals to pay the contractor, as well as payments due to pay subcontractors. Queensland Government projects have a different payment calendar compared to private sector projects and this is where complexity and heightened administration cost and time increases.

Member Feedback:

Complying with the minimum financial requirements is incredibly time consuming. As a Financial Controller in Queensland, I am employed solely in Queensland to ensure compliance with the MFR, Retention Trust and Project Trust Account requirements. The business also needed to hire a full-time accountant. The time required for compliance is constant and peaks at every month-end financial close process.

This is a significant indirect cost to the business, requiring two full time roles to respond to these requirements. If our project portfolio grows, which is anticipated given the volume of infrastructure to be delivered in South-East Queensland, the business will require more resources to meet financial requirements.

Further to the workforce requirements, accounting systems and software has required substantial technology engineering and upgrades to support monthly compliance tracking and reporting for MFR. This required engaging internal and external IT consultants and data technicians at significant cost.

The MFR framework is also very prescriptive in defining 'allowable assets' – any cash that is held in a project trust account is considered restricted cash and cannot count towards an allowable asset. To comply with MFR requirements cash must be reallocated from related entities into the Queensland licensed entity. This is a very limiting framework and makes operating the business more difficult.

Minimising payment risks

It is not clear that there is a substantial issue with delayed or non-payment or the extent to which this may be contributing to financial instability within the construction industry. However, there are a range of opportunities for reform that would improve financial health of construction industry and minimise the risk of late or non-payment. These include:

- Better procurement practices and contract terms – as outlined in earlier sections of this submission.
- Improved risk allocation – which is the primary cause of payment disputes.
- Open-book frameworks in delivery – providing real-time information on the financial management of projects, allowing the immediate identification of potential issues.
- Use of mandatory maximum payment terms – if it can be demonstrated that there is an issue with payments being made outside contract payment terms a maximum term could be imposed with penalties associated with failing to pay within the maximum term.
- Better and more efficient process for resolving disputed payment claims, including better access to adjudication processes when payments are missed.
- Greater consistency in Security of Payments legislation nationally, eliminating the need for constructors to implement processes and systems to meet the different requirements of each jurisdiction.
- Requirements for clients to meet payment times including the introduction of zero-day payment terms for Queensland Government delivery agencies – it is not unusual for Queensland delivery agencies to be late paying their monthly claims and in these circumstances, the project trust accounts become useless and the constructor must then self-fund subcontractor payments.

Industrial Relations

Request for information – Best Practice Industrial Conditions (BPIC)

The Commission would like to:

- understand whether there is any evidence that workplace and safety outcomes on BPICs sites are better than non-BPIC sites or that BPICs have led to industry-wide improvements in workplace health and safety
- encourage stakeholders to provide quantitative evidence on impacts, costs and benefits of BPICs to further inform the Commission's analysis.

The Commission would like to gather stakeholder feedback on:

- options for improving workplace practices on large construction sites
- options for re-setting industry practices more broadly
- what government could do to create conditions to encourage greater competition for large construction projects, including to encourage growth of existing Tier 2 construction firms
- whether there are likely to be any unintended consequences from the various reform options put forward in submissions to the inquiry.

Request for information – Workplace Health and Safety (WHS)

the Commission is seeking information on:

- whether options in the reform direction are workable, and whether they introduce any significant health and safety risks
- any alternative or additional reforms that should be considered to more effectively and efficiently manage WHS risks and resolve other issues raised.

BPIC

The preliminary recommendation to permanently remove BPIC is welcome, and the ACA commends the work undertaken by the Queensland Productivity Commission (QPC) to quantify the impacts of the introduction of BPIC in its interim report. This is the most detailed and rigorous attempt to date to fully understand the effect that this policy has had on construction in Queensland. There is no further data that ACA is able to provide that would support further analysis.

Improving workplace practices and re-setting industry practices more broadly

ACA commends the QPC on the extent of the proposals made within Reform Direction 9, which seek to eliminate the weaponisation of WHS, to re-establish to role of the regulator, to provide greater clarity and to introduce practices that are more collaborative and cooperative. As this reform direction largely aligns with our initial submission, we consider that what is proposed is workable and our members are open to working with the Queensland Government to ensure that implementation does not negatively impact health and safety.

In relation to resetting industrial practices and improving workplaces practices on large construction sites, as recommended in our initial submission, the ACA strongly encourages the QPC to consider the benefits of the Queensland Government adopting the Construction Industry Culture Taskforce's Culture Standard, which was formally launched on 5 August 2025. There is a need to fundamentally shift the culture of the construction industry – by attracting and retaining a diverse workforce we can improve workplaces, reset industrial relations and create a more productive industry.

In addition to adoption of the Culture Standard the ACA encourages the Queensland Government to engage with the Commonwealth Government on its development and implementation of the building and construction industry Blueprint for the Future. The Blueprint's primary objective is to re-set the construction industry and to bring together government, industry and unions to make change together.

There is a particular opportunity to accelerate or even pilot changes that are designed to re-set and improve industry practices – delivery of the 2032 Olympic and Paralympic Games infrastructure program. This pipeline of work provides an opportunity for government, workers and employers to align on conditions that will attract and retain the workforce needed to deliver – there is an opportunity to more explicitly link competitive conditions to clear and tangible productivity outcomes and to test a range of options that it is believed with have broad benefits.

Labour Market

Request For Information – Training and Apprenticeships

The Commission is seeking stakeholder views and evidence on:

- the underlying drivers, incidence and scale of issues in the training and apprenticeship system as they affect the construction industry
- further case studies where strategies to improve training and apprenticeship outcomes have been effective
- the design of an appropriate process to drive reform
- any other issues or considerations that should be identified.

Training and apprenticeships

The use of industry led structured pre-employment programs is considered to be a highly effective way to achieve entry-level employment outcomes and is an approach that has been used by multiple principal contractors. These programs provide a collaborative way to create outcomes not only with principal contractors, but also the associated subcontractors and are an excellent mechanism for individuals to move from the program into a formal apprenticeship/ traineeship, where an opportunity exists.

A key consideration is that these programs need to be truly industry led, with outcomes agreed upfront, as there has been a rise in third-party stakeholders running programs without industry consultation or support, creating limited employment outcomes or providing graduating participants that still have significant skills and knowledge gaps.

Government programs and initiatives have a tendency to focus specifically on ‘apprenticeships’, and while greater participation at this level is needed the reality is that skills need to be considered more broadly. An apprenticeship is only one option, and this only addresses the need for skills where a scope of work is covered by an apprenticeship.

There is a continuous call for increases in the number of skilled tradespeople to meet anticipated labour shortages. However, a large proportion of the civil infrastructure sector does not require ‘trade qualified’ workers to perform many roles. Instead, they require specific skills that are normally achieved through short courses and other pathways, not the completion of a full Certificate III or higher qualification. Consideration must be given to the full range of skills required and the various pathways available for individuals to acquire these skills.

The Queensland Building and Construction Training Policy (Training Policy) uses a standardised formula to achieve 10% of all labour hours to be worked by apprentices/ trainees, increasing to 15% for major projects with a value of >$100mil. This formula is expressed as ‘Deemed Hours’ and thus becomes the ‘training target’ for the project. However, this formula uses an assumed $45 per hour labour rate, which is not in line with the current market averages and subsequently sets a higher training target than intended.

Additionally, there is a requirement for 60% of the Deemed Hours to be worked by ‘New Entrant’ apprentices and trainees. In many instances this limits a project team’s ability to be productive as not only do new entrants have limited skills and capabilities, but they also require a higher level of supervision and support from those with experience. Further consideration needs to be given to targets or other incentives that balance skills development with productivity.

Consideration also needs to be given to the extent to which the Training Policy entrenches existing ways of delivering, possibly limiting innovation. For example, the Training Policy has not kept pace with the construction industry's move towards the greater use of 'offsite manufacture'. It does not recognise any offsite construction activities as contributing toward training targets, even where it can be clearly demonstrated that activity is directly related to the project.

Finally, the Training Policy was established as a mechanism to positively encourage skills development, but in recent years it has moved toward more of a 'compliance' driven approach rather than outcomes focused. The government has created overly prescriptive and onerous evidence requirements, which are a significant administrative burden on Principal Contractors and subcontractors. This has been done with seemingly very little to no consultation with the industry as there appears to be a lack of understanding as to how the industry actually operates.

APPENDIX – MODERN METHODS OF CONSTRUCTION

National Construction Strategy

Construction Technology and Modern Methods of Construction (MMC) stream

November 2024

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Contents

Executive summary

The physical networks of infrastructure are the foundation for the provision of services, prosperity and quality of life. It shapes social, economic, and environmental outcomes on which societies depend.

Meeting the needs of the Australian community are therefore dependent on access to high quality infrastructure and services. The construction industry is responsible for the delivery of major infrastructure, as well as housing, schools, hospitals and other diverse community facilities. The productivity of the sector is, by extension, a key metric in determining the ability of governments to deliver on community service expectations, delivering a high standard of living for Australians.

Australia's 5-year forward pipeline of infrastructure and buildings projects is valued at almost $691 billion, which carries both risk and opportunity in terms of its potential impact and value-for-money.[1]

The construction sector, which plays a crucial role in delivering infrastructure, contributes more than $220 billion to the Australian economy every year and creates many multiples in value throughout the construction supply chain.[2] It represents 10% of overall national gross domestic product (GDP) and employs approximately one million full-time equivalent workers.[3]

Relative to other sectors, such as transport and manufacturing, the construction sector productivity growth is lagging. It has remained flat for the last 30 years.[4] Over this same period, technology has advanced significantly, including the introduction of the world wide web (the browsable layer of the internet), smartphone and artificial intelligence (AI). Productivity's stagnation must be reversed so the construction sector can meet the commitments to transform society to be more connected, sustainable and accessible, through infrastructure investment.

Improving productivity is not an end unto itself. There is no use turbo-charging productivity if we only construct unattractive, unliveable, outdated and poor-quality houses and infrastructure that does not improve societal outcomes.

Productivity must also be coupled with improving performance in the construction sector to more firmly align the delivery of outcomes to community needs and aspirations. This includes social and environmental objectives, such as safety, equity, amenity, resilience, and sustainability.

Modern methods of construction (MMC) and Construction Technology have a role to play in boosting productivity over the short- and longer-term and, to some extent, already are. However, barriers still exist to the consistent and widespread use of many advances.

This report identifies the most likely barriers to the wider adoption of MMC and Construction Technology in the design and delivery of transport-related infrastructure.[5] It is a first step towards creating a shared vision, pathway and commitment to change.

One thing is for certain though: there will be limited impact on overcoming barriers to adoption of MMC and Construction Technology without genuine and long-lasting commitment to change across industry and governments of multiple jurisdictions.

Barriers to adoption of MMC and Construction Technology

Table 1 summarises the headline barriers to adoption of MMC and Construction Technology in the Australian construction sector. More detail is available at Section 5.

These barriers demonstrate that construction sector productivity is a systemic challenge and therefore requires a system-level perspective. Mature application of MMC and Construction Technology across the Australian construction sector will require significant organisational and institutional transformation.

Table 1 Headline barriers to wider adoption of MMC and Construction Technology

Pipeline uncertainty and granularity • Too short-term • Too granular • Too narrowly defined	Articulation of the committed funding pipeline of government-led infrastructure is too short-term (4 years maximum), focused at the project level (rather than program level), and focused on outputs rather than societal outcomes.
Misaligned incentives • Capital uplift is significant (human, physical, digital) • Constrained access to financing • Risk asymmetries • Geographic dispersion • Supply chain coordination	The incentives for many industry participants to invest in adopting MMC and Construction Technology are inadequate relative to the upfront costs, the scale of investment and the risk investment will be withdrawn.
Inadequate enabling environment • Intellectual Property not adequately valued or protected • Overly prescriptive requirements • Inconsistency in data and information management standards • Lack of transparency over market opportunities	Existing regulation, standards, processes and protections are inadequate for enabling planned deployment, consistent investment in and commitment to MMC and Construction Technology.
Gaps in knowledge and skills • Misconceptions over standardisation and quality • Benefits not well understood • More guidance and training needed for procurement teams	Limited awareness of alternative approaches, inadequate tools for incentivising and managing innovation and capability imbalances are creating missed opportunities for adoption of MMC and Construction Technology.

Phase 2 of the National Construction Strategy will undertake an exploration and validation of reform solutions to overcome these barriers, to deliver measurable productivity improvements and to drive lasting, systemic change.

1 Introduction

1.1 Introduction

Infrastructure investment fuels our economic growth and contributes to our society's quality of life. Despite over $2,616 billion dollars of investment over the last 30 years,[6] construction sector productivity has not improved relative to other sectors.

1.2 Defining the sector

The breadth and depth of the sector can be categorised and considered by asset class, level of investment, industry participants, lifecycle stages or end customer. This report will focus the analysis on transport-related infrastructure as an asset class. Transport-related infrastructure makes up or 68% of Australia's infrastructure investment (see Figure 1).[7]

The Australian construction sector's scale, context, and maturity are critical attributes to consider when discussing MMC and Construction Technology. Australia has a well-established construction sector, involving some of the most established global players as well as locally grown firms. The sector delivers high-quality infrastructure to support communities and economic growth. The construction sector is pivotal to Australia's strategic aspirations and success.

It is estimated that the sector directly employs over one million full-time equivalent workers and another five hundred thousand in the supply chain.[8] In Australia, a variety of construction companies exist to service demand for infrastructure delivery. These range from muti-national, multi-discipline companies capable of delivering multi-billion-dollar projects, to single person, small enterprises that specialise in niche areas or provide specific services to larger contractors.[9]

The sector is vast and comprises of construction and design industries, service providers and operators, regulators, communities, and policy and decision makers. It harbours a wide range of industries, including government, planning, engineering, architectural, environmental, heritage, economics, finance, procurement, quantity surveying, building, project management and many more. These actors play diverse roles from project initiation through to commissioning, operations and decommissioning of infrastructure, buildings and services. It is, therefore, a significant contributor to the national expenditure and flow-on economic activity. This amplifies the need to ensure that our investment in infrastructure – both public and private – is maximising the possible returns in the shortest possible time.

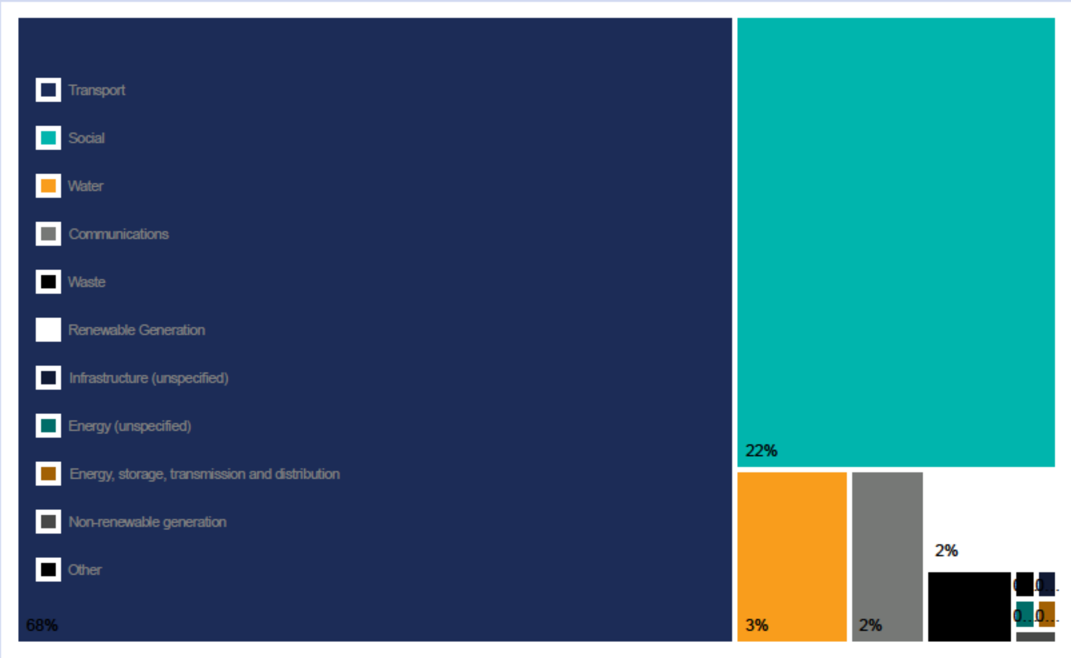


Figure 1: Australian infrastructure investment by sector

1.3 Taking a whole-of-system approach

MMC and Construction Technology applications have different and overlapping applications across all stages of the project and asset lifecycle, and at a system level. Many productivity gains are realised from continuous improvement throughout projects, between projects, across networks and over the useful life and decommissioning of assets. As such, there is risk to searching for productivity improvement within only a select stage or stages of the project or asset lifecycle.

Taking this whole-of-system approach allows decision makers to design the most beneficial intervention, which often occurs at the early planning phase. Decisions made at this stage have the greatest potential to influence longer-term outcomes across myriad of factors, including decarbonisation, socially focused outcomes and supply chain enablement, to name a few. It is the stage when key decisions like location, technology use, design and management of assets are made, and interdependencies between assets, players and projects are identified. Taking this broader lens also allows continuous improvement learnings to flow end-to-end and into sequential projects.

1.4 Construction sector productivity has stalled

The construction sector's productivity has not improved for 30 years.[10] Since 1990, the construction sector has lagged in performance relative to other sectors, particularly on measures of productivity (see Figure 2). This report defines sector-wide productivity as a measure of the rate at which output of goods and services are produced per unit of input. Further details regarding this definition can be found in Section 2 of this report.

Although the infrastructure pipeline is slowing, there remains $700 billion of projects scheduled to occur over the next five years. Striving for higher productivity means we can get more out of this investment, delivering projects more quickly and maximising their social impact. To provide an indication of the potential, by raising construction productivity to the national average would allow the delivery of an additional 1,000 new schools, 10,000 kilometres of road or 25,000 hospital beds.[11]

However, if construction productivity continues to stagnate, Australia's living standards will decrease as the ability to provide infrastructure efficiently and effectively reduces and access to services for the community will consequently decline.

