Sustainable Procurement for Modern Methods of Construction: Literature Review

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EXECUTIVE SUMMARY

Modern Methods of Construction (MMC) can improve the speed, productivity, quality, safety and sustainability of housing, building and infrastructure delivery. However, adoption in Australia remains fragmented and largely project-based, constrained by uncertain demand, conventional procurement, inconsistent regulation, limited manufacturing scale, financing challenges and workforce capability gaps.

This literature review supports SBEnrc Project 2.11.5, which examines how sustainable procurement and associated demand signals can enable MMC at scale. It focuses on procurement strategies and contractual mechanisms, non-price criteria and measurable indicators, and workforce transition and capability development.

The review finds that procurement is a key enabler of MMC. Greater pipeline certainty, early market engagement, collaborative delivery, appropriate risk and payment arrangements, and value-based evaluation can strengthen supplier confidence and investment. Procurement can also recognise benefits beyond lowest price, including faster delivery, reduced waste and carbon, improved safety, local capability and whole-of-life value.

These findings will inform the project's industry engagement and case studies and support the development of practical procurement strategies, evaluation criteria, indicators and action plans for scalable MMC adoption in Australia.

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1 INTRODUCTION

Modern Methods of Construction (MMC) offer significant potential to improve the speed, productivity, quality, safety and environmental performance of housing, building and infrastructure delivery. However, their wider adoption in Australia remains constrained not only by technical capability, but also by fragmented demand, conventional project-based procurement, uncertain risk allocation, limited recognition of non-price value and gaps in workforce capability.

SBEnrc Project 2.11.5, *Sustainable Procurement for Modern Methods of Construction*, therefore investigates how sustainable procurement and associated demand signals can enable the adoption and scaling of MMC across Australia's housing, building and infrastructure sectors.

This literature review establishes the evidence base for the project. It examines the current MMC landscape; relevant regulatory, policy and institutional settings; market structure, incentives and demand certainty; procurement strategies and contractual arrangements; non-price procurement criteria and measurement approaches; and workforce transition and capability-development pathways. These areas reflect the project's three interrelated priorities:

- identifying procurement mechanisms that reduce risk and support MMC uptake,
- developing measurable non-price criteria for supplier selection and performance reporting, and
- examining how procurement can support workforce transition.

The findings will inform the project's subsequent industry engagement and case studies across housing, building and infrastructure. In particular, the review identifies established practices, emerging opportunities and evidence gaps that will guide the development of practical procurement strategies, evaluation criteria, indicators and action plans for supporting scalable and sustainable MMC adoption in Australia.

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2 CURRENT LANDSCAPE OF MMC ACROSS HOUSING, BUILDING AND INFRASTRUCTURE

Modern Methods of Construction (MMC) are increasingly used to improve construction productivity, delivery speed, quality and environmental performance. In this report, MMC encompasses off-site manufacture, prefabricated and modular systems, Design for Manufacture and Assembly (DfMA), standardised components, digital engineering and platform-based approaches. Internationally, the direction of travel is from isolated prefabricated projects towards more integrated industrialised construction ecosystems connecting design, manufacturing, logistics, assembly and asset information. This pattern is evident in the United Kingdom's procurement-led approach and Singapore's DfMA-led industry transformation (HM Government 2022; Building and Construction Authority 2022a, 2022b).

This section establishes the current MMC landscape across housing, buildings and infrastructure. It first compares international market maturity, then examines Australian activity by sector and jurisdiction. Its purpose is to describe where and how MMC is being adopted. The policy, market, procurement, non-price value and workforce mechanisms that influence adoption are examined in detail in Sections 3-7.

2.1 Overall adoption and market

Global MMC adoption has accelerated in response to housing shortages, labour constraints, weak productivity growth, sustainability targets and the need for more predictable delivery. Maturity nevertheless varies markedly. Some jurisdictions have embedded MMC and DfMA in public procurement and regulatory systems, whereas others continue to rely on pilot projects or privately led innovation. To support a consistent comparison, Table 2.1 defines four maturity levels across five enabling dimensions. The framework assesses the readiness of an MMC ecosystem rather than the performance of individual projects.