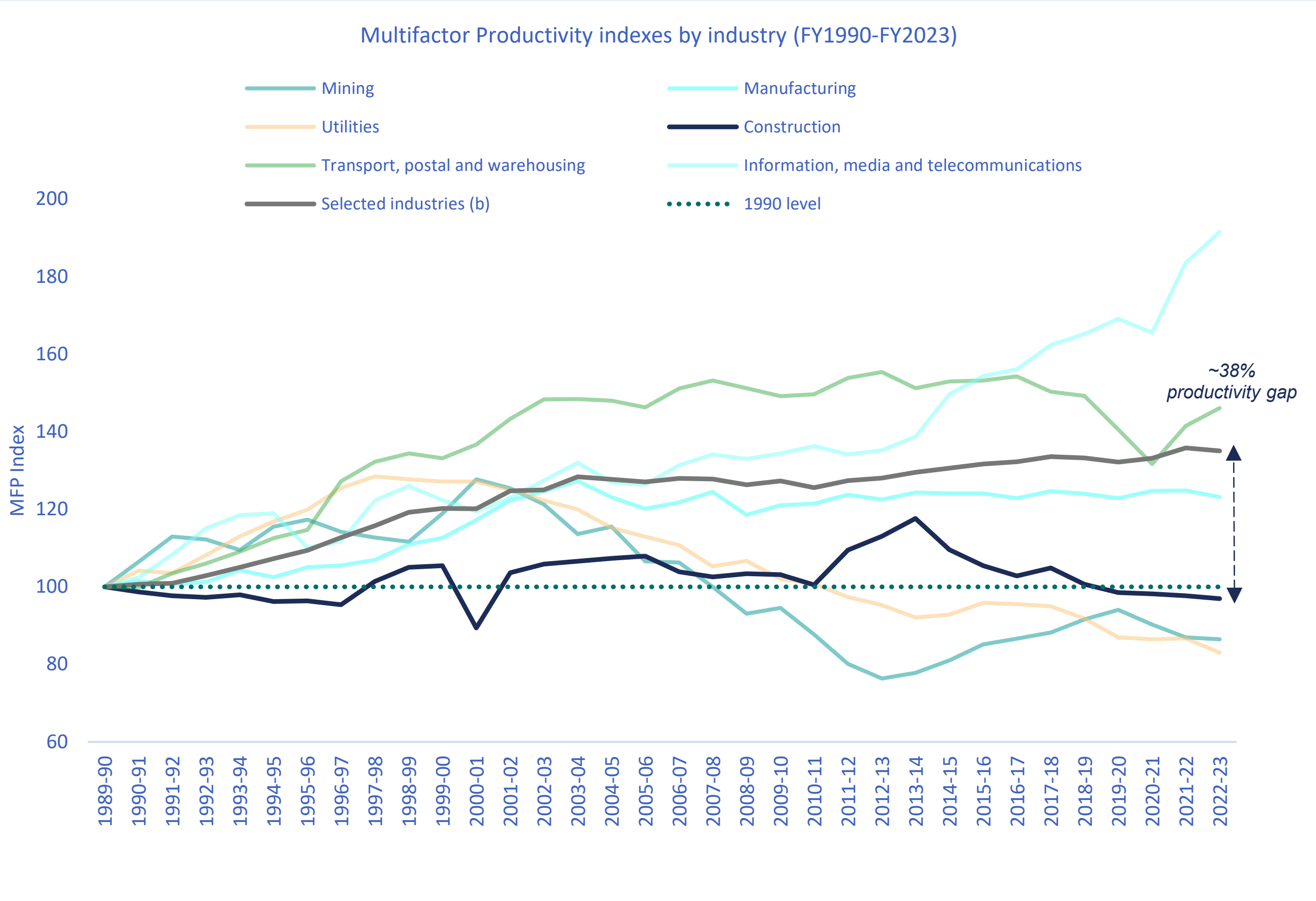


Figure 2: Estimates of Industry Productivity in Australia 1990 to 2023 [12]

1.5 The scope and approach of this paper

Four key areas of focus for the National Construction Strategy have been agreed with the Infrastructure and Transport Senior Officials' Committee (ITSOC):

- Data collection and benchmarking
- Procurement and contracting
- MMC and Construction Technology
- Workforce.

Area of Focus 3: MMC and Construction Technology has two phases, which are shown in Figure 3. This paper is focused on meeting the requirements of Phase 1. It articulates opportunities presented by MMC and Construction Technology such as Design for Manufacture and Assembly, product-based platforms, and 3D modelling to respond to the productivity challenges facing the Australian construction sector. It takes the first step towards understanding the benefits available and the barriers impeding wider adoption of MMC and Construction Technology.

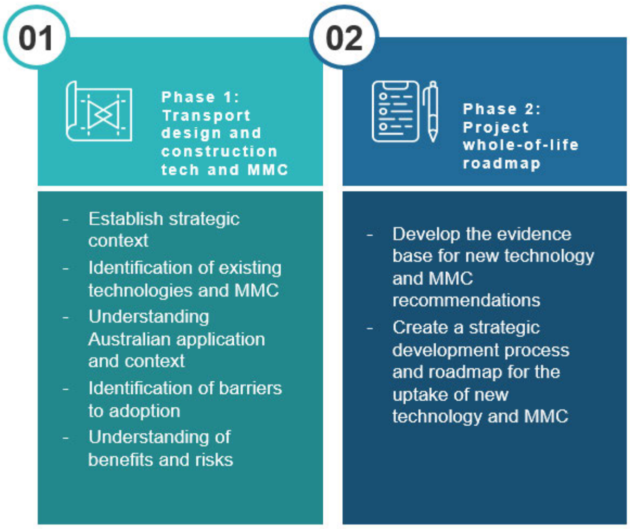


Figure 3: Two stages to Area of Focus

The evidence base for this report is sourced exclusively from desktop research. The scope does not include economic analysis of drivers for construction productivity performance, nor does it seek to demonstrate casual inference to an acceptable level of statistical significance.

This report (Phase 1) focuses on MMC and Construction Technology issues pertinent to the design and delivery stages of transport-related projects. Transport-related infrastructure makes up 68% of Australia's infrastructure investment.[13]

Design and construction phases present a significant opportunity to improve productivity, noting the need for a system-level and whole-of-lifecycle approach discussed in section 1.3. An exclusive focus on the transport sector's design and construction phases therefore narrows this paper's scope and enables an exploration of key MMC and Construction Technology relevant to Australia's largest infrastructure sector. The whole-of-life and systems coordination will be considered in subsequent phases of work.

Phase 2 will seek to validate the insights gathered in Phase 1 and provide actions for identified reform owners over predefined time horizons. Actions will seek to be as practical and realisable as possible.

This report was developed collaboratively by the Australian Constructors Association and Mott MacDonald.

1.6 This paper's structure

This paper is split into the following sections:

- **Introduction:** Provides a summary of the construction sector and the case for change, namely the lag on productivity in the sector.
- **Defining productivity:** Articulation of what productivity means and how it relates to efficiency, equity and effectiveness. Further, this section introduces the concept of industrialisation of the construction sector.
- **Modern methods of construction (MMC):** Provides a discussion of the MMC definition and context, MMC maturity and application in the transport sector at the design and construct phase, as well as domestic and international case studies.
- **Construction Technology:** Provides a discussion of the Construction Technology definition and context, Construction Technology maturity and application in the transport sector at the design and construct phase, as well as domestic and international case studies.
- **Barriers to adoption:** Articulates the barriers to adoption of MMC and Construction Technology in the Australian construction sector.
- **Next steps:** Describes how this paper's findings will inform Phase 2 via an indicative methodology, timeline, key stakeholders to engage, and how these activities will translate into the relevant stream of the National Construction Strategy.

2 Defining productivity

2.1 The definition of productivity

Productivity can be measured at the individual, machine, process, project, program, organisation, industry or whole-of-economy level.

At the economy-level, higher rates of productivity, on average, contribute to higher standards of living. All contributing economic activity feeds into this overall economic performance, including the construction sector, so there is a natural tendency to compare relative performance across sectors.

This report will define productivity in accordance with generally accepted definitions, while also exploring the related elements and discuss its relationship with broader societal outcomes.

Productivity is defined as a *measure of the rate at which output of goods and services are produced per unit of input.*[14]

Inputs may include labour, capital (such as plant and equipment) and intermediate services. *Outputs* can refer to goods and services produced, for example station boxes produced, track laid, or length of road constructed or resurfaced.[15]

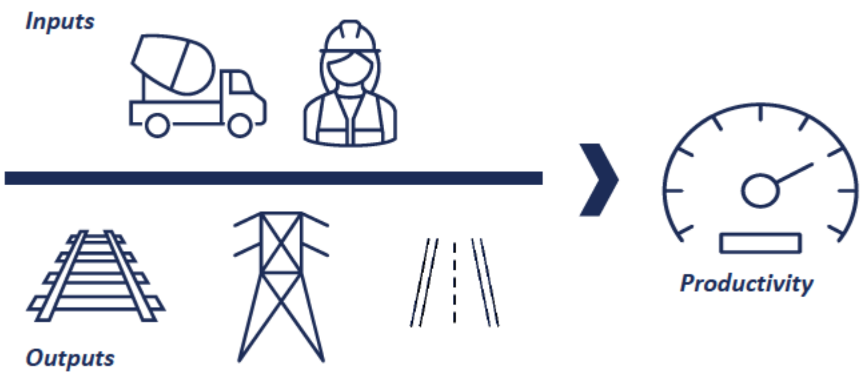


Figure 4 Components of productivity

2.2 Considering the component parts

The definition of productivity implies that producing more output using the same or less input is a good outcome. Similarly, the same amount of output produced for less total input also equals a good outcome.

Such a definition focuses productivity on measures of performance primarily associated with cost and time. Looking at productivity solely through this lens risks compromising the broader societal intent of investments in infrastructure.

Public investments in infrastructure must also consider *economy, equity* and *effectiveness* because the role of a benevolent government such as in present day Australia is to help maximise societal outcomes for all and to do this in the most effective way. There will inevitably be trade-offs between efficiency, equity and effectiveness.

Figure 5 represents a conceptual service process including its objectives, inputs, processes, outputs and outcomes, and how the relationships between these elements can represent productivity (technical efficiency), cost effectiveness and program effectiveness. A brief discussion of these elements follows after Figure 5 and in Box 1.

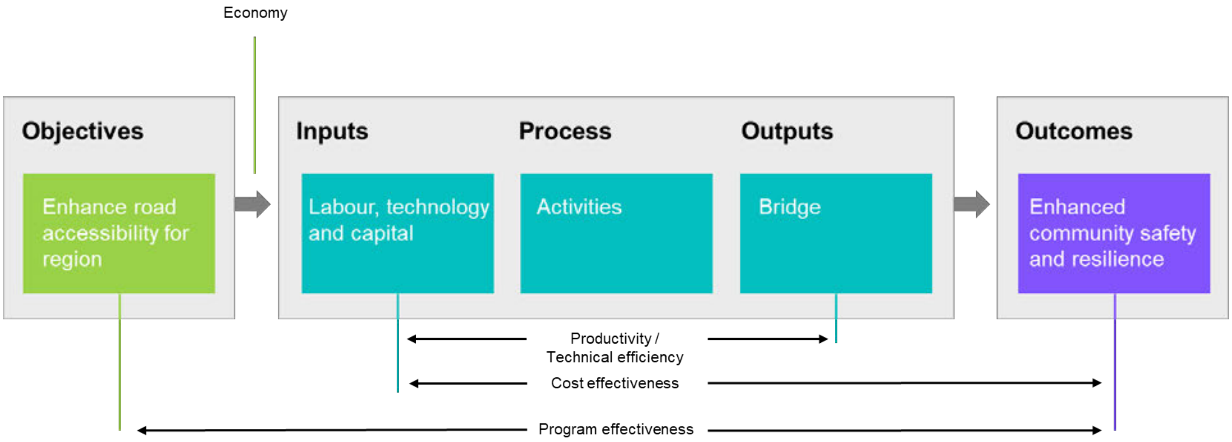


Figure 5 Example of a service process and relationship to efficiency and effectiveness

Note: Adapted from Report on Government Services (2024), Productivity Commission.

Economy is included to capture the cost and volume of resourcing (including funding allocated into the program) to achieve the stated objectives.

Effectiveness is focused on the achievement of outcomes, so it measures the extent to which the stated objectives are met by the policy, program or project.[16] Effectiveness can be further split into *cost-effectiveness* and *program effectiveness*. [17]

- **Cost effectiveness**: the unit cost of producing well-defined outcomes (i.e. cost vs outcomes).
- **Program effectiveness**: the measure of achievement of objectives compared with outcomes (i.e. objectives vs outcomes).

Equity measures the gap between service delivery outputs or outcomes for special needs groups and the general population.[18]

Equity of access relates to all Australians having adequate access to services, where the term adequate may mean different rates of access (depending on need) for different groups in the community.

Outcomes can be broad, such as standards of living, or specific such as increasing road safety. They are distinct from **outputs** such as material 'things' like a section of road, railway or tunnel.

When defining the objectives of a transport program, program owners will usually define goals that capture economic, social and environmental aspirations. A program that seeks to improve productivity through MMC and Construction Technology may define equity, effectiveness and efficiency measures.

Figure 6 illustrates how overall program performance should be measured by capturing equity, effectiveness *and* productivity / efficiency indicators collectively.[19]

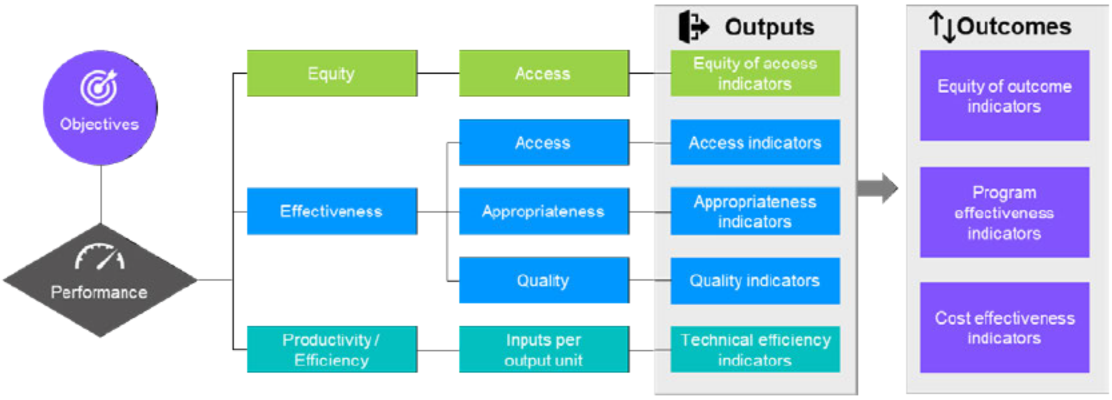


Figure 6: ROGS General Performance Framework

Box 1: Efficiency definitions

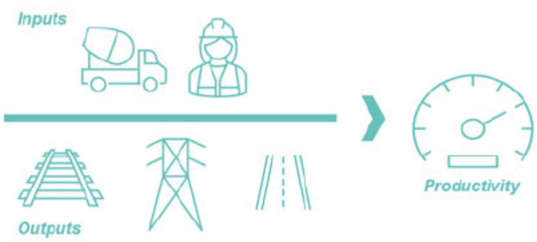
Most commonly, productivity is viewed through an efficiency lens, the rate of conversion from input to output. The term 'efficiency' can take on various meanings.

According to the Productivity Commission, these concepts are captured by the definitions of ***productive efficiency*** and ***technical efficiency***:

Productive efficiency: when no more output can be produced for given level of input.

Technical efficiency: when it is not possible to reduce any input without reducing output.

In the context of this report, it is assumed that productive efficiency and technical efficiency are equivalent terms, the measure of which can be represented as:



Another use of the term efficiency is ***allocative efficiency***, which is about ensuring the nation's resources are being used in economic activity that delivers the maximum social return. Existing systems and methods such as cost-benefit analysis and multi-criteria analysis aim to provide decision makers with clarity over the respective trade-offs between investment choices and therefore allocate resources most efficiently.

Finally, ***dynamic efficiency*** is the allocation of resources over time to improve overall efficiency and generate more resources, which can be achieved through innovation (like adoption of MMC and new technology in construction projects) or growing resource inputs like capital and labour.

2.3 The opportunity to enhance productivity

Construction is one of Australia's, and indeed the world's, largest sectors. Despite its scale and importance to the functioning of our communities and economies, the sector has remained focused on bespoke, customised processed with the majority of standardisation at the component level. The sector has not embraced the pace and breadth of industrialisation that other sectors have normalised.

The industrialisation of construction would shift standardisation further through the design of assets, networks and services in order to support efficiency in delivery, operation and maintenance. The industrialisation process would move to further adopt elements of early phase industrialisation, such as mechanisation, while also accelerating the move to adopt automated, digital and sustainable approaches that have come to define the future of modern industry. Table 2 presents the indicative phases of staged industrialisation, and their associated outcomes.

Table 2 Phases of staged industrialisation

				
Mechanisation and power	Assembly lines and mass production	Automation	Cyber physical systems, Internet of Things and network communications	Sustainable, Resilient, human-centric
Industrialisation 1	Industrialisation 2	Industrialisation 3	Industrialisation 4	Industrialisation 5

The wide-reaching nature of change and the inconsistent maturity of the sector today present challenges and barriers to adoption. Enhancing the productivity of the construction sector through industrialisation will require the cooperation of industry and government through planned and coordinated action.

MMC and Construction Technology present a significant opportunity to enable productivity enhancements. MMC and Construction Technology represent two significant planks in the move to industrialise construction. They draw on processes from across the stages of industrialisation. The adoption of MMC and Construction Technology will therefore require cooperation and sustained interventions across the project lifecycle. Table 3 presents examples of the relationships between system-level challenges and the benefits that can flow from investments in MMC and Construction Technology.

Table 3 Example benefits from adopting MMC and Construction Technology across the lifecycle

Lifecycle stage	Productivity and broader challenges	MMC opportunities	Technology opportunities	Benefits
Plan	Uncertainty of final solution Regulatory barriers Low carbon interventions	Early market engagement Supply-chain lead innovation Material choice Kit of parts Design for Manufacture and Assembly	Cost benchmarking ePlanning	Expand potential solution sets Encourage and incentivise collaboration across supply chain Greater alignment on vision and outcomes Flexible workforce
Procure	Pipeline visibility Market scale Appropriate risk apportionment Whole of life carbon reduction ambition versus upfront carbon	Early contractor involvement Sustainability targets in contracts Collaborative contracting Prefabrication	Digital marketplace Should cost modelling	Increased access to opportunity for smaller organisations Reduced costs of tendering Reliable demand profiles
Design	Client expectations of tailored solutions Reduce embodied emissions	Design for Manufacture and Assembly (DfMA) Product platforms Standardised product and component designs	Building Information Modelling (BIM) Digital engineering Artificial intelligence Augmented and virtual reality	Reduced design and procurement timeframes Enhanced whole of life asset management Immersive experience informing design outcomes Reduced risk to safety and delivery
Deliver (Project Management, Construction and Commissioning)	Non-standard requirements Cost of capital On-site safety Supply chain capacity Cost and availability of materials	Distributed / democratised supply chain Offsite construction Digitised distribution and construction	Automation and robotics Drone technology 3D printing Additive manufacturing	Increased competition for component parts and key skills Reduced delivery timeframe Reduced on-site risk Reduced community disruption Improved workplace conditions Enhanced workforce diversity
Operate	Asset condition and performance data quality Operational carbon emissions	Transparency over demand for asset componentry Tracking and reporting carbon emissions across value chain	Data analytics and predictive modelling Predictive maintenance	Planned (not reactive) maintenance Responsive supply chain Product performance modelling Product tracking
Decommission	Waste management	Circular supply chain Relocation Reinvigoration	Materials provenance tracking	Reduced environmental impact Reuse and redeployment opportunities

3 Modern methods of construction

3.1 Definition

MMC is a collection of methods to plan, design and build infrastructure and buildings with a focus on repeatability and standardisation. It leverages the skills of a constantly evolving workforce, supply chain and advancing technological landscape.[20]

Inherently, MMC is about increased standardisation. However, the scale of standardisation can vary from individual components up to a fully developed infrastructure network and the way society and industry cooperates. Together with the adoption of Construction Technologies, MMC represents industrialisation of construction with standard systems, manufactured at scale and deployed across infrastructure projects, networks and industries using standard repeatable processes.[21]

Standardisation streamlines the construction process and enhances efficiency across the entire value chain. Standardising components, designs, and methods allows for interoperability between different projects, ensuring consistent quality and reducing the time required for bespoke solutions.

MMC is the use of standardised design, component production and assembly processes. It can broadly be grouped under the following categories:

1. Offsite manufacturing and on-site assembly approaches	**Using offsite manufacturing and on-site assembly approaches** such as pre-manufacturing 2D and 3D primary structure systems, productionised construction, off-site construction, modular components, and assemblies to deliver efficiencies, consistency in quality and safer work environments with lower environmental impacts than traditional construction methods.
2. Shared requirements and standards	**Shared requirements and standards** that encourage investment into readily available interoperable components to drive faster delivery, for example design consistency and supply chain integration.
3. Digital technologies and on-site construction techniques	**Embedding and leveraging digital technologies, robotics** and **on-site construction techniques** that enhance on-site process efficiency.

The three categories identified above have been generated from a variety of sources as there is no official definition of MMC for infrastructure. The applications, examples and benefits of MMC will be presented using these categories for ease of reference in section 3.3.

The most recognised definition of MMC in Australia aligns with that developed in the UK by a specialist sub-group of the Ministry of Housing, Communities & Local Government (MHCLG). Box 2 provides further discussion on the 7 Category definition.

Box 2: MMC 7 category CAST definition

A contemporary MMC definition framework was developed by a specialist sub-group of the Ministry of Housing, Communities & Local Government (MHCLG) MMC cross industry working group. The subgroup, led by Mark Farmer of Cast Consultancy, developed this definition in response to gaining a betterer understanding and supporting the mortgage finance, insurance and valuation communities with the aim of supporting greater use of MMC across residential developments.

The framework introduces seven category definitions for MMC. These are:

1. Pre-manufacturing – 3D primary structural systems	**2. Pre-manufacturing – 2D primary structural systems.**	**3. Pre-manufacturing Components – Non-systemised primary structure.**	**4. Pre-manufacturing – Non-structural assemblies & sub-assemblies.**
5. Additive Manufacturing – Structural and non-structural	**6. Traditional building project led site labour reduction /productivity improvements.**	**7.Site process led site labour reduction / productivity / assurance improvements.**	**8th Category**

Figure 7 MMC Categories

This definition predominately focuses on building infrastructure and is not precisely applicable to linear/transport infrastructure. The CAST definition that does not adequately address the application of MMC to the transport sector, specifically when the scale of a competent is greater than that described in *1. Pre-manufacturing – 3D primary structural systems.* While this misalignment is present, the definition provided in the framework is still a valuable foundation for developing a more robust definition for MMC in the context of linear and transport infrastructure.

This gap in the framework has been addressed with the introduction of an 8th Category as illustrated in Figure 7 illustrates the seven CAST definitions and the addition of an 8th category for productionised construction. The 8th category productionised construction refers to large scale units constructed offsite. This could include whole structures such as buildings, bridges or other elements.

3.2 MMC impact framework

The potential of MMC can be considered in terms of the degree of standardisation and adoption.

An asset can be *standardised* from the most basic components, such as a screw or brick, to the scale of a network, such as the export of TGV technology from France to Morocco or Shinkansen from Japan to Taiwan.

A secondary concept of *adoption* is also critical. For instance, the dimensions of a brick appear highly standardised, however vary globally. Australia has a range of standard brick sizes based on their use while the size of a standard common brick varies between nations. Conversely, many examples exist of successful international, national and inter-state standardisation. For example, small modular nuclear reactor technology is a highly sophisticated infrastructure asset that can be fully produced offsite and deployed consistently at scale.

Figure 8 illustrates (conceptually) the extent to which MMC elements are standardised relative to adopted have influence over the cost and benefit of investment. These concepts are introduced briefly in this section for more detailed consideration for Phase 2 of the National Construction Strategy, for example in the assessment of proposed interventions.

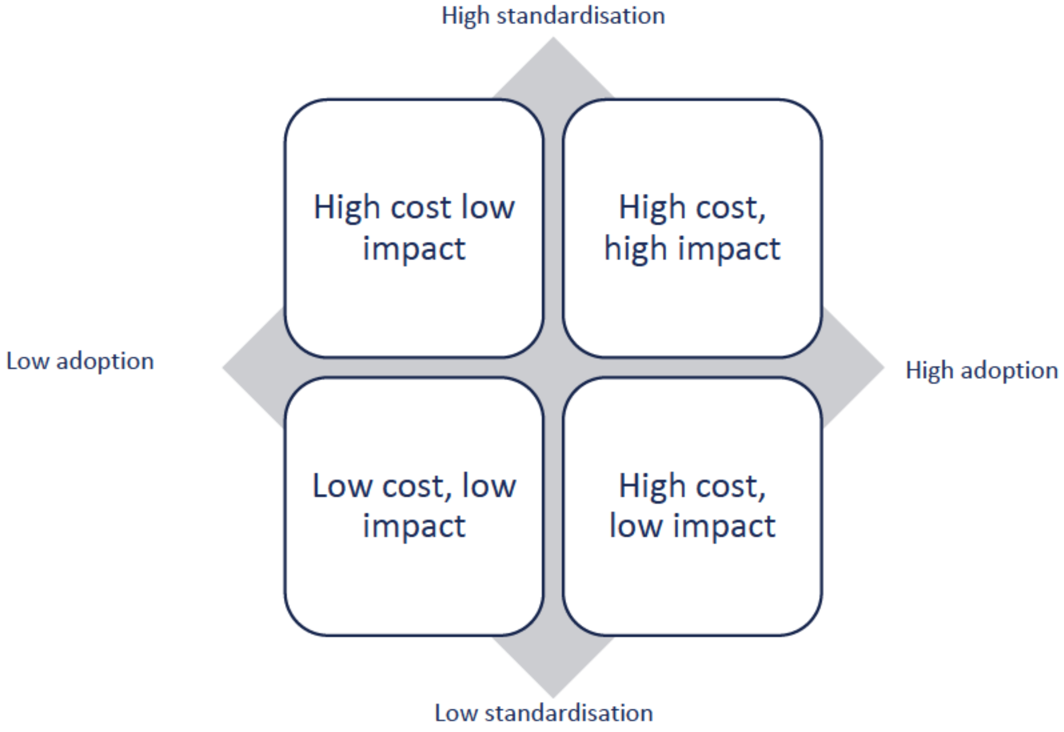


Figure 8 The extent to which MMC elements are standardised relative to adopted are influential over the cost and benefit of investment

The impact of MMC can be considered at the component and sub-component level, organisational level and scale of adoption.

3.2.1 Components and sub-components

The extent to which a specific component or sub-component is standardised across a sector is one dimension of MMC impact.

Components and sub-components can be standardised in terms of such specifications as size, shape, colour and material. Some basic examples include a brick used in the construction of buildings or a specific type of bolt used to bind a panel and a frame. These are examples of a 'kit of parts.'

Australia's transport infrastructure includes 18 separate rail networks, each with different standards, technologies, and operating processes. This introduces barriers to impact because components and sub-components must be designed and built to meet these specific standards, e.g. sleeper length, track width.

3.2.2 Organisational

The extent to which an organisation adopts MMC principles and practices is a second dimension of MMC impact. Simplistically, this approach can drive the highest potential cost reductions. The precise scale of potential deployment will be moderated by site and physical restrictions.

3.2.3 Scale of adoption

The scale of adoption of MMC is another dimension of impact.

MMC adoption may be constrained to the asset level (e.g. modular classrooms), or it may extend across a whole portfolio of asset classes (e.g. whole schools). A sector-level deployment of standardisation is highly mature.

3.3 Applications in transport

To support examination of the applications of MMC in the design and delivery of transport-related infrastructure, a simple maturity assessment is provided, which consists of:

- the *level of development* (from early research to mature products), and
- the *level of adoption in the construction industry*.

Table 4 presents this assessment framework and the corresponding assessment definitions. For example, prefabricated concrete structures such as culverts are commonly used in road drainage. However, 3D printing is less common and commercial practices are still emerging – therefore it has unrealised potential.

Table 4 Maturity Assessment (indicative)

	Level of adoption in construction	
Level of adoption across other industries	Low	High
Low (i.e R&D, prototypes)	Future Technology	Near Future / Emerging
High (established)	Unrealised Potential	Modern Practice

The discussion that follows in this section is organised according to the definition of MMC provided in section 3.1. That is:

1. Offsite manufacturing and on-site assembly approaches
2. Shared requirements and standards
3. Digital technologies and on-site construction techniques

Each definitional element includes a description of the example components, applications in construction, the benefits available and the indicative maturity assessment.

3.3.1 Offsite manufacturing and on-site assembly approaches

Table 5 Offsite Manufacturing and on-site assembly approaches

Component	Description and Applications	Benefits	Maturity
3D primary structural systems	3D Structural systems refer to volumetric units that can be brought to a site, ranging from more basic 3D structures to complete pods with finishes and services pre-installed. Applications: • Prefabricated room pods e.g. bathroom pods, ticket offices, control rooms and small station buildings that can be manufactured offsite.	Reduced project timelines. Reduced on-site disruptions to community and existing services. Higher quality control.	Unrealised potential
2D primary structural systems.	Flat panel units for basic flooring, walls, and roof structures. Applications: • Use of precast panels for constructing noise barriers along highways and railways.	Rapid assembly and reduced timelines. Improved durability.	Modern Practice
Non-systemised primary structure.	This is used to describe pre-manufactured structural members made of framed or mass engineered materials, such as timber, steel, or pre-cast concrete.	Reduces on-site time and labour requirements.	Unrealised potential

Component	Description and Applications	Benefits	Maturity
	Applications: • Precast concrete bridges, tunnels, and viaducts for rail and road networks. • Structural steelwork frames for airport terminals and train stations.	Lower material costs. Improved on-site safety	
Structural and non-structural Additive Manufacturing	On-site printing and fabrication of building and construction components. This can extend to large scale delivery and on-site fabrication that can typically occur during tunnelling and boring works. Applications: • On-Site concrete printing. • On site 3D printing of non-structural components. • Tunnel Boring Machines.	Improved delivery for bespoke project requirements.	Unrealised potential
Non-structural assemblies & sub-assemblies.	Pre-manufactured non-structural finishes and components. Applications: • Non-structural walling systems, roofing finish cassettes or assemblies. • Non-load bearing volumetric units. • Pre-assembled mechanical and electrical units such as HVAC systems, lighting units, and plumbing fixtures	Reduces time and labour requirements. Rapid installation Built in controlled environments, reducing installation errors on-site.	Unrealised potential
Productionised Construction	Referring to large scale units constructed offsite. Applications: • Offsite construction of entire bridge components to be assembled on site. (refer to case studies).	Reduced on-site disruptions to community and existing services. Reduces on-site time and labour requirements. Higher quality control.	Near Future/Emerging

3.3.2 Shared requirements and standards

Table 6 Shared requirements and standards

Component	Description and Applications	Benefits	Maturity
Design consistency and interoperability	Standardisation of architectural and engineering designs across projects. Interoperability involves the seamless exchange and integration of data, materials, and systems across various platforms, ensuring that different components can work together efficiently. Applications: • Consistent designs and interoperable systems are applied in modular construction, prefabrication, and offsite manufacturing. Design standards allow for the repeated use of components and building systems across different projects.	Reduces design duplication and promotes the reuse of designs across multiple projects. Lowers design and production costs. Easier integration of different systems or technologies.	Unrealised potential

Component	Description and Applications	Benefits	Maturity
		Improves communication across disciplines and stakeholders.	
Supply chain integration	The coordination and collaboration between various stakeholders – designers, manufacturers, contractors, and suppliers – to streamline material procurement, production, and delivery. Applications: • Just-in-time manufacturing, offsite fabrication, and efficient delivery to construction sites. Digital platforms, such as Building Information Modelling (BIM), are often used to improve transparency and real-time monitoring of the supply chain.	Reduced delays Improved cost efficiency Quality Control Scalability	Unrealised potential
Compliance with regulations and building codes	Ensuring that construction processes, materials, and designs comply with local and international standards, regulations, and building codes specific to safety, environmental impact, and structural integrity. Applications: • Modular components and prefabricated units are designed and tested to meet building code standards before being delivered to the site, reducing the need for adjustments or modifications during construction.	Risk Mitigation Efficiency Market Acceptance	Modern Practice
Quality Assurance (QA) and testing	Using common standards to ensure that materials, components, and construction processes meet specified standards for performance, durability, and safety. Applications: • QA and testing occur at the manufacturing level before modular components are transported to the construction site.	Consistent Quality Time efficiency Reduced defects	Unrealised potential
Modular and prefabrication compatibility	Standardised dimensions, materials, and connection methods make prefabricated components compatible across different suppliers and projects. Applications: • Structural elements such as walls, floors, and roofs are built in a controlled environment. These prefabricated modules are then transported to the site for assembly	Reduces time and labour requirements. Cost efficiency Reduced waste and material requirements Improved flexibility	Unrealised potential

3.3.3 Digital technologies and on-site construction techniques

Digital technologies and on-site construction techniques often involve the use of new technologies as enablers of MMC. There is overlap between MMC and Construction Technology as discussed in section 4.

Table 7 Digital technologies and on-site construction techniques

Component	Description	Benefits	Maturity
Digital process improvement	BIM is a digital representation of the physical and functional characteristics of a construction project. It allows for the creation and management of information throughout the lifecycle of infrastructure, from design to operation and maintenance. Applications: • BIM is used to develop highly detailed models of roads, bridges, tunnels, railways, and other transport systems. It facilitates collaboration among architects, engineers, and contractors, allowing them to work from a unified data environment. • Further examples of digital process improvement, supported by Construction Technologies is shown in section 4.	More accurate material quantity estimates Manage scheduling with high precision. Manage real-time on-site storage capacity. Enhanced collaboration and communication through real time sharing and updating of project information. Risk mitigation and cost saving through the identification of conflicts early in the design phase.	Near Future/Emerging
Design for Manufacture and Assembly (DfMA)	DfMA is an approach that simplifies the design process to optimise the manufacture and assembly of components. A "kit-of-parts" refers to standardised, prefabricated components that can be assembled quickly on-site. Applications: • DfMA principles are applied to create modular elements for infrastructure such as pre-cast bridge sections, tunnel linings, or station platforms. The kit-of-parts is manufactured offsite and delivered for quick assembly. [22]	Improved efficiency Supports Standardisations Cost reductions	Near Future/Emerging
Site worker augmentation	Visual aids such as augmented reality (AR) or digital 3D models help workers better understand designs, workflows, and project requirements by superimposing virtual elements over real-world environments. Applications: • Visual aids allow site workers to view construction sequences, check component placements, and visualise finished structures before they are built.	Improved accuracy Improved safety. Improved accessibility.	Future Technology

Component	Description	Benefits	Maturity
	Physical Aids such as external exoskeletons can be used to improve physical labour experience for on-site construction workers. Applications: • Physical aids assist with the assembly of large modular components or the handling of heavy equipment, reducing the physical strain on workers.	Improved worker site safety Reduced fatigue Increased efficiency.	Future Technology
	Productivity tools can refer to digital and technological systems that improve the efficiency, accuracy, and speed of construction processes. These tools typically include GPS systems, sensors, software platforms, and real-time monitoring solutions. Applications: • Productivity tools are used to track the movement of construction machinery, manage the placement of materials, and monitor the progress of work. GPS-enabled systems guide equipment like graders and bulldozers to ensure accurate positioning of roads, rail tracks, or tunnels. Digital dashboards provide real-time insights into worker productivity, machinery use, and project timelines.	Improved Accuracy Increased Efficiency Cost Control Better Decision-Making	Near Future Emerging
Site Management Tools	The use of robots or automated machines to perform repetitive or dangerous construction tasks, such as bricklaying, welding, or assembly of prefabricated components. Applications: • Robots can be used to assemble bridge components, lay concrete, or carry out precise welding in hard-to-reach areas.	Increased Safety Improved consistency Improved productivity	Near Future/Emerging
	Autonomous plant refers to self-operating construction machinery such as excavators, bulldozers, and cranes that use AI and sensors to perform tasks without human intervention. Applications: • Autonomous vehicles can handle large-scale earthworks, such as grading roads or excavating tunnels, while maintaining precise alignment with design specifications.	Cost Efficiency Improved precision Continuous operation	Near Future/Emerging
	Digital Verification refers to the use of advanced digital technologies, such as drones, laser scanning, and AI-driven inspection tools, to monitor and verify the quality, accuracy, and progress of construction work. It replaces traditional manual inspection methods with automated, data-driven systems. Applications: • Digital verification tools are used to ensure that construction follows design	Increased accuracy Real-time monitoring Cost and Time savings Enhanced Safety	Construction Technology

Component	Description	Benefits	Maturity
	specifications and regulatory standards. Drones can scan and capture data from large transport projects, such as highways, bridges, and rail networks, providing real-time visual and structural insights. Laser scanning is employed to ensure precise measurements for alignment and grading, while AI-powered tools analyse the data to flag issues, such as material defects or construction inconsistencies.	Data-driven insights	
Traditional building product led site labour reduction / productivity improvements	Productivity improvements to traditional single building products. The overall aim being to reduce extent of site labour required. Applications: • Pre-cut configurations • Easy Jointing features • These components are manufactured in a larger format to improve sale and delivery.	Pre-manufactured components reduce the amount of time needed for on-site assembly, speeding up large projects such as highways or bridges. Pre-manufactured elements reduce the need for large, on-site operations, lowering the impact on traffic or rail services.	Unrealised potential

3.3.4 Case Studies

Project

Sydney Metro - Crows Nest Station[23]

Project Owner

Transport for NSW

Methods

2D primary structural systems

Non-systemised primary structure

Project context and application

Crows Nest station is a new underground station on the Sydney Metro Line. **Significant foundational elements of the construction were completed via MMC.** This included the installation of precast concrete beams and that were fabricated offsite and installed via crane. MMC was proven to improve the overall safety during the delivery phase, improve sustainability outcomes and improved cost effectiveness when compared to a traditional method of construction. This was achieved by reducing the need for propping and formwork and decreasing material waste. This application of MMC enabled the foundations of a project to be completed with the forementioned benefits, without detracting from the design techniques that establish the identity and character of the space.

Project context and application

Woolgoolga to Ballina was the final link of the Pacific Highway, between Hexham and the Queensland border. The project spans 129-kilometrs, comprising of nine interchanges, more than 170 bridges and more than 350 connectivity structures. **The final delivery was comprised of more than 8900 precast elements.**

A standard approach was used to enable program certainty, risk management, economies of scale, logistics and simple interfaces between bridge and civil contractors. Additionally, digital engineering systems such as and GIS systems provided improved project information to stakeholders.

Project

Woolgoolga to Ballina Pacific Highway Upgrade[24]

Project Owner

Transport for NSW

Methods

Productionised Construction

Digital Process Improvement

Project

Laing O'Rourke Centre of Excellence for Modern Construction

Project Owner

Laing O'Rourke

Methods

MMC

Digital Engineering

Construction Technology

Lean automation

Quality assurance

Project context and application

The Laing O'Rourke Centre of Excellence for Modern Construction is Europe's largest and most advanced pre-assembly manufacturing facility.

The Centre of Excellence employs 400 people, who work closely with digital engineers and project teams across the business to design and precision manufacture a range of components for use in major building and infrastructure projects. These include twin walls, floor slabs, pillars, high quality facades and our new digital modular bridges to span roads and railways.

The Laing O'Rourke DfMA 70:60:30 operating model is based on an unrivalled in-house capability in modern methods of construction. This translates 70 per cent of the construction offsite into a controlled environment, delivering a 60 per cent improvement in efficiency, and a 30 per cent improvement in project schedule.

Project

High Speed 2 - Thame Valley Viaduct [25]

Project Owner

UK Department of Transport

Methods

Non-systemised primary structure.

Project context and application

The Thame Valley Viaduct is an 880m long viaduct crossing the flood plain of the River Thame. This viaduct is part of the greater HS2 program.

MMC was successfully implemented in every major element being manufactured in an off-site facility before being assembled on-site. This included 68 concrete piers each weighing 42 tonnes. This approach saw a reduction in the project's carbon footprint by approximately one third. The prefabricated required less lorries to deliver material to site, simplified construction, cut waste, and reduced disruption for the community during construction.

Project context and application

The 1100 tonne steel bridge over the existing Nottingham train station was delivered as an overpass for the local tram network.