Table 2.1. MMC ecosystem maturity framework

Level	Policy and strategy	Procurement	Regulation and standards	Manufacturing and digital capability	Typical priority
Advanced	Implemented national or state strategy	MMC and DfMA actively supported	Established and widely applied	Mature production capacity with integrated digital engineering	Scale, optimise and improve interoperability
Developing	Strategy established; implementation continuing	Partial or program-specific support	Relevant standards selectively applied	Growing but fragmented capacity and digital adoption	Coordinate the market and strengthen continuity
Emerging	Early initiatives and pilots	Conventional project procurement dominates	Limited dedicated guidance	Small production base and uneven digital integration	Build capability and demonstrate demand
Nascent	No material coordinated strategy	No specific MMC support	No dedicated framework	Minimal manufacturing and digital capability	Create the market and enabling institutions

Note: Developed by the research team from the enabling conditions identified in HM Government (2022), ISO 19650-1:2018, ISO 19650-2:2018, Building and Construction Authority (2022b), Infrastructure NSW (2023), prefabAUS (2023), World Economic Forum (2016), McKinsey & Company (2019) and Farmer (2016). The years for the BCA and prefabAUS publications have been aligned with the matching entries in the report bibliography.

Table 2.2 applies the framework to selected jurisdictions. The United Kingdom and Singapore illustrate policy- and procurement-led transformation. The United Kingdom has used the Construction Playbook and associated MMC guidance to promote manufacturing-led delivery and longer-term relationships, while Singapore has combined DfMA requirements, regulatory direction and public-sector demand. China has achieved scale through strong policy direction and large manufacturing capacity. Australia

and North America demonstrate considerable technical and private-sector capability, but their markets remain fragmented across jurisdictions and project pipelines. The United Arab Emirates has growing strategic interest and advanced-project applications, although its local supply ecosystem remains less mature.

Table 2.2. Indicative international MMC maturity comparison

Jurisdiction	Indicative maturity	Evidence of progress	Principal continuing gap
United Kingdom	Advanced	Government sourcing guidance, public-sector MMC programs and movement towards platform approaches (HM Government 2022; Cabinet Office 2022)	Scaling integrated supply chains and sustaining specialist capacity
Singapore	Advanced	DfMA embedded in industry transformation policy and supported through regulation and procurement (Building and Construction Authority 2022a, 2022b)	Cost, design flexibility and reliance on imported inputs
China	Advanced	Large-scale industrialised production supported by government direction and digital construction (State Council of the People's Republic of China 2022; Li et al. 2024)	Consistent quality and verified environmental performance
Australia	Developing	Growing prefabrication, modular delivery, digital engineering and state-led demonstrations (Zhang et al. 2022; prefabAUS 2023; Soltani et al. 2025a)	Fragmented demand, standards and procurement; limited manufacturing scale
United States and Canada	Developing	Expanding off-site housing and modular-building activity (National Institute of Building Sciences 2023; Real Estate Institute of Canada 2025)	Fragmented regulation and inconsistent demand across states and provinces
United Arab Emirates	Emerging	National industrial strategy and advanced-manufacturing investment (UAE Ministry of Industry and Advanced Technology 2021)	Limited evidence of a construction-specific MMC ecosystem

Note: The ratings are qualitative ecosystem assessments based on the dimensions in Table 2.1; they are not project-performance scores. Each row identifies the sources supporting its assessment. The UAE rating is deliberately cautious because the available source concerns industrial strategy rather than a dedicated construction-sector MMC program.

Across these jurisdictions, the central challenge is no longer the technical feasibility of prefabrication. It is the coordination of demand, design standards, product assurance, manufacturing, logistics, digital information and workforce capability across multiple projects. Advanced markets are therefore shifting from procuring individual modular buildings or components to supporting repeatable product families, interoperable component systems and longer-term delivery pipelines. This distinction is important for Australia: visible modular projects demonstrate capability, but they do not by themselves constitute a scalable industrialised construction ecosystem.