The bridge was constructed in two separate sections and delivered over several weeks using hydraulic push-pull system.

The benefit of this approach meant the adjacent highway and railway lines experienced very minimal disruptions and remained fully operational throughout.

Project

Nottingham Station Tram Bridge[26]

Project Owner

Nottingham City Council

Methods

Productionised Construction

4 Construction Technology

4.1 Definition

Construction Technology can be defined as a set of new productive techniques or tools which offers a significant improvement over the established technology for a given process in construction. What is seen as new technology is continually redefined, as successive changes in technology are undertaken.[27] New technologies often include emerging technologies.[28] whose development, practical applications, or both are still largely unrealised. For this report, Construction Technology includes the application of technologies in construction, such as:

- artificial intelligence (AI) and machine learning technologies
- advanced digital, information and communication technologies
- advanced manufacturing and materials technologies
- autonomous systems, robotics, positioning, timing and sensing

New Technologies contrast with current or established technologies, which are technologies that are widely adopted, part of the 'business as usual' with limited unrealised potential.

Construction Technologies are a key part of MMC with the potential to either replace traditional methods and technologies (3D Printing, drones, robotic) or complement them (e.g. automation to speed up assembly or 3D visualisation software). While there is overlap between MMC and Construction Technology and modern methods often lend themselves to deploying certain technologies, neither are direct subsets of the other for example some prefabricated off-site manufacturing technologies have been used since World War II.[29]

To support examination of the applications of Construction Technology in the design and delivery of transport-related infrastructure, a simple maturity assessment is provided, which consists of:

- the *level of development* (from early research to mature products) and
- *level of adoption in the construction industry*.

Table 8 presents this assessment framework and the corresponding assessment definitions.

For example, logistics tracking technologies like radio frequency identification (RFID) are commonly used in fulfilment centres (commercialised), but the technology is no widely adopted in construction – therefore it has unrealised potential.

Table 8 Maturity Assessment

	Level of adoption in construction	
Level of adoption across other industries	Low	High
Low (i.e R&D, prototypes)	Future Technology	Near Future / Emerging
High (established)	Unrealised Potential	Modern Practice

4.2 Applications in transport

Construction Technology in transport infrastructure delivery has the potential to improve many processes including appraisal, design optimisation, constructing, reporting, and managing processes. One of the biggest potential applications comes from integrating different technologies and enabling the flow of information across different phases of the asset lifecycle.[30] In transport infrastructure, there are many Construction Technologies across digitisation, automation and advanced manufacturing and materials used in planning and design through to construction and commissioning as shown in Figure 9.

To date, the adoption of Construction Technologies in the Australian construction industry has had mixed success. Analysis by McKinsey shows the Australian construction industry lags the same industries in the United States and Europe in uptake with slower adoption rates, lower levels of innovation and digitally supported 'ways of working'.[31]

Globally, the construction industry ranks amongst the lowest levels of digitisation when comparing across industries.[32] The lower level of digitisation and the use of digital innovations is one of the factors that correlates significantly with differences in productivity between industries (see Figure 9). Digital and data tools and practices are key to unlocking productivity gains and efficiencies across infrastructure planning, delivery, and operations.[33] Implementing best technology practices could result in a productivity improvement of up to 15% as well as more than 5% in cost efficiencies. If proven digital tools and practices are used now, the sector can realise these benefits rapidly.[34]

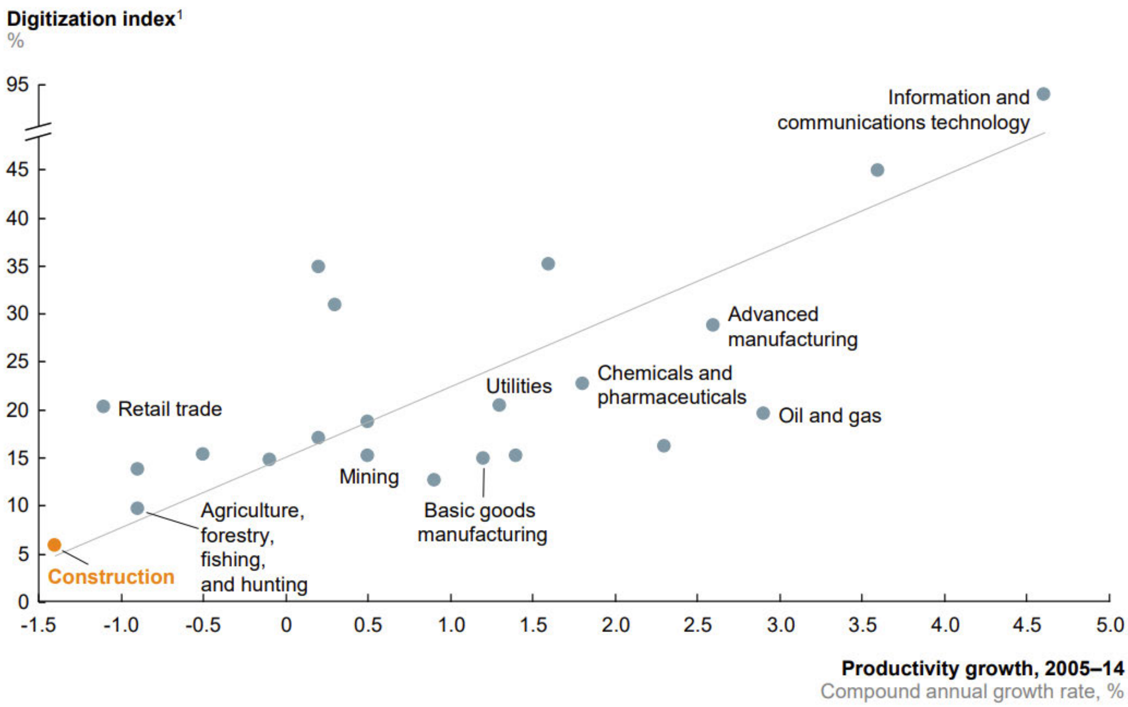


Figure 9 Digitisation and Productivity, McKinsey, 2019

The adoption of Construction Technologies and innovations is not just an opportunity to increase productivity, it can also deliver many benefits of safety and sustainability. For example, technology can eliminate physically dangerous tasks or reduce carbon emissions through dematerialisation.

Infrastructure Australia estimates that buildings and infrastructure are responsible for nearly one third of all of Australia's emissions, and 7% of this is upfront carbon is primarily through materials manufacturing and construction activities.[35] Construction Technologies such as lower carbon embodied materials and adoption of MMC, which can lead to less emissions during construction will contribute meaningfully to Australia's decarbonisation goals.

Applying Construction Technology in these ways will reduce the cost of projects through the more effective use of labour, increased design efficiency, and reduced risk and associated contingency costs. Technology can unlock the capacity of the existing labour force to add even greater value.

Benefits will also be realised in more efficient asset operation and extended asset lives, through optimised and automated asset management, improved design leading to better performance, and more efficient and comprehensive maintenance.

Table 9 Construction Technologies

Construction Technologies	**Infrastructure Delivery Lifecycle**							
	Plan & procure			**Design**	**Deliver**		**Operate & decommission**	
Examples of key technology types that offer new tools, services and methodologies for construction and delivery infrastructure projects.	**Upstream Process**	**Logistics and Transportation**	**Planning & Procurement**	**Design**	**Program, Project Management**	**Construction**	**Commissioning**	**Asset & Waster Management**
1. Artificial intelligence (AI)								
Artificial intelligence (AI) technologies	✓	✓	✓	✓	✓	✓	✓	✓
2. Digital Technologies								
Advanced imaging, scanning techniques, computer vision, photo telemetry and geotechnical scans			✓	✓	✓	✓	✓	✓
3D visualisation environments for example Augmented Reality (AR), Virtual Reality (VR) and Digital Twins		✓	✓	✓	✓	✓	✓	✓
Structural engineering software		✓		✓		✓		
Geospatial technologies		✓	✓	✓	✓	✓		
Advanced data analytics and visualisation	✓	✓	✓	✓	✓	✓	✓	✓
Design configurators	✓	✓		✓	✓	✓		
Advanced BIM systems			✓	✓	✓	✓		
Cost estimating and cost management software, programme optimisation software, project reporting and controls,	✓		✓	✓	✓	✓		
Cloud-based and real-time collaboration tools	✓	✓	✓	✓	✓	✓	✓	✓
Workflow and workforce management apps	✓	✓	✓	✓	✓	✓	✓	✓
Decision making software and tools (e.g. risk management and reduction tools, carbon calculators, social value and community engagement tools)	✓	✓	✓	✓	✓	✓	✓	✓
Common Data Environments (CDE)	✓	✓	✓	✓	✓	✓	✓	✓
Procurement and contract management, technologies and tools, payment applications and insurance solutions	✓	✓	✓	✓	✓	✓	✓	✓
Waste management and circular economy tools	✓	✓	✓	✓	✓	✓	✓	✓
Digital handover and asset management software				✓			✓	✓
3. Advanced manufacturing and materials								
3D printing / additive manufacturing	✓			✓		✓		
New construction materials and recycled construction materials, composite materials and biotechnologies	✓			✓		✓		

Construction Technologies	Infrastructure Delivery Lifecycle							
	Plan & procure			Design	Deliver		Operate & decommission	
Examples of key technology types that offer new tools, services and methodologies for construction and delivery infrastructure projects.	Upstream Process	Logistics and Transportation	Planning & Procurement	Design	Program, Project Management	Construction	Commissioning	Asset & Waster Management
Logistics systems and materials tracking	✓	✓			✓	✓		
Factory fabrication, DfMA, and modular construction	✓		✓	✓		✓		
4. Autonomous systems, robotic and automation processes								
Advanced robotics and automation	✓	✓	✓	✓		✓	✓	✓
Autonomous systems, drones, connected plant and equipment			✓		✓	✓	✓	✓
Smart PPE and Safety applications	✓	✓	✓	✓	✓	✓	✓	✓

4.2.1 Artificial Intelligence (AI)

Table 10 Artificial Intelligence (AI)

Technology	Description	Benefits	Maturity
Artificial intelligence (AI) and machine learning (ML) technologies	AI is one of the key emerging technology trends across industries, with recent rapid and significant growth in the capability and availability. Industry construction surveys show that 30% of Australian companies are currently trialling or using AI software to increase efficiencies and 94% having plans to use AI in the future.[36] AI is a key technology that can integrate with most other new and emerging technologies through the application of machine learning, deep learning, neural nets, fuzzy logic, natural language processing, computer vision, optimisation, generative AI and other techniques. Application: In construction, AI has a broad range of application and potential applications - streamlining and replacing repetitive tasks, preforming predictive analysis and risk assessment to generative design and optioneering and enabling advance data analytics and monitoring. AI's integration into many of the other Construction Technologies is a key enabler to realising productivity gains with estimates of annual global productivity boosts of up to 3.5%.[37] Some examples of current use of AI include generative design, predictive maintenance, optimising planning construction programs, optimising layout, or traffic flow optimisation for urban transportation efficiency38 and even detecting and analyse potential hazards, monitor and flag unsafe activities.[39]	Better Decision-Making Improved efficiency Improved data management Enables shift away from 'project-by-project' approaches Increase time efficiency Increase scalability and repeatability Data-driven insights Integration of project information Better Decision-Making Real-time monitoring	Near Future / Emerging

Technology	Description	Benefits	Maturity
	Automated assistants and natural language processing tools aid with task management, decision support and interpreting and synthesising information.		

4.2.2 Digital Technologies

Table 11 Digital Technologies

Technologies	Applications, benefits and examples	Benefits	Maturity
Advanced imaging, scanning techniques, computer vision, photo telemetry and geotechnical scans	Images and scans captured using a range of technology including thermal cameras, 3D and 4D scanning and ground penetrating radar (GPR). Applications: • Advanced scanning using GPR and image processing of subsurface conditions to reduce the risk of utility strikes in projects and reduced the effort of extensive potholing.[40] • Non-destructive testing of materials and components. • Analysis of site imagery to understand environmental conditions such as ecology for the production of reliable and detailed surveys.	Risk Mitigation Increase time efficiency Scalability and repeatability	Modern Practice
3D visualisation environments – AR, VR and Digital Twins	3D representations of physical assets including full digital twins. Applications: • Design visualisation, including in-situ augmented reality overlays of building Information Modelling (BIM) design models onto construction sites. • Simulation and predictive analysis. • Iteration of workflows and construction methodologies to determine the best approach.	Data-driven insights Integration of project information Better Decision-Making	Near Future / Emerging
Structural engineering software	Engineering software that enables and automates the calculation of design and structures. Applications: • Standardised design processes that remove human error and reduce data fragmentation, enabling engineers to focus on the anomalies and assurance. • Generative and parametric design, testing and iteration which can reduce material requirements – for example steel reinforcement.	Improved consistency Improved productivity Increased accuracy Increased efficiency in material use	Modern Practice
Geospatial technologies	Geospatial technologies combine positioning information, imagery and geospatial and non-geospatial data into mapping and analytical tools. While these technologies are already frequently already used on infrastructure projects, advances	Data-driven insights Integration of project	Modern Practice

Technologies	Applications, benefits and examples	Benefits	Maturity
	in geospatial technology and greater integration and interoperability with Common Data Environments. Applications: • Optimisation of routes or data driven site selection or aster planning tools, including rapid massing and testing. • Measuring and monitoring construction activities. • Combining other spatial data sources, including as automated sensors, image processing and AI to provide advanced data analytics and decision-making tools.	information Better Decision-Making Real-time monitoring Data sharing	
Advanced data analytics and visualisation	Advanced data analytics are tools and techniques used analyse and interpret large, complete and multi-dimensional datasets including to model and predict future states. This technology leverages the CDE, advances in AI and machine learning and the production of informative and interactive visualisations and presentations. Applications: • Predictive analysis to understand project trends and risks.	Data-driven insights Integration of project information Better Decision-Making Better Risk Management and Cost Management	Modern Practice
Design configurators	Customising standard designs based small number of inputs for pre-engineering components according to preset rules. Applications: • Provides a streamline and automated design process allowing for both customisation and repeatability, for example kit of parts selectors.	Improved consistency Improved productivity	Near Future / Emerging
Advanced BIM systems	BIM and digital engineering (DE) are established digital tools and approaches delivering specification and information concerning the design, construction operation and maintenance of infrastructure. BIM is a digital representation of the physical and functional characteristics of a construction project. Applications: • BIM is used to develop highly detailed models of infrastructure – for example a station design facilitation collaboration among engineering disciplines.	Enhanced collaboration and communication through real time sharing and updating of project information More accurate material quantity estimates Improved logistics Supports standardisation	Modern Practice

Technologies	Applications, benefits and examples	Benefits	Maturity
Cost estimating and cost management software, programme optimisation software, project reporting and controls,	Software tools and process that integrate project data with key project management functions. Applications: • Rapid and accurate cost estimation based on common data such as BIM. • Curation and analysis of project performance with advance visualisation. Optimisation of construction schedules through scenario testing and simulations. • Deployment of AI to provide predictive analysis and benchmarking against historical performance. • Application of standard processes and the adoption of rules and measurements that allow for real time assessment of progress.	Cost Control Better Decision-Making Improved efficiency	Modern Practice / Unrealised Potential
Cloud-based and real-time collaboration tools	Cloud-based and online collaboration technologies are software and applications that enable communication, document sharing and project management. Applications: • Online meeting platforms are used for coordination meetings, workshops reducing the need for physical travel. • Online information management systems are used to share documents across project teams, organisation across Australia and globally.	Enhanced collaboration and communication through real time sharing and updating of project information. Time savings Improved efficiency	Modern Practice / Unrealised Potential
Workflow and workforce management apps	Workflow tools to help standardise and automate construction process for people, materials and equipment. Applications: • Design management tools to reduce error and ensure compliance with quality assurance and approval processes. • Support the digitisation of administrative processes. • Collect and gather data for the project CDE.	Improved consistency Improved efficiency Improved data management	Modern Practice
Decision making software and tools (e.g., risk management carbon calculators, social value and community engagement tools)	Tools and software platforms that support decision making through data collection, measurement and reporting often leveraging advance data analytics and visualisation. Applications • Tools that estimate track, support and reduce the carbon impact of various construction processes.	Improved consistency Improved efficiency Better Decision-Making	Modern Practice / Unrealised Potential

Technologies	Applications, benefits and examples	Benefits	Maturity
	• Digital customer experience and community engagement tools to engage with project stakeholders and capture feedback		
Common Data Environments	Common data environments (CDE) are central repository of project information. It is a digital engineering environment that links project data and facilities interoperability between different tools and process. Applications: • Infrastructure projects require a 'golden loop' of information that flows through the end-to-end delivery process[41] from planning and design to operational performance. This can be achieved by setting up a Common Data Environments as the common information framework.	Better Decision-Making Improved efficiency Improved data management Enables shift away from 'project-by-project' approaches	Modern Practice / Unrealised Potential
Procurement and contract management technologies and tools	Software, tools and platform to manage the procurement progress including tender issuing, RFIs, consideration of response and contract management. Applications: • Electronic document management system and data rooms to manage and control tender information and responses	Enables fair tender process Ensures consistency and control	Modern Practice / Unrealised Potential
Payment applications and insurance solutions	Applications, tools and software that can certify and assure payments, accelerate the payment cycles and reducing financing costs – includes technologies such as blockchain. Applications: • Delayed and disputed payments throughout the infrastructure supply chain are significant industry issues Technologies that enable and guarantee reliable payments mechanisms will strengthen the construction industry and support industry participants – particularly small and medium enterprises. • The construction industry faces significantly increasing insurance premiums.[42] Technologies that can provide better understanding project and program risks and novel way of securing bonds and financial guarantee can help reduce transaction costs and premiums for projects.	Ensures consistency and control Risk Mitigation Improved cost efficiency	Near Future / Emerging
Digital handover and asset management software	The digital handover includes automation and process improvements for the collation and validation at project handover. This can include digital assess to support operations and maintenance.	Continuous improvement Improved operational efficiency	Near Future / Emerging

Technologies	Applications, benefits and examples	Benefits	Maturity
	Knowledge from a project is a valuable asset that can help drive continuous improvement or set up operators of assets for success in delivering services.[43] Application: • Computerised maintenance management software (CMMS) to optimised and automate operations maintenance tasks, linked with condition-based monitoring and building and equipment sensors can refer back to design parameters and specifications.	Enables shift away from 'project-by-project' approaches	

4.2.3 Advanced manufacturing and materials

Table 12 Advanced manufacturing and materials

Technologies	Description	Benefits	Maturity
3D printing / additive manufacturing	Additive manufacturing and techniques like 3D printing create new materials and objects. Applications: • These approaches make use of digital models and can offer efficient prototyping, production speeds, or assembly and repair. • While this method is used in aerospace, automotive, healthcare, and consumer goods, it is increasingly adopted for mass customised prefabricated construction.[44]	Supports Standardisations Increased efficiency in material use Improved or enhanced designs	Near Future / Emerging / Unrealised Potential
New construction materials and recycled construction materials,	Innovations in concrete, insulation, steel, timber, composites and aggregates or the recycling of waste and other materials for use in construction. Applications: • Mass laminated timber or cross-laminated timber panels (CLT) have been used in building construction projects offering environmental benefits, the speed of construction, carbon storage and favourable aesthetics.[45] • Use of recycled materials in projects with the application of recycled alternatives in roads infrastructure range from 2% to 83% depending on geography, availability, time, and other measures.[46]	Supports Standardisations Reduced waste Improved efficiency	Unrealised Potential
Logistics systems and materials tracking	Logistics and tracking systems can monitor and track the location and status of materials or assemblies.	Time savings Reduced waste	Unrealised Potential

Technologies	Description	Benefits	Maturity
	Applications: • Optimise construction activities and schedules through accurate information of the transport and location of materials. • Allow for 'just in time' delivery reducing storage and handling costs through GPS and RFID.	Improved logistics	
Factory fabrication, DfMA, and modular construction	DfMA is an approach that simplifies the design process to optimise the manufacture and assembly of components. A "kit-of-parts" refers to standardised, prefabricated components that can be assembled quickly on-site. Applications: • DfMA principles are applied to create modular elements for infrastructure such as pre-cast bridge sections, tunnel linings, or station platforms. The kit-of-parts is manufactured offsite and delivered for quick assembly. [47]	Improved efficiency Supports Standardisations Cost reductions	

4.2.4 Autonomous systems, robotics, automation and site processes

Table 13 Autonomous systems, robotics, automation and site processes

Technologies	Applications and benefits	Benefits	Maturity
Advanced robotics	Hardware and software that uses sensor technologies to perform physical task often in autonomous or semi-autonomous ways. Applications: • Use of robotics for physical repetitive task can reduce delivery cost, increase speed, and increase worker safety. • Autonomous robots can inspect and maintain assets more frequently and in hard-to-reach or remote locations.[48]	Improved consistency Improved efficiency Cost reductions	Near Future / Emerging
Autonomous systems, drones and connected plan and equipment	Systems such as Autonomous Ground Vehicles (AGVs), drones and wireless monitoring and connected plant and equipment. Applications • Drones have applications in site survey and inspections, material delivery. • Connect equipment can provide information and feedback on usage, progress and enable predictive maintenance. See Case Study on Autonomous TBMs).	Improved consistency Improved efficiency Cost reductions	Near Future / Emerging
Smart Personal Protective Equipment (PPE) and Safety Applications	Equipment such as wearables with integrated technology such as computer vision or communication technology or smart equipment that can help lift heavy objects or reduce the impact of falls.	Risk Mitigation Improved safety	Future Technology

Technologies	Applications and benefits	Benefits	Maturity
	Applications: • Integrate computer vision in PPE to identify hazards in real time, reducing potential accidents on-site. • Wearable devices to monitoring physical wellbeing and exhaustion in the physically demanding work environments. • Digital safety reporting and site communication tools.		

4.3 Case Studies

Project

Sydney Metro - Northwest, Stage 1 and City and Southwest, Stage 2

Project Owner

Transport for NSW

Technologies

Digital Engineering

Building Information Modelling (BIM)

Common Data Environment

3D Virtual Reality

Geospatial Technologies

Electronic Document Management System (EDMS)

Project context and application

Sydney Metro – Stage 1 Northwest and Stage 2 City and Southwest are some of Australia's biggest public transport projects, delivering Sydney's first fully-automated railway network.

Sydney Metro has focused on the adoption of a digital engineering approach from the outset, driving increased collaboration and delivering better project outcomes using a wide range of digital and Construction Technologies and a comprehensive digital engineering approaches to delivery.

For example, Sydney Metro deployed full digital modelling from the outset. For initial work the design team did not produce drawings for the concept design – they had a digital model for review and comments until 30% design – and then only produced drawings as procurement currently requires that in Australia.[49] By digitising the design process and using co-ordinated 3D Building Information Modelling (BIM) this part of the project was able to eliminate 900 drawings and enable significant programme and cost savings.

Digital technologies were also used for customer-centred design creating 3D Virtual Reality model of new underground stations which allowed members of the public to 'walk through' and interact with them providing feedback to the design team.

Another example of digital applications was an acoustic assurance tool – a GIS-based system - that allows for a better understanding of how to meet planning requirements around noise and vibration.

Station structural engineering was investigated using generative and parametric design tools in collaboration with the architect, contractor, and quantity surveyor. The design process utilised 3D printing, script sharing, material take offs and constructability workshops.

Project

Sydney Metro West[50]

Project Owner

Sydney Metro

Technologies

Advanced robotics

Artificial intelligence

Autonomous systems

Project context and application

The twin nine-kilometre rail tunnels between Sydney Olympic Park and Westmead will be constructed with ‘Australia’s first autonomous tunnel TBMs’.

These two machines will utilise innovative artificial intelligence software to automatically steer, operate and monitor several TBM functions. An operator will remain in control with the autonomous system executing repetitive tasks on behalf of the operator. The technology approach also allows the TBMs to be more accurate and precise ultimately reducing the time required to excavate the nine-kilometre tunnels, therefore saving project costs. This technology controls tunnelling speed and force and lessening the impact the equipment and the need for maintenance.

TBMs are already a key MMC and productionised construction in transport project and here this is further enhanced by integration with Construction Technologies such as AI.

Technologies

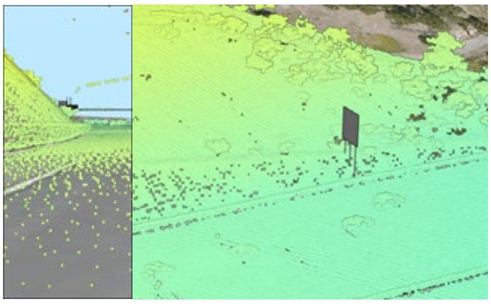
Advanced robotics

Artificial intelligence

Safety Applications

Project context and application

MULE (or Material Unit Lift Enhancer) is an **advanced robotics system** used on Sydney Metro to lift and place heavy materials during construction. It received Sydney Metro Health and Safety Supply Chain Award for its innovation in workplace safety at the Waterloo Station site for using artificial intelligence and advanced robotics to help workers with physically demanding tasks.



Project

Torrens to Darlington (T2D) Project

Project Owner

Department for Infrastructure and Transport

Technologies

Geographic Information Systems

Building Information Modelling

Project context and application

The $15.4b T2D Project is the final 10.5km section of the North-South Corridor with two separate tunnels, connected by an open motorway currently being delivered in South Australia.

As part of this project **digital elements were brought together** to undertake quick line of sight and obstruction assessments for at road level visibility of signage.

Combining BIM IFC models of signage High Resolution Digital Elevation (DEM) models LiDAR data IFC models of gantry and overhead signage were georeferenced into the landscape using aerial imagery and digital elevation surfaces and then checked for visibility at driving level/road lanes for desktop determination of obstructions.

The next section identifies the barriers to adoption of MMC and Construction Technology that have been identified in this desktop study.

5 Barriers to adoption

MMC and Construction Technology is adopted, in part, in the design and delivery of Australian transport construction projects. This desktop study has identified a set of likely barriers that impede more widespread maturity and adoption of these methods and applications.[51]

The barriers to adoption of MMC and Construction Technology are summarised in Table 14 and then discussed in more detail below:

Table 14 The Barriers to Adoption of MMC and Construction Technology Summary

Pipeline uncertainty and granularity • Too short-term • Too granular • Too narrowly defined
Misaligned incentives • Capital uplift is significant (human, physical, digital) • Constrained access to financing • Risk asymmetries • Geographic dispersion
Inadequate enabling environment • Intellectual Property not valued • Overly prescriptive requirements • Inconsistency in data and information management standards • Lack of transparency over market opportunities
Gaps in knowledge, skills and behaviour • Misconceptions over standardisation and quality • Benefits not well understood • More guidance and training needed for procurement teams

?

Pipeline uncertainty and granularity.

Articulation of the committed funding pipeline of government-led infrastructure is too short-term (4 years maximum), focused at the project level (rather than program level), and focused on outputs rather than societal outcomes.

- Committed funding from governments for infrastructure is only ever provided over a maximum four-year time horizon that aligns with the forward estimates period. This short timeframe (less than 10 years) creates uncertainty over the scale of opportunity for industry to commit to large-scale investments in MMC and Construction Technology.

- Government infrastructure planning and announcements have a tendency to focus at the project level rather than program or portfolio level, further reducing the scale of opportunity presented to industry for investment.

- Project-level requirements (contrasted with program and portfolio level) do not adequately link to broader societal objectives, which drives a focus on project-level objectives rather than sectoral reform and opportunity, including those presented by MMC and Construction Technology.

Misaligned incentives

The incentives for industry to invest in adopting MMC and Construction Technology are inadequate compared with the risks

- A large amount of financial, human, physical and digital capital is required to successfully transform and retool businesses and processes from traditional to modern methods of construction. For example, skill shortages are often highlighted as a key barrier to MMC and Construction Technologies – in 2024, 76% of construction firms reported a technical skills gap in digital technology – which requires.[52] Australian firms typically required require the investment outlay to be recouped within a few years or have high 'hurdle rates of return.[53]
- Construction Technologies have large upfront costs, which can be a barrier to adoption for small and medium-sized enterprise. Cost was reported as a barrier to digital adoptions by nearly 40% in a 2024 survey of the Australian construction industry and 34% reported facing the barrier of a lack of allocated budgets for technology investment.[54]
- MMC and Construction Technology investments requires access to working capital and longer-term financing sources that can be more difficult to obtain and service for many industry participants, given the large proportion of small and medium enterprise in Australia's construction sector. and Australian business invested around 16% of expenditure on Construction Technologies, one of the lowest in the Asia Pacific region.[55]
- The risk asymmetries often disproportionately impact industry relative to government do not enable first-mover advantage for MMC transformations. Procurement models do not consistently generate genuine pain-share / gain-share outcomes for industry and government.
- The geographic dispersion of economic activity stimulated by transport-related infrastructure in Australia is a persistent challenge for industry players due to the marginal costs of transportation and logistics. Geographic barriers limit the accessibility of MMC products and Construction Technologies, particularly for off-site manufacture, modular construction and new or recycled materials. Haulage over longer distances can add significant time and costs, reducing or negating any productivity benefits. It may also negate the sustainability benefits due to the emissions generated. Such geographic barriers are found to be dividing the supply capacity even within states and between metropolitan and regional areas.[56]

Inadequate enabling environment
Existing regulation, standards, processes and protections are inadequate for enabling consistent investment in and commitment to MMC and Construction Technology

- Intellectual Property is not sufficiently valued by the public sector. Existing government panel agreements and standard forms of agreement require suppliers to forego intellectual property rights to the buying government entity. Furthermore, market engagement, pre-tender and unsolicited bid processes do not adequately protect the IP of industry participants, which limits the potential reach of innovative design and delivery solutions.
- Existing risk settings, regulations and standards do not adequately support the introduction of Construction Technology and certain materials used by MMC market participants. For example, industry consultation highlighted *'existing specifications and prescribed specific characteristics for products rather than performance outcomes'* as one of the key barriers that limits the entry of new and innovative and lower-carbon materials into the market.[57]
- There is inconsistency in the data and information governance and standards required to enable MMC and Construction Technology applications, nationally. This includes transparency over and the reapplication of effective data models, BIM, and digitised logistics coordination for translation across other projects, programs and portfolios.
- Government tender processes for transport infrastructure projects usually target Tier 1 contractors and thereby exclude large proportions of the supply chain, which limits the potential for and access to innovation in MMC and Construction Technology.

Gaps in knowledge, skills and behaviour Limited awareness and skills imbalances are creating missed opportunities
• There is a misconception that standardisation of manufacturing components equates to lower quality and homogenous outcomes in design.
• There is a misconception that the construction industry lacks innovative capacity and output. A more precise assertion is that the scale and certainty of transport infrastructure opportunities the construction sector may pursue does not support larger and more risky investment above current levels. Project leaders and manager explicitly seek to minimise risk, not increase it.
• The benefits offered from adopting MMC and Construction Technology are not well understood across the sector which is limiting awareness and reducing opportunities to measure and capture value at multiple stages of the project lifecycle, including business case, procurement, design and delivery.
• There is insufficient guidance available to government project and procurement teams about risk appetite, identification and apportionment to best inform tender processes and contracting models that would enable MMC and broader market enablement objectives.
• The inconsistent 'buy-in' for adopting MMC and Construction Technology entrenches skills imbalances across the construction sector. This is further impacted by the lag between refining and attaining education qualifications and their application in the delivery of infrastructure.

6 Next Steps

6.1 Introduction

Phase 1 is the foundational step to a MMC (modern methods of construction) and Construction Technology adoption roadmap as part of the National Construction Strategy (see Figure 10).

Phase 1 has identified the barriers to adoption of MMC And Construction Technology. Phase 2 will dive deeper into these barriers (where necessary) to strengthen the evidence base upon which to define the most impactful government, community and industry enabling actions to increase the adoption of MMC and Construction Technology.

To be effective, the roadmap must provide practical actions, with ownership clearly stated over specific time horizons.

Phase 2 will continue to focus on the design and delivery of transport infrastructure (to be confirmed with ITSOC). Phase 3 (out of scope) is focused on the implementation of the National Construction Strategy, including tracking and reporting against interim and headline measures of success.

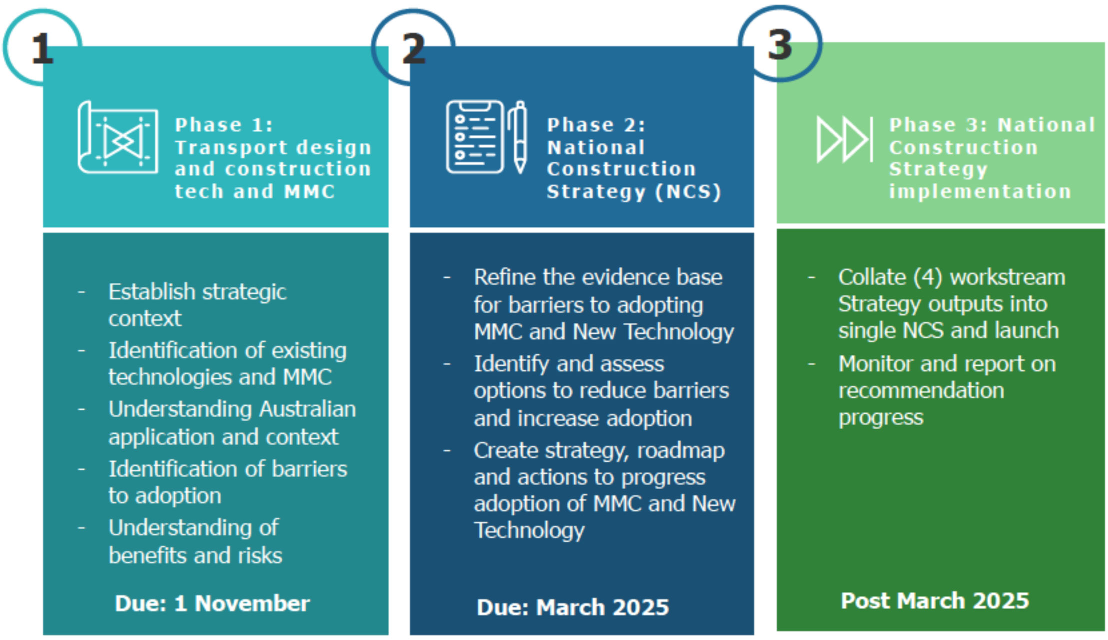


Figure 10: Phases of the National Construction Strategy

6.2 Objectives of Phase 2

Phase 2 will:

- Validate the barriers identified in Phase 1 with agreed stakeholders across the construction industry and government at national and state and territory levels.
- Validate the benefits and complexities associated with the uptake of MMC and Construction Technology to support prioritisation of enabling actions.
- Define the industry-led, government-led and shared reform solutions to overcome barriers to MMC and Construction Technology adoption and the benefits they will contribute towards, including decarbonisation.

- Create a roadmap for implementing these reforms.
- Define interim and headline measures of success across the roadmap horizons.

6.3 Approach to Phase 2

Phase 2 will combine targeted research, engagement with stakeholders across industry and government, and qualitative and quantitative analysis to achieve consensus on the most impactful pathway forward for increasing the uptake of MMC and Construction Technology.

Phase 2 will be delivered across three stages:

Stage 1	Stage 2	Stage 3
Using stakeholder engagement to test and refine barriers to adoption	Using theory of change to define impactful and measurable solutions	Develop an engaging and implementable strategy and roadmap development

The methodology for Phase 2 is represented in Figure 11 and the corresponding relationship with each stage is also shown.

The analytical toolkit that will deliver against these principles are:

- Stakeholder engagement (via workshops and survey)
- Theory of Change (to lay out the vision relative to the current state)
- Multi Criteria Analysis (to enable prioritisation and robust decision making)

These tools will be deployed across each stage.

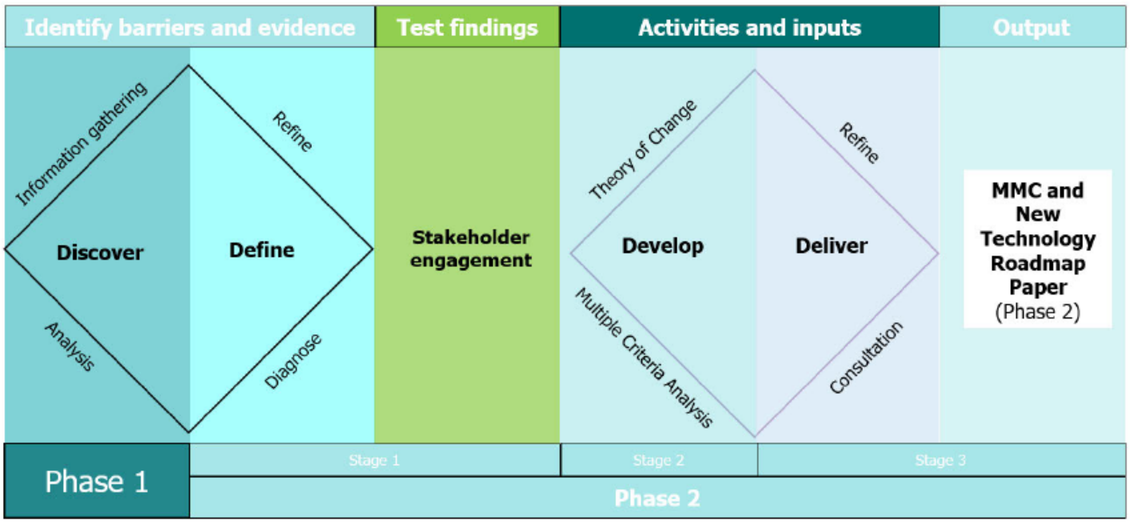


Figure 11: Proposed methodology to deliver Phase 2

Theory of Change sets a framework for intended reforms and desired end outcomes to be tested, challenged and refined. This is accomplished by defining 'daisy-chain' interventions. These sequenced interventions will be used to understand activities and intermediate outcomes required to deliver on the end outcome(s) (see Figure 12).

The step-by-step representation of the roadmap will assist in realising the vision of the National Construction Strategy of higher productivity. Using Theory of Change will result in better identification and assessment of key drivers of change, improve prioritisation and selection of reforms, and identify pragmatic infrastructure reforms.