Two additional gaps cut across this transition. First, inconsistent MMC classifications, component interfaces, assurance pathways and information standards limit interoperability between projects and suppliers. Second, circular-economy requirements-including design for disassembly, material passports, reuse and lifecycle traceability-remain weakly integrated into mainstream MMC delivery. These gaps constrain the movement from efficient off-site production towards genuinely interoperable and circular construction systems (ISO 19650-1:2018; ISO 19650-2:2018; World Economic Forum 2016; McKinsey & Company 2019).

2.2 Current status of MMC in Australia

Australia's MMC market is developing, with activity across social and affordable housing, education, health, public buildings, transport infrastructure and remote facilities. Adoption is driven by housing shortages, high construction costs, workforce constraints, regional access challenges, sustainability commitments and pressure to improve productivity. Governments and industry are increasingly exploring volumetric modular construction, panelised systems, prefabricated components, DfMA, digital engineering and standardised design solutions (prefabAUS 2023; Building 4.0 CRC 2020).

However, most activity remains organised through individual projects, demonstration programs or sector-specific packages. Capability differs between jurisdictions, and Australia lacks a fully coordinated national market supported by common assurance pathways, interoperable digital systems and dependable multi-project demand. The following subsections summarise the distinctive patterns evident in housing, buildings and infrastructure.

2.2.1 Housing

Housing is currently the most prominent area of Australian MMC activity. Modular, panelised and prefabricated systems are being used or investigated for social and affordable housing, regional accommodation and remote-community delivery. The attraction is strongest where conventional construction is constrained by limited labour, repeated dwelling types, restricted site access or the need to accelerate supply. Public programs in New South Wales, Queensland and Western Australia illustrate three complementary approaches: developing an interoperable housing system, using a government delivery organisation to expand modular supply, and providing capital support to manufacturers (Homes NSW 2025; Queensland Government 2022; WA Government 2025).

In New South Wales, Homes NSW and Building 4.0 CRC have developed System 600, a kit-of-parts approach based on a 600 mm grid. Rather than requiring complete buildings from a single proprietary modular supplier, the system coordinates component dimensions and interfaces so that parts and subassemblies can be produced by a distributed supply chain. This approach seeks to retain design flexibility while reducing the number of unique components, simplifying logistics and creating opportunities for repeatable production (Building 4.0 CRC 2024; prefabAUS 2025). It illustrates the difference between procuring a one-off modular product and establishing a platform that can support multiple housing configurations.

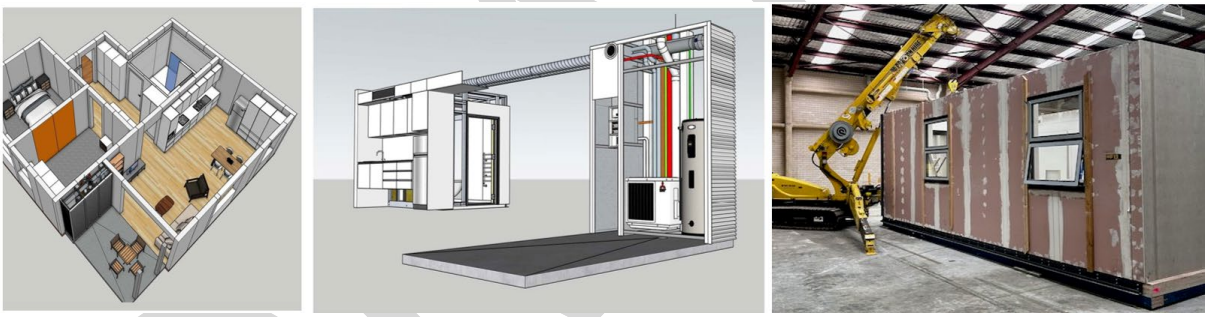


Figure 2.1 System 600 concept: coordinated components, integrated services and off-site manufacture. Source: Building 4.0 CRC (2024) [link]