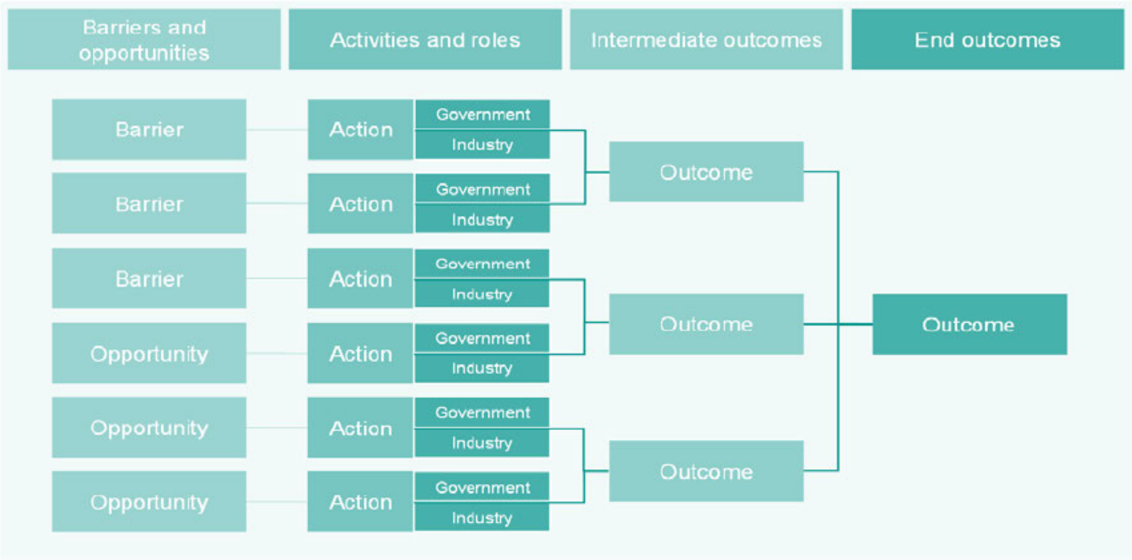


Figure 12: Theory of Change framework

The Theory of Change will be combined with Multi-Criteria Analysis (MCA) to express the trade-offs of each reform. MCA is a method to evaluate and prioritise different options based on multiple criteria.

MCA is often used in policy and project prioritisation processes to complement and target quantitative analyses, that is often undertaken before implementing significant reform.

An MCA process will require:

- **Problem definition:** Define barrier and opportunity.
- **Identify criteria**: Determine criteria to evaluate options. These could include, for example, ease of implementation or reform impact.
- **Assess recommendations:** Evaluate each recommendation against the criteria.
- **Weighting:** Assign subjective weighting to each criteria based on their importance.
- **Score calculation:** calculate MCA score for each recommendation by combining assessment and weights.

Figure 13 presents an example of a prioritisation matrix which outlines how proposed interventions can be assessed in terms of their relative impact.

Relative impact	Definition
High positive	Likely to have a relatively significant positive impact on construction sector productivity with additional benefits
Low positive	Likely to have a relatively small positive impact on construction sector productivity with some/no additional benefits
None	Likely to have little/no impact
Negative	Likely to create new or expand existing challenges in the construction sector

Figure 13 MCA prioritisation matrix example

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National Construction Strategy - Modern Methods of Construction (MMC)

Phase 2 - Recommendations and actions to enable wider MMC adoption in Australia

June 2025

MOTT MACDONALD

National Construction Strategy - Modern Methods of Construction (MMC)

Phase 2 - Recommendations and actions to enable wider MMC adoption in Australia

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Phase 2 - Recommendations and actions to enable wider MMC adoption in Australia

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0.1	26/03//2025	Ben Melville	Mike Matthews Stuart	Peter Colacino	Draft recommendations and actions
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0.3	05/06/20215	Ben Melville	Mike Matthews Stuart	Peter Colacino	Final submission
0.4	30/06/2025	Elise McCaul	Ben Melville	Peter Colacino	Final submission, with ACA updates

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Contents

Executive summary

Australia's construction industry continues to face a challenging environment. Stagnant productivity is a key structural issue that has persisted in the construction sector for over three decades. Addressing this is fundamental to delivering the transport infrastructure needed to support Australian communities.

In recognition of the crucial role the construction sector plays in delivering Australia's transport infrastructure pipeline, senior officials from each of Australia's transport and infrastructure agencies (ITSOC) have commissioned the development of a National Construction Strategy (the Strategy) to harness insights from across governments and industry to improve productivity in the transport infrastructure construction sector.

The Strategy is being guided by the investigation of four key themes:

- Data Collection and Benchmarking: This workstream is investigating establishing national productivity data metrics for the transport infrastructure construction sector.
- Workforce: This workstream is investigating culture, flexibility and diversity of the transport infrastructure construction workforce.
- Procurement and Contracting: This workstream is developing national guidance on procurement methods and assessment of non-cost outcomes.
- New Technology and Modern Methods of Construction: This workstream is exploring productivity enhancing tools and modern methods of construction, and the barriers to adoption.

This workstream is focused on **Theme 4: New Technology and Modern Methods of Construction** and a *Phase 1 paper* sets out the key barriers to adopting Modern Methods of Construction (MMC) in the Australian Transport sector (Table 1).

Table 1 - Headline barriers to wider adoption of MMC (Phase 1 Report)

Pipeline uncertainty and granularity • Too short-term • Too granular • Too narrowly defined	Articulation of the committed funding pipeline of government-led infrastructure is too short-term (4 years maximum), focused at the project level (rather than program level), and focused on outputs rather than societal outcomes.

Misaligned incentives • Capital uplift is significant (human, physical, digital) • Constrained access to financing • Risk asymmetries • Geographic dispersion • Supply chain coordination	The incentives for many industry participants to invest in adopting MMC and Construction Technology are inadequate relative to the upfront costs, the scale of investment and the risk investment will be withdrawn.
Inadequate enabling environment • Intellectual Property not adequately valued or protected • Overly prescriptive requirements • Inconsistency in data and information management standards • Lack of transparency over market opportunities	Existing regulation, standards, processes and protections are inadequate for enabling planned deployment, consistent investment in and commitment to MMC and Construction Technology.
Gaps in knowledge and skills • Misconceptions over standardisation and quality • Benefits not well understood • More guidance and training needed for procurement teams	Limited awareness of alternative approaches, inadequate tools for incentivising and managing innovation and capability imbalances are creating missed opportunities for adoption of MMC and Construction Technology.

The majority of these barriers are structural, suggesting that changes to policy, regulation and accepted ways of operating will achieve greater adoption of innovative solutions to infrastructure delivery. However, it must be noted that the financial instability that the construction industry is currently experiencing is also a substantial barrier. In this environment constructors are unable to make the investment required to adopt new technology or take the risk proposing a new approach. While improved productivity will assist in addressing this barrier, this will only come in time.

This paper (phase 2) identifies six key reform areas to overcome these barriers, each supported by actionable recommendations and a high-level phased implementation timeline:

1. **Leadership and Vision:** Establish a national taskforce to drive industry transformation, set a clear vision, and coordinate cross-sector collaboration.
2. **Forward-Planning and Engagement:** Develop a transparent, 10-year infrastructure pipeline and an MMC Value Toolkit to build industry awareness, support business case integration, and promote systems thinking.
3. **Policies, Regulations and Standards Alignment**: Harmonise national standards and regulations to reduce fragmentation, enable scalability, and align with international best practices.
4. **Procurement and Commissioning:** Reform procurement processes to encourage early contractor involvement, performance-based specifications, and digital integration, while reducing risk and enabling innovation.
5. **Data Alignment and Information Sharing**: Enhance digital maturity through consistent data standards and establish a national digital platform as a single source of truth for infrastructure planning, delivery, and knowledge sharing.
6. **Labour and Capability Uplift:** Address workforce shortages and skills gaps by developing a multidisciplinary training framework, new education pathways, and incentives for industry-VET collaboration.

The paper was informed by extensive industry engagement, global benchmarking, and alignment with the National Construction Industry Forum’s Blueprint for the Future. It responds to pressing challenges including labour shortages, supply chain disruptions, and the need for sustainable, digitally enabled construction practices.

By implementing these recommendations, Australia can unlock significant productivity gains, modernise the industry and deliver infrastructure more efficiently, sustainably, and safely.

This paper is structured as follows:

- Chapter 1 of this report presents the headline recommendations, their ideal sequence of implementation and the outcomes each will contribute towards.
- Chapter 2 defines the specific actions required to mobilise and deliver these recommendations, supported by relevant examples.
- Chapter 3 presents a Snapshot of the MMC industry.
- Chapter 4 presents key trends relevant to the wider adoption of MMC.
- Chapter 5 contains an Appendix which aligns the recommendations provided in this report with the Draft Blueprint for the future delivered via the National Construction Industry Forum (NCIF).
- Chapter 6 provides a list of references.

1 Summary of recommendations, outcomes and timing

Timing	Recommendations	Outcomes			
		Pipeline certainty and granularity	Better aligned incentives	Consistent enabling environment	Enhanced knowledge, skills and behaviours
Immediate action	Establish clear ownership for coordination of MMC initiatives		✓	✓	✓
	Define behaviours and leadership model that will encourage collaboration and enable innovation		✓	✓	✓
	Develop a MMC Value Toolkit that allows experiences and knowledge to be shared			✓	✓
0-12 months	Create and share a national 10-year program pipeline for transport infrastructure	✓	✓	✓	
	Develop national standards for transport infrastructure components, with the aim of broad adoption		✓	✓	
	Develop national procurement guidelines that support and encourage new ways of delivering infrastructure		✓	✓	

Timing	Recommendations	Outcomes			
		Pipeline certainty and granularity	Better aligned incentives	Consistent enabling environment	Enhanced knowledge, skills and behaviours
12 – 24 months	Develop construction-specific data and information principles that enable standardisation of collection and use		✓	✓	
	Establish an open access, single-source-of-truth national digital platform that is focused on ease of access and sharing information			✓	✓
	Develop a multi-disciplinary skills and training framework			✓	✓
	Establish education and skills development pathways and programs			✓	✓

*Detailed recommendations and actions can be found in section 2

2 Detailed recommendations, actions and outcomes

1. Shared vision

Recommendations	Actions	Outcomes
1.1 Establish a clear ownership to drive and champion the transformation of the industry to increase national productivity	1.1.1 Task an **existing organisation** or create a **new organisation** to drive transformation • Option A: Industry, government and employee representative bodies with shared objective but separately governed, such as the National Construction Industry Forum • Option B: Blended organisation representing industry and government. • Option C: industry-led organisation 'supported' by government 1.1.2 Establish a **vision, objectives, targets, governance** • Develop a national outcomes framework that articulates the aspiration for wider adoption of MMC in transport infrastructure. • Define key terminology to support shared understanding of scope, purpose and progress. • Develop terms of reference (TORs) including roles, responsibilities and accountability measures for 1.1.3 Develop a **short-term action plan**	• **Dedicated leadership**: An organisation accountable for the transformation will provide a central point of focus and leadership for driving productivity in transport infrastructure. • **Cross collaboration**: Bring together key local and global insights from across the value chain (government, academia, prefab, smart buildings, manufacturing, contractors/suppliers etc.). • **A clear vision**: A clearly defined and agreed upon vision sets the foundation for improving productivity in transport infrastructure. • **Industry understands the end goal and how we get there**: A defined roadmap will support industry's understanding on what the future state objectives are and how they can input along the way.

	• Set out current vs target state for the adoption of MMC at each level of the construction value chain. • Map key industry agencies, bodies and disciplines for consultation and any interdependencies e.g. key standards across construction, manufacturing and logistics. • Map out key milestones/feedback points to ensure cross industry transparency and participation.	
1.2 Define **behaviours and leadership model** that will encourage **collaboration** and enable **innovation**	1.2.1 Identify and document **behaviours** and **ways of working** that **enable collaboration** and greater **adoption of innovation**. 1.2.2 **Identify key project leadership roles** that have responsibility for decision-making, in setting project objectives and determining project team culture. 1.2.3 **Assess options,** such as a **standard project charter,** for establishing how teams behave, work together and role of leaders that can be **used across all land transport projects**.	**A shared, clear vision**: A clearly defined and shared understanding of the behaviours that set the foundation for greater collaboration, innovation and ultimately improving productivity. **Shared ideas and knowledge:** Brings together key project leaders and project teams to share ideas and collectively solve issues as they arise. **Coordinated project leadership**: Defined leadership roles and responsibilities support decision-making and shared responsibility for project performance.

Proof points relevant to 1. Leadership and vision

Exemplar practice:

- **Hong Kong – Construction Industry Council (CIC)**[1]
  - Statutory body established in 2007 to drive the sustainable development of the construction industry
  - The CIC is primarily funded through a levy on construction projects - 0.53% of total value of construction operations (exceeding HK$3,000,000).

  Example recent initiatives by CIC:

  - Smart Site Safety System Labelling Scheme (4SLS): Launched in January 2025, this scheme aims to enhance site safety through the adoption of smart technologies. It includes guidelines and standards for implementing smart safety systems on construction site
  - Construction Innovation and Technology Fund (CITF): The CITF continues to support the industry by funding projects that adopt innovative technologies. Recent projects include the use of robotics and automation to improve construction efficiency and safety
  - Sustainable Construction E-platform: This platform provides resources and tools to promote sustainable construction practices. It includes guidelines on green building standards and best practices for reducing the environmental impact of construction activities.

- **United Kingdom - Construction Innovation Hub**[2]
  - The Construction Innovation Hub was a partnership initiative formed in 2018, receiving £72 million funding by UK Research and Innovation through the Industrial Strategy Challenge Fund.
  - It was established through a collaboration between the Manufacturing Technology Centre (MTC), the Building Research Establishment (BRE), and the Centre for Digital Built Britain (CDBB) as part of Innovate UK's Transforming Construction Challenge.
  - The Hub's mission is to create better outcomes for current and future generations by driving the adoption of manufacturing and digital approaches that improve the delivery, resilience, and performance of infrastructure.
  - The Hub collaborates with over 600 organisations, including industry bodies, policy-makers, practitioners, and academics, to address the sector's performance and productivity challenge.

2. Forward-planning and engagement

Recommendations	Actions	Outcomes
2.1 Create and share a **10-year programme pipeline** across all governments for transport infrastructure projects • 0-4 years (programs and projects) • 4-10 years (envelopes of funding for programs/strategic initiatives in asset types)	2.1.1 All governments (Federal, state and territory, and local) to **agree consistency in transparency** of 10-year transport programme pipeline for projects over a prescribed value, such as $50 million. 2.1.2 Collate a **single, dynamic inter-government dataset** of future investment pipeline and catalogue assets and sub-components with high degrees of design consistency, focusing on asset types. 2.1.3 **Integrate the 10-year pipeline with existing frameworks and databases** such as that used to deliver the state and territory project pipelines, Infrastructure Australia Market Capacity Report[3] and/or the Australia & New Zealand Infrastructure Pipeline (ANZIP).[4]	• **Investment clarity:** A more granular and long-term view of the transport infrastructure pipeline will enable government and industry to appropriately invest in their organisational capabilities to meet the market demands and remain competitive. • **Understand collective impacts of projects:** Moving from a project-specific pipeline to one that focuses on sub-components will help understand the collective impacts of projects and improve overall efficiency. This can enable opportunities for manufacturing innovation hubs to support multiple component development.
2.2 Develop a MMC value toolkit to build industry awareness and buy-in, and support the consideration of MMC within deliverability assessments and business cases through: • promoting benefits • articulating risks	2.2.1 Develop collateral to better articulate the **benefits** (including non-financial benefits), **risks** and whole of life costs of MMC. 2.2.2 Collate **case studies** that demonstrate the value of MMC, both international and local. 2.2.3 Develop suggested **accountability and KPI measures** for organisations introducing MMC approaches,	• **Better awareness of MMC:** A value toolkit will lead to a better understanding across government and industry of the purpose, opportunities, risks and benefits of adopting MMC. • **Appropriate scale of MMC in business cases:** A value toolkit will

Recommendations	Actions	Outcomes
• measuring the value of MMC • growing support and desire for change	to help demonstrate the realisation of benefits to stakeholders.	help project managers, agencies, and planners articulate the potential benefits of adopting MMC-led approach to delivery within the business case and how to integrate MMC considerations into the overall project planning and assessment process. • **Demonstrating MMC value will stimulate investment:** Appropriate and agreed benchmarks and targets will support consistency in demonstrating the value of MMC adoption and help track progress over time to build momentum and stimulate further investment. • **Shift industry to a systems-thinking mindset**: A change in the way the construction industry thinks about and measures value, demonstrating the delivery of broader, system-wide outcomes beyond traditional cost, time and quality.

Proof points relevant to 2. Forward-planning and engagement

Exemplar practice:

- **UK Construction Hub's Platform:** In 2020, the UK Construction Hub's Platform team partnered with five of the government departments working collaboratively to collate a cross-departmental data set of future requirements across a £50 billion five-year new build pipeline. The departments identified for standardisation opportunities were Department for Education (DfE), Department of Health and Social Care (DHSC), Ministry of Housing, Communities and Local Government (MHCLG), Ministry of Justice (MoJ), and the Ministry of Defence (MoD).[5]

  Key insights included:

  1. 70% of those government spaces analysed share consistent geometrical characteristics – namely a mid-span framing system
  2. 30% of spaces are general use areas, such as circulation, bathrooms and storage, with bedrooms the largest frequency of the government of estate at 13%
  3. Departments shared an informed understanding of value drivers, not least the collective commitment and shift in focus towards driving a net-zero carbon agenda across all departments pipeline

- **Accountability and KPI measures in Asia:** Having clear metrics (through Hong Kong University, building control in Singapore, and CIC in HK) helped track progress and demonstrate measurement of improvement.
  - In Hong Kong, they delivered 70+ projects using MMC (2017-2023) with an approved supplier base of 19 manufacturers.[6]
  - In Singapore, (2013-2020) they delivered 50 projects and grown suppliers from 6 to 32.[7]

- **Value of change management in digital adoption:** Construction businesses undertaking more than the average number of change management activities increased their use of technology adoption by 20% - equivalent of an increase from using 6.2 to 7.4 technologies for the average business.[8]

- **Value toolkit:** UK's Construction Innovation Hub - Value Toolkit [9]

3. Policies, regulations and standards alignment

Recommendations	Actions	Outcomes
3.1 Draft a set of aligned **National Transport Infrastructure Component Standards**	3.1.1 Identify **opportunities for standardisation** through: • Co-creation with relevant agencies, bodies and asset owners on **shared outcomes enabled by standardisation** • Study to identify **domestic** (such as RISSB and Austroads) and **international best practice** and bridge the gap between top-down standards (e.g. Uniclass) and bottom-up agency preferences • **Prioritise scope** for standardisation based on **future construction pipeline** (e.g. common spaces / components / beams) and ability to move the needle in terms of project delivery and design • A **look-back review** of major projects across each transport sub-sectors to identify scope for standardisation and MMC adoption • Conduct **gap analysis** of jurisdiction-specific standards (e.g. technical design, digital application, sustainability, materials use and circular economy) relative to shared outcomes and national framework • Develop **nationally consistent prioritised standards,** where possible emphasising alignment to established international standards.	• **Shared vision**: A benchmark between jurisdictions on shared problems and outcomes will underpin the development of a consolidated set of national standards. • **Overcoming variability in standards**: Understanding where misalignment exists between transport infrastructure policies, frameworks and standards, is a key first step to enabling standardization across the industry. Leveraging existing standards ensures industry is not re-inventing the wheel and there are no competing standards. • **A standard approach provides foundation and confidence for investment**: Aligning transport infrastructure to national and international standards across the asset lifecycle (e.g. planning, design, operations etc.) will provide a consistent benchmark and confidence for industry to invest in aligned MMC approaches.

Recommendations	Actions	Outcomes
	3.1.2 Identify opportunities for **feedback and piloting** across industry.	

Proof points relevant to 3. Policies, regulations and standards alignment

- **National framework not conducive for scaling MMC:** PreFabAus' roadmap 2023-2033 states that the current regulatory framework is not conducive to the scale required for prefabrication or Smart Building, with inconsistent standards across states and a lack of recognised quality certification. Additionally, financing models favour conventional onsite construction, creating barriers to investment in prefabrication projects.[10]
- Around **30% of opportunities and actions** from the MMC workshops (see section 2.3) related to a need for national standardisation to enable MMC. The below examples of existing practice were specifically called out from workshop attendees:

  - **International:**
    - Uniclass (North American system): A comprehensive classification system used in the architecture, engineering, and construction (AEC) industry.
    - Omniclass (UK system): A comprehensive classification system used in the architecture, engineering, and construction (AEC) industry.
    - *ISO19650*: International standard for managing information over the whole lifecycle of a built asset using Building Information Modelling (BIM)
    - Industry Foundation Classes (IFC): An open, neutral data format developed by buildingSMART to facilitate interoperability in the AEC industry.
    - Information Delivery Specification (IDS): A standard developed by buildingSMART for defining information requirements in the AEC industry in a computer-interpretable form.
    - buildingSMART Data Dictionary (bSDD)): An online service provided by buildingSMART International that hosts a collection of interconnected data dictionaries, with definitions of terms used to describe the built environment.

Proof points relevant to 3. Policies, regulations and standards alignment

- Australian/New Zealand Standards (AS/NZS): Jointly developed standards by Standards Australia and Standards New Zealand to ensure consistency, safety, and quality across various industries in both countries.

- **Australia:**
  - Austroads: Standards harmonisation project.[11]
  - Austroads: Road Asset Data Standard.[12]
  - NSW Smart Infrastructure Policy.[13]
  - Standards Australia: Common data model being developed by Standards Australia for building construction.[14]

4. Procurement and commissioning*

*The following recommendations are based on workshop feedback regarding procurement and commissioning to better support and enable MMC. These recommendations should be reviewed and updated according to the actions from the procurement workstream led by the Victorian Infrastructure Delivery Authority (VIDA).

Recommendations	Actions	Outcomes

4.1 Tender processes and market engagement should be reviewed to enable national consistency
 	
This review should include **determining a common approach to the measurement of innovation** as part of any tender assessment of **value for money**
	• 4.1.1 **Review of relevant guidelines** for infrastructure project delivery and procurement guidelines (e.g. **National Guidelines for Infrastructure Project Delivery**) to give regard to contemporary procurement procedures (such as the UK Project Routemap).
	
	• 4.1.2 Draft **new set of national procurement guidelines** for the sector which should consider the following:
	  ○ How to evaluate and measure innovation as part of any value for money assessment undertaken as part of procurement
	  ○ Incorporation of performance-based specifications
	  ○ Maximizing benefits throughout the value chain e.g. connect manufacturing to design phase
	  ○ Opportunities to encourage more early contractor and supply chain involvement e.g. at the planning stage
		• **Consistent standard for procurement across different jurisdictions:** updating guidelines will ensure contemporary procurement procedures are reflected nationally and consistently for infrastructure delivery.
		
		• **Enhanced collaboration:** Performance-based specifications can foster a more collaborative relationship between buyers and suppliers, as they work together to meet performance goals.
		
		• **Encourages innovation:** Consistent incentives to deliver productivity gains will provide industry with flexibility to propose creative integrated and interoperable solutions and confidence to invest in MMC and digital approaches.
		
		• **More time to set up MMC processes:** Earlier engagement puts supply chain in a better position to participate, innovate and set up and deliver MMC

Recommendations	Actions	Outcomes
	○ Procuring construction projects based on product platforms comprising of the kit of parts, production processes, knowledge, people and relationships required to deliver all or part of construction projects ○ Incentivise the development of digital capabilities throughout the supply chain and other client organisations to promote integration and interoperability throughout the sector ○ Better flow of information to enable earlier identification of risks and more effective risk management ○ Contract standardisation to an established, internally recognised best practice suite, such as NEC or FIDIC, incorporating supply chain relationships. ○ Setting targets, such as environmental sustainability, early in the procurement process to drive desired outcomes. ○ Reporting on productivity outcomes	processes e.g. DfMA, off-site manufacturing, modular design etc. • **Reduced risk ownership:** Contracts can share risks more fairly between buyers and MMC suppliers, such as tailored insurance policies or clauses that address performance guarantees or contingencies for potential challenges.

5. Data alignment and information sharing

Recommendations	Actions	Outcomes
5.1 Enhance **industry data and information management maturity** to ensure consistent standards and protocols are applied across jurisdictions, to support the digital transformation of the sector	5.1.1 Desktop review of **current best practice international data and information management** and relevance for transport infrastructure e.g. ISO 19650 5.1.2 Develop a **data and information principles** for the construction sector. 5.1.3 Review and **update the National Digital Engineering Policy Principles** (2016) in line with data and information principles and latest contemporary trends (e.g. Artificial Intelligence). 5.1.4 Government should **cultivate a network of trusted digital collaborators** who can share and access information, with a structured hierarchy of roles such as creators, reviewers and users.	• **Transformed project and programme delivery**: Improving the consistency and quality of data will be transformational in how projects and programmes are delivered in the future by improving safety, enabling innovation, reducing costs, and supporting more sustainable outcomes. • **Improved efficiency**: By reducing duplication and information silos, construction leaders could save 1.5 days a week on average by having a more uniform data environment. • **Improved data quality and governance**: A set of principles will ensure consistency, accuracy, and reliability of data, reducing errors and enhancing trust in the information used across the industry. A network of trusted participants will ensure data governance is regularly and consistently conducted and information is managed and shared efficiently (similar to the *Trusted Information Sharing Network)*.

Recommendations	Actions	Outcomes
		• **Enhanced decision-making**: By organising and managing data efficiently, decision-makers have access to accurate, relevant, and up-to-date information, enabling better strategic planning and operational decisions. • **Scalability and adaptability**: A consistent set of principles ensures data systems can scale and adapt seamlessly to evolving needs and technological advancements.
5.2 Establish a **single-source-of-truth (SSOT) national digital platform** to share programme information, specifications, standards and other materials for knowledge-sharing and lessons learned	5.2.1 Identify existing organisation to lead in establishing a single-source-of-truth digital platform e.g. Digital Transformation Agency 5.2.2 Review **key systems and data environments used** by construction businesses across jurisdictions, to identification duplication and opportunities for consolidation 5.2.3 Implement a **national digital platform** to input and exchange key nationally relevant information such as: ○ construction pipeline and requirements ○ design and component specifications ○ technical standards ○ training materials	• **Cost savings**: Consolidating data and systems reduces high storage, maintenance and training costs. • **Enhanced security**: Older, fragmented systems are more prone to cyber threats due to outdated security protocols. **Enhanced digital literacy**: Organisations wishing to be part of the national digital platform would need to achieve a certain level of information management competence. This ensures that data shared within the platform is secure and reliable and enhances the digital openness of the industry.

Recommendations	Actions	Outcomes
	○ reporting and performance metrics ○ case studies and lessons learned	• **Single platform to access standardised information**: A digital library of standard requirements, protocols and parts will ensure industry has quick access to the same information and is delivering to the same standards. This will help to facilitate cross-referencing with other standards and process workflows. • **Confidence in the information shared across the industry**: A unified platform ensures all stakeholders work from consistent, accurate, and up-to-date information. Confidence in the accuracy of the information and ease of access will encourage better knowledge transfer project to project.

Proof points relevant to 5. Data alignment and information sharing

Existing Practice:

- Trusted Information Sharing Network (TISN): Australia's TISN allows organizations to access and share information about infrastructure assets nationally. Benefits of being part of TISM include identifying and managing risks, addressing security gaps, and informing policy programs.[15]

- UK Gemini Principles: In 2018, UK government, industry and academia developed and published the Gemini Principles that establish the common definitions and values that will make it easier to share data in the future and outline the evolving approach to information management in the sector.[16]
- The value of information management in the construction (2021): A study by KPMG and Atkins for the Centre for Digital Built Britain, as a partner of the Construction Innovation Hub, provides demonstrable evidence of benefits within and beyond the organisations using Information Management (IM).[17]

- **Hong Kong's Construction Industry Council:**
    - Sustainable Construction E-platform: This platform provides resources and tools to promote sustainable construction practices. It includes guidelines on green building standards and best practices for reducing the environmental impact of construction activities.[18]

- **United Kingdom - Construction Innovation Hub:**
    - Product Platform Rulebook: An open-access guide designed to support industry – clients, consultants, contractors, manufacturers and product suppliers – in building capability and capacity to develop and deploy product platforms to meet demand.[19]

- **Multiple data environments:** The median number used by construction businesses across Asia Pacific is 11 different data environments for their operations, with half of this number being used to engage with subcontractors or suppliers.
- **Higher associated costs:** Additional training and skills development costs (48%) and higher operational costs (45%) were the most common impacts associated with operating multiple data environments.[20]

6. Labour and capability uplift

Recommendations	Actions	Outcomes
6.1 Develop a multi-disciplinary (e.g. Construction, Manufacturing and Logistics) **skills and training framework** to address the skills gap and better understand how to transition people from traditional industry skills to new industry skills	6.1.1 Assess **MMC and digital readiness** of sub-contractors / supply chain to identify gaps for skills development 6.1.2 Leverage existing industry skills frameworks and reports (e.g. Infrastructure Australia Market Capacity Report) to establish an **Industry Competencies Framework** centred around the necessary leadership, skills, and behaviours needed across all infrastructure projects to enable MMC and emerging digital technologies e.g. Artificial intelligence and machine learning	• **Understanding benchmark capability:** Developing an understanding of the MMC and digital maturity and capabilities of subcontractors and suppliers will demonstrate where focus is needed to lift the capability of the supply chain to create the most productivity gains. • **Consistent approach and strategy to skills development:** A universal framework ensures that skills are defined, assessed, and applied consistently across different contexts, creating a universal language for competencies. • **Uplift in competencies to drive sector transformation:** o **Leadership**: Strong leadership skills to drive change and innovation within the industry. o **Skills**: E.g. Project management, logistics, asset management, materials moving, data analytics, BIM, predictive maintenance, robotics operations and maintenance

		◦ **Behaviours**: Innovation, collaboration, and openness to new methods and technologies. • **Improved workforce mobility:** Standardized competencies make it easier for individuals to transfer their skills across roles, organizations, and disciplines, enhancing career progression and workforce mobility. • **Targeted training**: A clear framework helps identify skill gaps and design training programs tailored to specific needs, improving the efficiency and effectiveness of learning.
6.2 Establish **education and skills development pathways and programs** to build the future workforce	6.2.1 Review existing pathways and identify opportunities for enhancing **skills development pathways** for apprenticeships, TAFEs and qualified professionals 6.2.2 Promote a **new trade certificate for MMC and digital construction**, aimed at transforming the role of trade workers 6.2.3 Incentivise industry to **collocate or partner** with VET providers (including TAFE) as part of future MMC innovation hubs 6.2.4 Explore **funding opportunities for training and adoption** of specific skills and technologies e.g. Artificial Intelligence and Machine Learning	• **Talent attraction, retention and growth**: A strategic pathway lays the foundation and direction for attracting and developing the next generation of talent. • **Improved workforce capabilities**: Ensures employees have up-to-date skills, increasing productivity and innovation within organisations. • **Future-readiness**: Helps organisations adapt to technological advances and industry changes by nurturing a multi-skilled, versatile workforce.

Proof points relevant to 6. Labour and capability uplift

Existing Practice:

- Singapore: Productivity Innovation Project (PIP)[21]
  - Initiative by the Building and Construction Authority (BCA) aimed at enhancing productivity in the construction industry, by encouraging and facilitating Singapore-registered construction-related businesses to adopt innovative technologies and re-engineer work processes.
  - The scheme co-funds up to 70% of the costs for technology adoption and innovations that improve productivity at construction sites. The level of support varies based on the expected productivity improvement and the type of project
  - Key focus areas are Design for Manufacturing and Assembly (DfMA), Integrated Digital Delivery (IDD) and Integrated Construction and Prefabrication Hubs (ICPH)

- Hong Kong: Construction Innovation and Technology Fund (CITF):[22]
  - HK$1 billion through a training fund, which provides up to 70% (80% if Hong Kong technology) for training and adoption costs associated with pre-approved technologies applied in certain areas. Recent projects include the use of robotics and automation to improve construction efficiency and safety.

- United Kingdom: Building offsite property assurance scheme (BOPAS):[23]
  - A UK scheme seeking to overcome insurance hurdles for the use of volumetric, which includes insurance accreditation, assessments and an online database. Standards are under development.

- 2024 Infrastructure Market Capacity Report | Infrastructure Australia – Section 3: Workforce and skills.[24]
  - Annually produced national report that includes analysis and discussion of infrastructure-workforce supply shortages by state, territories and occupational groups.

3 Industry MMC Snapshot: State of Play

3.1 Construction productivity and the need for standardisation

Construction is one of the largest sectors in Australia and globally. As of June 2024, the sector represents 7.1% of the national gross domestic product (GDP) and 17% of all businesses in Australia were construction businesses.[25] This report focuses on transport-related infrastructure within the construction sector, which accounts for 59% of Australia's Major Public Infrastructure investment.[26]

Despite significant funding and rapid technological advancements, the Australian construction sector's productivity has remained flat for the past 30 years. Compared to other sectors like manufacturing, where productivity rose by 126% globally between 1997 and 2021, global construction productivity fell by 7% during the same period.[27] In Australia over the last 20 years, the construction industry's average annual productivity dropped by 0.5%, the fourth worst performer across the market sector industries, which saw an overall 0.3% increase, and in the year 2023-2024 it continued to drop from 0.3 to -0.8.[28]

Despite its scale and importance, the construction sector has remained focused on bespoke, customised processes with the majority of standardisation at the component level. Industrialisation in construction is necessary to enhance productivity through standardisation and repeatability.

Modern methods of construction (MMC) is inherently about increased standardisation, yet it can vary from individual components up to a fully developed infrastructure network and the way government, industry and society cooperates.

For more information on construction productivity in Australia and definitions of MMC, please refer to the phase 1 report.

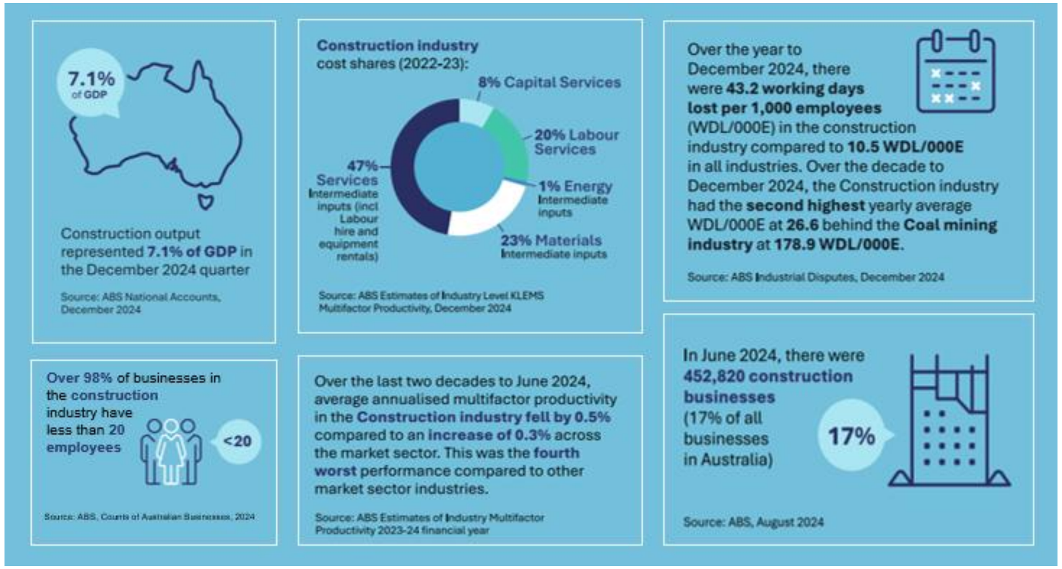

Figure 1 - Construction productivity snapshot in Australia (Blueprint for the Future 2025, National Construction Industry Forum)

3.2 Global comparison

3.2.1 Offsite-manufacturing and preassembly:

- Prefabrication accounts for less than 5% of total construction in Australia, which is significantly lower than in other advanced economies (Sweden: 84%, New Zealand – 32% Netherlands: 20%, Japan: 15%, Germany: 10–20%, China: 10-15%).[29],[30],[31] Singapore has mandated use of prefabricated bathrooms in all government-owned residential projects since 2014 and about 80% of each housing module in some projects is built offsite.[32]
- In KPMG's '2023 Global Construction Survey' of nearly 300 participants, while only 25% of Engineering and Construction (E&C) companies were at the time using off-site manufacturing across all projects, 61% were starting to adopt it on a few projects. The proportion of projects using 50% or more off-site manufacturing was expected to rise from 14% to 28% over the next five years.[33]

3.2.2 Digitisation:

- Globally, the construction industry ranks amongst the lowest levels of digitisation when comparing across industries. The lower level of digitisation and the use of digital innovations is one of the factors that correlates significantly with differences in productivity between industries (see Figure 2).[34]

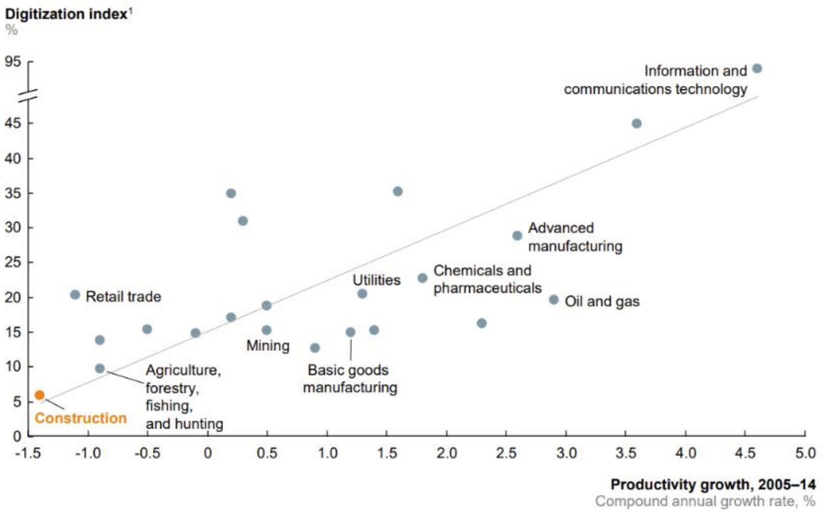

Figure 2 - Digitisation and Productivity, McKinsey, 2019

3.3 Recent developments in MMC in Australia

There has been recent progress in advancing the use of modern methods of construction (MMC) in Australia.

3.3.1 Australian Government and national developments

- **ABCB Prefabricated, Modular and Offsite Construction Handbook:** The Australian Building Codes Board (ABCB) published a *Prefabricated, Modular and Offsite Construction Handbook* in December 2024 with the objective of increasing the understanding and effectiveness of existing building standards and regulations.[35] The handbook does not seek to introduce any new standards, nor does it address state and territory legislation or the end-to-end process of the use of MMC. It is however an important first step in determining evidence on compliance with the construction code.

- **Allocated budgets to MMC development:**
  - **$54 million:** In the pre-election March budget, the Australian government allocated $54m to grow the prefabricated and modular construction sector and support innovative methods of construction.
  - **$120 million:** The March budget added a further allocation of $120m announced in November 2024 by the Treasury as part of the National Productivity Fund ($900m total) to incentivize states and territories to remove red tape preventing the uptake of modern methods of construction.
  - **$10 million:** The NSW Government has invested $10 million in an MMC program as part of its $224 million Essential Housing Package. This program aims to demonstrate how MMC can deliver quality and permanent social homes faster.

- **National Construction Industry Forum's draft Blueprint for the Future:**
  - In March 2025, the National Construction Industry Forum released their draft *Blueprint for the Future: A building and construction industry that works for everyone*. The Forum is an advisory body under the Australian Government Department of Employment and Workplace relations with 16 members from industry associations and unions and three ministers. Alignment of the key recommendations from the blueprint and the recommendations in this report can be found at Appendix A.