Queensland's MMC program, delivered through QBuild, uses factory production to support social housing, government accommodation and regional delivery. Western Australia's Housing Innovation Fund supports manufacturers of modular units, wall frames and other prefabricated components, reflecting the need to expand supply capacity as well as place orders (Queensland Government 2022; WA Government 2025). The South Australian Housing Trust and Renewal SA have also progressed modular and prefabricated housing initiatives, including regional delivery and a multi-supplier pilot (Government of South Australia 2024; Department for Housing and Urban Development 2025). In Tasmania, the Modular Housing Finance Guarantee Scheme has been proposed to address the mismatch between conventional construction lending and value created off site (Tasmanian Government 2026). The Australian Capital Territory has considered opportunities to aggregate demand, while the Northern Territory uses transportable and modular solutions for remote communities. In remote and First Nations contexts, faster assembly must be balanced with culturally appropriate design, local participation, maintainability and transport constraints.

The housing evidence demonstrates growing confidence in MMC but also exposes the limits of project-by-project demand. Manufacturers require sufficient continuity to invest in factories, automation, product development and skills. Finance and payment arrangements must also recognise that substantial value is created off site before components are installed. These commercial matters are examined in Sections 4 and 5.

2.2.2 Buildings

MMC adoption in the wider building sector is most visible in schools, early-learning facilities, health facilities, government accommodation and other assets with repeatable spatial and functional requirements. These asset classes can use standardised rooms, structural systems, service modules and facade assemblies while still allowing different site layouts and architectural responses. Government clients can also aggregate demand across portfolios, creating more favourable conditions for reuse than a sequence of unrelated bespoke projects.

New South Wales has developed kit-of-parts and DfMA approaches for educational facilities, including reference buildings assembled from standardised hubs and component libraries. Victoria has extensive experience with permanent modular school buildings and kindergartens, while Queensland uses standardised and modular solutions for government and regional facilities. Research collaboration through Building 4.0 CRC has further supported advanced manufacturing, digital workflows and industrialised building systems. Across these examples, the strategic benefit lies not merely in moving work into a factory but in reusing verified designs and components across a program.

Other jurisdictions contribute different capabilities and use cases. Western Australia's investment in wall-frame, panel and volumetric production can support public and commercial buildings as well as housing. South Australia's defence and advanced-manufacturing base offers transferable capability for DfMA, systems integration and prefabricated public facilities. The Australian Capital Territory's construction-productivity reforms support innovation and more efficient approvals, although evidence of scaled MMC building programs remains limited. Tasmania's renewable timber resources provide an opportunity for engineered-timber and panelised systems, but its smaller market makes sustained manufacturing demand difficult without interstate or coordinated public procurement (Government of South Australia 2024; WA Government 2025; ACT Government 2026; Shou et al. 2026).

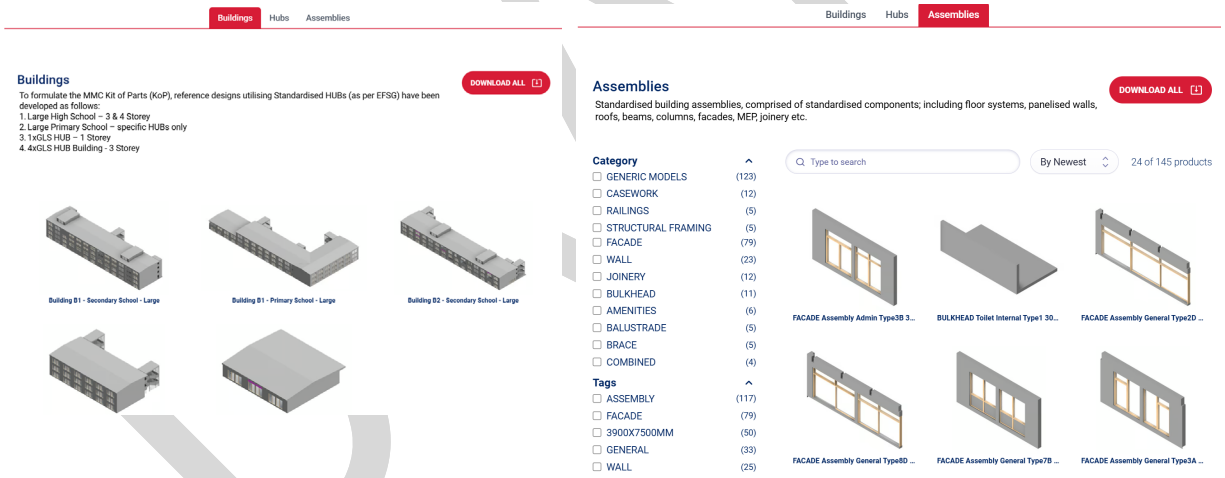


Figure 2.2. Examples from the NSW education MMC kit-of-parts library. Source: School Infrastructure NSW (n.d.), cited in Infrastructure NSW (2024) [Link]

The principal limitation is that reusable technical solutions are not consistently connected to multi-project procurement, common product assurance or long-term supplier relationships. Without these links, standard components can remain isolated within individual programs and fail to generate broader manufacturing scale. Section 5 considers the procurement arrangements needed to convert repeatability at the design level into repeatability across delivery programs.

2.2.3 Infrastructure

Australian infrastructure has long used prefabricated elements, including bridge beams, precast segments, rail components, utility modules, roadside structures and remote-site facilities. Digital engineering, asset information standards and controlled manufacturing can reduce work in live transport environments, improve dimensional accuracy and shorten possessions or road closures.

MMC therefore has clear value where safety, access, quality assurance and disruption are important, even when complete volumetric modules are unsuitable (Modular Building Institute 2022; World Bank 2023; Infrastructure NSW 2024).

The infrastructure opportunity is broader than component prefabrication. Repeated asset families-such as station elements, service buildings, bridge components, equipment rooms and utility assemblies-can be designed as configurable systems supported by reusable digital objects and standard interfaces. This creates potential for learning and continuous improvement across a capital program. Australia nevertheless remains more experienced in procuring prefabricated components for individual projects than in procuring open, reusable platforms across projects. Existing digital engineering capability provides a foundation, but scaling requires alignment between asset standards, design authority, procurement pipelines, supplier capability & whole-of-life information requirements.

Jurisdictional experience is uneven but complementary. New South Wales combines major infrastructure pipelines with digital engineering and DfMA policy development; Victoria links modular public-asset delivery with advanced-construction research; and Queensland applies factory-produced systems where regional access and labour availability constrain conventional delivery. Western Australia brings extensive experience in modular camps, workforce accommodation and prefabricated service buildings from the resources sector, although long transport distances remain a constraint. South Australia's defence sector provides relevant systems-integration and advanced-manufacturing capability, while the Northern Territory has strong use cases in remote health, education, accommodation and community infrastructure. Tasmania and the Australian Capital Territory have smaller markets but can apply standardised components to repeatable public facilities (Infrastructure NSW 2023b, 2024; Queensland Government 2022; Infrastructure WA 2022; Shou et al. 2026).

2.3 Key drivers and comparative assessment across Australian jurisdictions

The Australian MMC landscape reflects different economic and geographic priorities. New South Wales and Victoria show comparatively strong policy, research and digital capability, supported by major housing, education and infrastructure programs. Queensland, Western Australia and the Northern Territory have strong use cases in regional and remote delivery, where site labour and logistics constraints make off-site production attractive. South Australia can draw on advanced manufacturing and defence capability; Tasmania has opportunities associated with timber and value-added manufacturing; and the Australian Capital Territory's sustainability agenda supports interest in low-carbon and digitally enabled construction. Table 2.3 consolidates the earlier jurisdictional comparisons without treating the ratings as precise quantitative scores.