3.3.2 Commonwealth Bank of Australia's MMC financing initiative

In January 2025, the Commonwealth Bank of Australia became the first bank to endorse MMC and provide financing, when CommBank announced a partnership with prefabAUS, and became the organisation's first bank member. The bank agreed to sponsor the development of a standard form contract for MMC to simplify and speed up the process of financing a prefab home.[36]

3.4 Industry engagement: MMC Workshops

3.4.1 Overview

To inform this report, three workshops were held in February 2025 with specialists identified from across government, academia and industry on each of the following categories:

1. **Shared requirements and standards**
2. **Off-site premanufacturing, preassembly and innovative materials**
3. **Digitalisation**

During each workshop, attendees provided input via a digital tool (Mentimeter) responding to the following two topics:

a) Opportunities for industry reform to better enable MMC
b) Specific actions to realise these opportunities

The outputs from these workshops have informed the recommendations and actions in section 1 of the report.

3.4.2 Engaged organisations

The organisations involved in the three workshops are shown in the table below:

Category	Organisations
Government departments / agencies	• NSW Department of Education • Transport for NSW • Infrastructure NSW • Major Transport Infrastructure Authority (MTIA) • Victorian Transport Digital Engineering • Victorian Infrastructure Delivery Authority (VIDA) • Level Crossing Removal Project (VIC) • North East Link Project (VIC) • Suburban Rail Loop Authority (VIC)

Category	Organisations
	• Metro Tunnel Project (VIC) • Eastern Freeway Upgrades (VIC) • Queensland (QLD) Government • Transport and Main Roads (QLD) • Department of State Development, Infrastructure, Local Government and Planning (QLD) • Department of Energy and Public Works (QLD) • Department of Logistics and Infrastructure (NT) • Department of Transport (WA) • Main Roads West Australia • Western Australian (WA) Government • MetCONNX Alliance (WA) • Infrastructure Canberra • Major projects Canberra (ACT) • Access Canberra (ACT) • Department for Infrastructure and Transport (SA) • Infrastructure Australia • High Speed Rail Authority
Industry (Non-Contractors)	• Hub Australasia • Civil Contractors Federation (CCF) • Consult Australia • Australian Constructors Association (ACA) • Engineers Australia • National Transport Research Organisation (NTRO) • Australasian Railway Association (ARA) • Roads Australia • Master Builders Queensland • Manufacturing Skills Queensland • Building Smart Australia • PrefabAus

Category	Organisations
	• Australian Steel Institute (ASI) • Cement Concrete & Aggregates Australia (CCAA) • Ausco Modular • Holcim • Vossloh • Oracle • AIG Group • McNab • Ghella • WSP • Jacobs • Aurecon Group • Mace Group • SMEC • Robotics Australia Group • TEMPO Institute • Felix • KalTechD • Autodesk • IIMBE • Sensum • Bluescope • Boral • DEOS Digital • GC3 Digital • Bentley Systems • BECA • Geometry Gym • IDD Tech

Category	Organisations
	• UniPhi
Industry (Contractors)	• Richard Crookes Construction • Laing O'Rourke • Seymour White • McConnell Dowell • CPB Contractors • John Holland • Fulton Hogan • Acciona • UGL Ltd • Lendlease • Besix Watpac
Academia	• John Grill Institute for Project Leadership • University of Sydney • Monash University

3.4.3 Summary of outputs

Opportunities for industry reform to better enable MMC:

Category	Number of opportunities	%
1. Leadership and vision	5	2%
2. Forward-planning and engagement	28	10%
3. Policies, regulations and standards alignment	84	31%
4. Procurement and commissioning	46	17%
5. Data alignment and information sharing	60	22%

Category	Number of opportunities	%
6. Labour and capability uplift	26	9%
7. Other	25	9%
Total	**274**	

Specific actions to realise these opportunities:

Category	Number of actions	%
1. Leadership and vision	25	15%
2. Forward-planning and engagement	30	18%
3. Policies, regulations and standards alignment	49	30%
4. Procurement and commissioning	24	15%
5. Data alignment and information sharing	15	9%
6. Labour and capability uplift	17	10%
7. Other	5	3%
Total	**165**	

4 Trends relevant to MMC adoption in Australia

4.1 Infrastructure demand in Australia

- **Need for services to deliver societal outcomes:** The stagnation of productivity must be reversed so the construction sector can meet the commitments to transform Australian society to be more connected, sustainable and accessible, through infrastructure investment. However, improving productivity is not an end unto itself and opportunities for reform should also consider broader social and environmental objectives, such as safety, equity, resilience, and sustainability. MMC can support these objectives to more firmly meet community needs and aspirations. For example, offsite manufacturing can shorten construction times by 20-50% compared to traditional methods,[37] leading to significantly less time spent on-site and therefore fewer disturbances for local communities such as congestion, noise and dust pollution, as well as reduced risk of accidents.
- **Transport-related infrastructure pipeline:** Australia's 5-year forward pipeline for transport-related infrastructure is projected at $126 billion, the largest expenditure category of the Major Public Infrastructure Pipeline, accounting for 59% of total spending. This presents both risks and opportunities in terms of potential impact and value-for-money.[38] Enhancing productivity is essential to maximise this investment, enabling quicker project delivery and greater social impact.
- **Growth in adjacent sectors such as housing:** To meet Australia's housing crisis, the Australian Government will provide $3.5 billion in payments to state, territory, and local governments through the National Housing Accord over five years, starting from July 2024.[39] This pipeline, combined with Australia's limited supply of construction labour, creates opportunities for increased use of prefabrication and Smart Buildings. PreFabAUS have set targets for Smart Building to grow from 15% to 30% of the total construction sector by 2033, with 80% of building elements to be manufactured off-site.[40] Other public buildings such as railway stations also have potential uses for prefabrication, benefitting from repeatability and use of high value small units.[41]
- **Geographical shift of investment:** There is a significant geographical shift in investment to the north, with Queensland and Northern Territory major public infrastructure pipelines growing by $16 billion, while New South Wales and Victoria have reduced by $39 billion. This creates local constraints such as accessing skilled workers and sourcing construction materials, plant and equipment due to their geographical distance.[42]

4.2 Supply chain challenges

4.2.1 Economic uncertainty influenced by geopolitical activity

- **Trade tensions:** Ongoing trade tensions between major economies, particularly the US and China, are creating volatility in global markets. This can disrupt the supply chain for essential construction materials like steel and timber, potentially increasing costs and causing delays.[43]

- **Economic policies in China:** China's economic policies, particularly stimulus measures aimed at boosting infrastructure and property markets, can significantly influence the demand for Australian raw materials. If successful, these policies could drive up prices for materials, impacting construction costs in Australia.
- **Global economic uncertainty:** The broader global economic uncertainty, including inflation and fluctuating currency values, is affecting the construction sector. Developers are facing tighter margins due to rising material costs and economic instability. [44] Energy-intensive materials like concrete and bricks continue to increase in price, reflecting energy cost pressures in the production process.

4.2.2 Non-labour constraints

- **Financial instability within the construction industry:** High rates of insolvency and low margins within the construction industry are indicators of the financial strain within the industry. In this environment there is limited will or ability to undertake the investment that is needed to adopt new construction technologies and MMC.
- **High cost on materials:** By cost shares, materials accounts for the largest proportion (73%) of total non-labour spend on the Major Public Infrastructure Pipeline, followed by plant (15%) and equipment (11%). The cost of construction materials continues to remain high with most materials experiencing year-on-year growth for three straight years. Businesses have noticed a 10–20% price escalation of non-labour costs over 2023-2024 and believe prices are yet to peak.[45]
- **Materials in demand for transport infrastructure:** Concrete is the top construction material needed by volume to complete transport infrastructure works over the five-year outlook (c. 68 million tonnes), followed by rock/bluestone (c. 27 million tonnes), asphalt (c. 15 million tonnes) and steel (c. 3 million tonnes). Concrete and steel, the construction materials most in demand, are vulnerable to cross-sector competition in the event of supply shortages.[46]
- **Recycled materials:** In 2022, Infrastructure Australia estimated that based on current technology and standards, approximately 27% of the conventional material tonnage needed to deliver 998 road projects across Australia between 2015–31 could be replaced with a range of recycled materials.[47]

4.2.3 Labour and skills shortage

- **Labour shortage:** There was a predicted shortage of 197,000 infrastructure workers in 2024, although a drop of 32,000 workers (-13%) in shortages predicted from 2023, illustrating the efforts by government to adjust pipelines in line with market capacity. However, the sector will continue to experience shortages in roles across all occupational groups, with trades workers expected to surpass engineers as the group most in shortage. The Northern Territory will experience the most acute workforce shortage as a proportion of supply, with a 40% rise in demand compared to 2023's forecast.[48]
- **Attraction and retention issues:** The construction industry is grappling with an aging workforce, alongside struggling to attract young talent required to meet future demand. This is in part due to insecure and antiquated careers without long-term pathways, demonstrated by nearly 8% of the construction workforce exiting the industry each year. Almost half a million new construction workers will be needed in the five years to

November 2026, half of which will be technicians and skilled trades.[49] Creating pathways for a more multi-skilled workforce, blending traditional construction skills with more contemporary modern methods of construction skillsets like digital literacy and prefabrication, can create more attractive careers for the next generation and develop a workforce that is more flexible to changing needs.

- **Lack of diversity:** The construction workforce is predominantly male, with only 14% female representation. Increasing diversity is seen as a potential solution to labour shortages. Women in the construction industry are also significantly more likely to experience sexual harassment, with 53% of women reporting sexual harassment at work.[50] Offsite manufacturing can offer a more attractive work environment, particularly for women and younger workers, by providing safer, cleaner, and more controlled working conditions.

4.3 Digitalisation of the industry is driving a need for reskilling

- **Adoption of digital technologies on the rise**: In a recent survey of 894 construction businesses in the Asia pacific region, an average business was found to use 6.2 out of 16 digital construction technologies, a 20% increase from 5.3 technologies the year before. In this same period, Virtual Reality use doubled from 28% to 56%, and Artificial Intelligence and Machine Learning use increased from 26% to 37%.[51] Transport-sector companies ranked data digitisation as having high to moderate impact, more than the average for the industry.[52]
- **Digital literacy a major barrier to adoption:** 88% of businesses surveyed reported facing at least one barrier to adopting digital technology in their business. The most common barrier to adopting digital technology was a lack of digital skills among employees (cited by 32% of businesses), as well as uncertainty about the required skills (30%).[53]
- **Multiple data environments a barrier to upskilling:** The median number of different data environments used by construction businesses across Asia Pacific was 11, with half of this number being used to engage with subcontractors or suppliers. Additional training and skills development costs (48%) was the most common impacts associated with operating multiple data environments.[54]
- **Technological integration:** Technologies like Building Information Modelling (BIM), digital twins, and Artificial Intelligence are being increasingly integrated into modular construction processes. Smart technologies, such as Artificial Intelligence-driven design tools and smart sensors, are also demonstrating improved efficiency and precision in modular construction.[55]

4.4 Sustainability and safety are complementary drivers to productivity reform

4.4.1 Offsite premanufacturing, preassembly and innovative materials:

- **Enhanced staff safety and less waste:** An offsite-manufacturing factory environment can be made much safer than onsite construction, leading to fewer days lost to injury. Process control technologies and automation also reduce time, rework and material waste.[56]
- **Potential for the transport sector:** Railway stations have potential uses for prefabrication, with precast concrete expected to gain high demand in rail applications.[57]
- **Uptake of recycled materials:**

  - Infrastructure Australia estimated the national uptake for 2022–2023 of three recycled materials used in construction to replace conventional materials[58]:
    - 13.9% supplementary cementitious materials – used to replace cement in concrete mixes across buildings, transport, water and energy infrastructure.
    - 9.3% reclaimed asphalt pavement – used to replace asphalt in pavements for different road classes.
    - 1.5% recycled crushed concrete – used to replace aggregate in road pavements
- The use of eco-friendly materials like cross-laminated timber (CLT) and recycled steel is on the rise, aligning with green building certifications. Modular construction is helping achieve sustainability targets by reducing waste and optimising material use.[59]

4.4.2 Digitalisation:

- **Reduced risks and improved safety:** 48% of construction businesses surveyed in the Asia pacific region saw an increase in staff safety due to increased digitalisation of their operations. The businesses with greater digital maturity were more likely to experience a decrease in safety incidents, with 41% of businesses using six or more technologies observing a decrease in safety incidents, compared to only 27% of businesses using less than six technologies.
- **Improved environmental sustainability:** 49% of businesses reported improvements in environmental sustainability due to increased digitalisation.[60]

4.4.3 Example government commitments

- **Boosting national demand for recycled materials**:
  - The **National Framework for Recycled Content Traceability** was endorsed by Australia's environment ministers on November 10, 2023. This framework provides guidance and clarity to businesses on how to collect and share information such as history, location or source of recycled materials. This initiative aims to boost demand for recycled materials by providing greater awareness of circular economy principles opportunities and increasing buyers’ confidence of quality of supplies.
  - As part of the renegotiated **Federation Funding Agreement Schedule on Land Transport Infrastructure Projects (2024–2029)**, an agreement was established with state and territory governments to optimise their procurement practices to support recycle content uptake on land-transport infrastructure projects.

5 Appendix

5.1 Draft Blueprint for the future (National Construction Industry Forum) – Alignment with MMC Recommendations

Draft Blueprint Theme	Draft Blueprint Recommendation	MMC Workstream Aligned Recommendations
a. Collaboration and alignment	**1.2** Continue to strengthen and develop the role of the NCIF as an authoritative industry voice, including providing advice on…. the National Construction Strategy (for Land Transport)	**1.1** Establish a national taskforce to drive and champion the transformation of the industry to increase national productivity
	1.7 NCIF to explore the development of a modern suite of collaborative forms of contract and subcontract.	**4.1** Tender processes and market engagement should be reviewed to align as a nationally consistent guideline
	2.1 NCIF to develop a Joint Construction Industry Charter, setting out clear shared goals and expectations for a safe, sustainable and productive building and construction	**1.1** Establish a national taskforce to drive and champion the transformation of the industry to increase national productivity **1.1.2** Establish a vision, objectives, targets, governance
b. Governance, lawfulness and compliance	**2.6** Recommend identifying opportunities for greater information sharing and cooperation between regulators and agencies including project funding/data	**2.1** Create and share a 10-year programme pipeline across all governments for transport infrastructure projects **5.2** Establish a single-source-of-truth (SSOT) national digital platform to share national programme information, specifications, standards and other materials for knowledge-sharing and lessons learned

Draft Blueprint Theme	Draft Blueprint Recommendation	MMC Workstream Aligned Recommendations
	3.1 NCIF to identify best practice and provide advice on procurement frameworks and settings with a view to develop a nationally consistent set of procurement principles, by Reviewing current guidance and arrangements on value for money and how current practices are working (e.g. how to assess, how to report, what consequences for not delivering) to identify opportunities for potential improvements • Reviewing procurement frameworks (for example NSW Government guidelines limiting tenders) to determine what elements are effective or best practice • Considering opportunities for greater transparency in tendering of goods and services • Considering standardised clauses for government construction contracts	**4.1** Tender processes and market engagement should be reviewed to align as a nationally consistent guideline
c. Regulation and procurement	**3.4** NCIF to provide advice on barriers to small and medium enterprise (SME) market entry, innovation, and unnecessary red tape.	**4.1** Tender processes and market engagement should be reviewed to align as a nationally consistent guideline
	4.2 NCIF to provide advice to government about the pathways to the construction industry, to identify targeted strategies to address structural barriers to entry.	**6.2** Establish education and skills development pathways and programs to build the future workforce **6.2.1** Review existing pathways and identify opportunities for enhancing skills development pathways for apprenticeships, TAFEs and qualified professionals (e.g.

Draft Blueprint Theme	Draft Blueprint Recommendation	MMC Workstream Aligned Recommendations
		mandatory completion of TAFEs)
d. Skills, workforce and participation	**4.4** Recommend Commonwealth and State and Territory Ministers consider a nationally coordinated skills accreditation system with consistent regulation and licensing	**6.1** Develop a multi-disciplinary (e.g. Construction, Manufacturing and Logistics) skills and training framework to address the skills gap and better understand how to transition people from traditional industry skills to new industry skills **6.2** Establish education and skills development pathways and programs to build the future workforce
	4.8 NCIF to identify opportunities to increase training infrastructure, and the capacity of the VET system to support apprentices and trainees on Australia's national priorities including energy, housing and Infrastructure.	**6.2** Establish education and skills development pathways and programs to build the future workforce **6.2.2** Promote a new trade certificate for MMC and digital construction, aimed at enhancing the role of trade workers, not replacing them **6.2.3** Incentivise industry to collocate or partner with VET providers as part of future MMC innovation hubs
	4.11 Recommend BuildSkills Australia, as the relevant Jobs and Skills Council for construction: • build on its existing Housing Workforce Capacity Study to undertake analysis into public and civil construction workforces	**6.1** Develop a multi-disciplinary (e.g. Construction, Manufacturing and Logistics) skills and training framework to address the skills gap and better understand how to transition people from traditional industry skills to new industry skills

Draft Blueprint Theme	Draft Blueprint Recommendation	MMC Workstream Aligned Recommendations
	undertake a study as to the application of trade licensing in the building trades.	**6.1.1** Assess MMC and digital readiness of subcontractors / supply chain to identify gaps for skills development
	4.13 Recommend the relevant Jobs and Skills Councils (BuildSkills Australia and Powering Skills Organisation): • analyse where and how training currently happens (i.e. head contractor, trade contractor or smaller contractor), the implication of training delivery in different • settings and ways to support quality learning and assessment outcomes.	**6.1** Develop a multi-disciplinary (e.g. Construction, Manufacturing and Logistics) skills and training framework to address the skills gap and better understand how to transition people from traditional industry skills to new industry skills **6.1.1** Assess MMC and digital readiness of subcontractors / supply chain to identify gaps for skills development
	5.1 NCIF to explore modern/collaborative standard forms of industry contracts and options for greater use.	**4.1** Tender processes and market engagement should be reviewed to align as a nationally consistent guideline
e. Financial viability	**6.2** NCIF to develop a scope of work to undertake analysis of where, why and how labour hire is currently used, to inform industry and government on how procurement frameworks and practices might best address issues.	**4.1** Tender processes and market engagement should be reviewed to align as a nationally consistent guideline
f. Industry projectification	**7.1** CIF to invite the Australian Bankers Association, key developers and other like financial institutions in the industry to discuss and consider issues facing the	**4.1** Tender processes and market engagement should be reviewed to align as a nationally consistent guideline

Draft Blueprint Theme	Draft Blueprint Recommendation	MMC Workstream Aligned Recommendations
	industry, and collaborate with the finance sector, to influence good behaviour.	
g. Risk allocation	**7.2** NCIF to provide advice on surety and professional indemnity requirements for projects	**4.1** Tender processes and market engagement should be reviewed to align as a nationally consistent guideline
	7.3 NCIF to develop guidelines on appropriate risk management / risk allocation	**2.2** Develop a MMC value toolkit to build industry awareness and buy-in, and support the consideration of MMC within deliverability assessments and business cases through: • promoting benefits • articulating risks • measuring the value of MMC • growing support and desire for change
	8.1 NCIF to develop performance indicators across the four Blueprint threads of safety, culture productivity and sustainability to support ongoing monitoring and benchmarking of the industry.	**2.2** Develop a MMC value toolkit to build industry awareness and buy-in, and support the consideration of MMC within deliverability assessments and business cases through: • promoting benefits • articulating risks • measuring the value of MMC • growing support and desire for change
h. Reporting and transparency	**8.2** NCIF to develop advice on improvements to data collection to inform policy	**5.1** Enhance industry data and information maturity to ensure consistent standards and protocols are applied across jurisdictions, to support the digital transformation of the sector

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