Table 2.3. Qualitative profile of MMC capability and opportunity across Australian jurisdictions

Jurisdiction	Policy and procurement	Manufacturing capacity	Digital engineering	Remote-delivery opportunity	Platform readiness
NSW	Strong policy activity; procurement still substantially project-based	Developing, with new investment interest	Strong relative capability	Moderate	Developing-strong: System 600 and education kit-of-parts
Victoria	Established program experience and research links	Comparatively strong	Strong	Lower	Developing-strong, particularly in repeatable education assets
Queensland	Growing program-based use; wider alignment developing	Developing	Developing	Strong	Developing through QBuild and standardised designs
Western Australia	Targeted investment; demand remains program- and project-led	Developing, supported by funding and resources-sector experience	Developing	Very strong	Developing; logistics and pipeline continuity constrain scale

Jurisdiction	Policy and procurement	Manufacturing capacity	Digital engineering	Remote-delivery opportunity	Platform readiness
South Australia	Targeted housing and public-sector initiatives	Developing, with defence and advanced-manufacturing capability	Developing	Moderate	Developing; construction demand is comparatively small
Tasmania	Targeted modular housing and finance reform	Limited-developing, with timber-system potential	Limited	Moderate	Emerging; interstate demand may be required for scale
ACT	Sustainability and productivity reforms; limited procurement volume	Limited	Developing-strong	Lower	Emerging; aggregation with other jurisdictions may help
NT	Remote housing and facilities drive project demand	Limited local capacity	Limited	Very strong	Emerging; logistics, maintenance and local participation are critical

Note: The profiles preserve the six dimensions used in the original assessment but use qualitative descriptors rather than formal scores. They synthesise Homes NSW (2025), Infrastructure NSW (2023, 2024), Victoria Government (2019, 2024), Queensland Government (2022, 2024), WA Government (2021, 2025), Government of South Australia (2024), Tasmanian Government (2022, 2026), prefabAUS (2023), Zhang et al. (2022), Soltani et al. (2025a) and Shou et al. (2026).

As Table 2.3 indicates, jurisdiction-specific constraints also differ. New South Wales must convert strong digital and platform initiatives into repeatable demand beyond pilot projects, while Victoria still faces national interoperability and manufacturing-scale constraints. Queensland requires further procurement reform and regulatory alignment; Western Australia faces long logistics chains and uncertain pipeline continuity; and South Australia is constrained by comparatively limited market scale and demand continuity. Tasmania has a small procurement pipeline and supplier base, the Australian Capital Territory has limited procurement volume, and the Northern Territory faces acute logistics, workforce, local-manufacturing and Indigenous-participation challenges.

Across jurisdictions, the recurring constraint is not an absence of technical examples. It is the limited integration of examples into a predictable market. Conventional procurement usually defines demand one project at a time and rewards project-specific solutions. Manufacturers consequently face uncertainty over whether investment in automation, product assurance, digital libraries and workforce development can be recovered across future work. Procurement readiness should therefore be understood as the ability to translate an asset pipeline into repeatable demand while maintaining competition, probity and design flexibility-not simply an agency's willingness to purchase modular products.

The comparison also shows that no single jurisdiction possesses every enabling condition. Larger states may provide demand and digital capability, while smaller or remote jurisdictions may offer compelling use cases but insufficient local scale. Cross-agency and interjurisdictional coordination could therefore support common components, aligned assurance requirements and aggregated demand. The detailed policy and regulatory conditions for such coordination are considered in Section 3, market and financing conditions in Section 4, and procurement mechanisms in Section 5.

2.4 Synthesis and implications

Australia has established meaningful MMC capability in housing, education, public buildings, infrastructure components and remote delivery. Its strengths include a growing advanced-manufacturing base, established prefabrication experience, significant government asset pipelines and increasingly mature digital engineering. New platform-oriented initiatives also demonstrate a shift from standardising complete buildings towards coordinating reusable parts, interfaces and information.

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The market nevertheless remains fragmented across sectors, agencies and jurisdictions. Most demand is expressed through discrete projects or short programs; product assurance and digital requirements vary; and manufacturing, logistics and workforce capability are unevenly distributed. Consequently, successful demonstrations do not consistently translate into repeatable national demand or sustained supplier investment. The principal maturity gap is the transition from isolated MMC applications to scalable, interoperable construction systems supported by coordinated pipelines and appropriate commercial arrangements. This finding provides the basis for the following sections, which examine the institutional, market, procurement, value-measurement and workforce conditions required to support that transition.

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3 REGULATIONS, POLICIES AND INSTITUTIONAL SETTINGS

MMC are often presented as a technical response to housing supply, productivity and sustainability challenges. Their adoption, however, depends equally on the institutional environment: whether regulation can recognise factory-made systems; whether product assurance, inspection and responsibility are clear; whether policy creates sufficiently durable demand; and whether public and private clients can evaluate the wider value of off-site production. Regulatory ambiguity increases approval, insurance and financing risk, while fragmented policy and episodic procurement make it difficult for suppliers to invest in manufacturing capability (Gad et al. 2022; Shou et al. 2026).

This section examines these institutional conditions. It first draws lessons from international policy and public-sector demand mechanisms, then reviews Australia's regulatory and policy settings, including the important private-market channel. Western Australia is used as one jurisdictional illustration of how supply-side support can develop faster than coordinated demand. The section concludes by identifying government roles, implementation constraints and gaps in the Australian evidence. Detailed market financing and supplier-investment dynamics are examined in Section 4, and procurement models and contractual mechanisms in Section 5.

3.1 International best practice and the demand-signal lesson

International experience indicates that higher MMC adoption rarely results from technology promotion alone. Leading jurisdictions combine technical standards and assurance with a demand mechanism that makes repeat work visible. The mechanism varies-mandates, procurement frameworks, bulk purchasing, planning incentives or harmonised product rules-but its purpose is consistent: to reduce uncertainty sufficiently for suppliers to invest in factories, certification, digital systems and workforce capability. The important lesson is therefore not simply that government supports MMC, but how policy is translated into an order pipeline and repeatable requirements (Cabinet Office 2022; HM Government 2022).

Singapore combines regulatory direction, public-sector leadership and Design for Manufacture and Assembly (DfMA) requirements. Its approach has normalised Prefabricated Prefinished Volumetric Construction (PPVC) in suitable high-density developments and linked MMC to broader industry transformation and digital delivery (Building and Construction Authority 2022a, 2022b). The Clement Canopy illustrates the mechanism at project scale: its two 40-storey residential towers contain 505 apartments and used 1,866 concrete modules, with PPVC applied from levels 2 to 40 (Wong Seng et al. 2021; Building and Construction Authority 2022b). Hong Kong similarly uses Modular Integrated Construction requirements and development incentives, while recognising that restricted numbers of accepted proprietary systems may initially limit competition (Hong Kong Government 2023; Hong Kong Institution of Engineers 2019). These cases show that mandate and assurance can accelerate adoption, but market depth must develop alongside them.

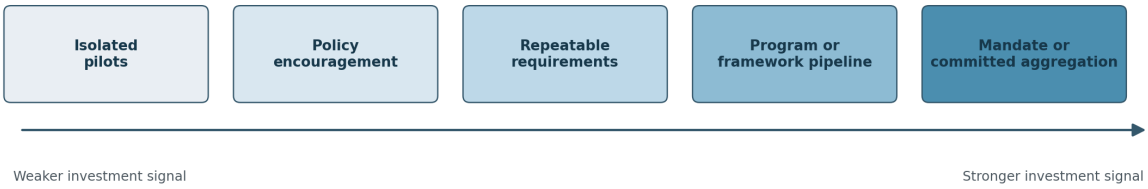
The United Kingdom provides the closest procurement-led comparator for Australia. The Construction Playbook requires public clients to harmonise, digitise and rationalise demand and to consider platform approaches and MMC across programmes rather than treating each project as a bespoke commission. The associated MMC guidance explains the commercial and contractual conditions needed to support investment, including early supply-chain involvement, outcome-based specifications and longer-term pipelines (Cabinet Office 2022; HM Government 2022). The Department for Education's MMC1 framework made this logic concrete by establishing a £3 billion off-site construction framework, while the related GenZero work developed a platform approach in which up to 85 per cent of a school building can comprise prefabricated panels and service-intensive volumetric modules (Department for Education 2021; Mott MacDonald 2024). The UK experience also provides a caution: factory capacity without dependable orders can expose suppliers to severe utilisation and cash-flow risk. Policy support is therefore credible only when it is connected to committed, appropriately sequenced demand.

Table 3.1. International policy mechanisms supporting MMC demand

Jurisdiction	Principal mechanism	Institutional lesson for Australia
Singapore	DfMA and PPVC requirements, regulatory guidance and public-sector leadership.	Align regulation, assurance and procurement so repeatable solutions are normal rather than exceptional.
Hong Kong	Government-building requirements, pre-acceptance processes and development incentives.	Early system acceptance can accelerate delivery, but competition depends on a sufficiently broad supplier market.
United Kingdom	Construction Playbook, MMC guidance, programme frameworks and platform approaches.	Aggregate demand and standardise interfaces while retaining competition at project or work-package level.
Canada	Growing use of public support and bulk-purchase proposals for factory-built housing.	Multi-year purchasing commitments may provide a clearer signal than isolated grants or pilots.
European Union	Increasing harmonisation of construction-product information and digital traceability.	Cross-border recognition and common product information reduce repeated assurance effort.
Australia	National reforms and state initiatives, but demand remains largely project- or program-specific.	The central gap is converting policy interest and asset pipelines into coordinated, repeatable demand.

Sources: Building and Construction Authority (2022a, 2022b); Hong Kong Government (2023); Hong Kong Institution of Engineers (2019); Cabinet Office (2022); HM Government (2022); Real Estate Institute of Canada (2025); Shou et al. (2026). Ratings or mechanisms are indicative and do not imply uniform practice within each jurisdiction.

Figure 3.1. Indicative strength of public-sector MMC demand signals



Note: Conceptual synthesis developed by the research team from Cabinet Office (2022), HM Government (2022) and Shou et al. (2026). The continuum indicates relative institutional strength; it is not a quantitative ranking of jurisdictions.

3.1.1 Early system selection without loss of probity

MMC suppliers are often engaged after key dimensions, interfaces and approvals have already been fixed. At that stage their manufacturing knowledge can produce only marginal changes, while redesign may create cost and probity concerns. International practice demonstrates two auditable alternatives. Two-stage early contractor involvement can competitively appoint a contractor or specialist supplier to contribute buildability and manufacturing advice before final price agreement. Programme-level platform procurement can go further by defining pre-assured component interfaces and performance requirements before individual projects are tendered. Both approaches can preserve transparency when the early appointment, information requirements, evaluation process and transition to delivery are clearly documented (Wondimu et al. 2020; Cabinet Office 2022).

The transferable principle is early system selection rather than early commitment to an untested proprietary supplier. A public client may establish an open performance specification, standard interfaces and assurance requirements, then allow multiple suppliers to compete within that system. This can provide manufacturers with earlier technical certainty while protecting contestability. The appropriate procurement and contractual forms are considered in Section 5; the institutional point here is that probity does not require clients to postpone all market engagement until design completion.

3.1.2 Best-practice exemplars across sectors

The demand-signal lesson extends beyond housing. Standardised public-building programs, modular bridges and repeatable service-intensive infrastructure show that MMC value is strongest when procurement recognises delivery certainty, reduced site disruption, quality assurance and whole-of-life performance. Conversely, specifying a prefabricated material or product does not itself demonstrate environmental value; carbon and lifecycle performance must be assessed across the complete asset. This distinction is important for non-price evaluation because the claimed benefit must be measurable rather than inferred from the use of MMC (Du et al. 2014; World Bank 2023).

Table 3.2. Cross-sector exemplars and their transferable lessons

Example	Sector and MMC form	Principal lesson
Clement Canopy, Singapore	Housing; 505 apartments in two 40-storey PPVC towers using 1,866 concrete modules	A mandate-led setting, technical assurance and repeat demand can normalise high-rise volumetric construction.
DfE MMC1 and GenZero, United Kingdom	Public buildings; £3 billion off-site framework and a platform-based school design	Aggregated procurement and common interfaces can support supplier investment and repeatable performance.
101 George Street, Croydon	Build-to-rent housing; 44- and 38-storey towers assembled from more than 1,500 modules	Institutional forward funding can give a manufacturer sufficient certainty to commit production capacity.
Collins House, Melbourne	Private residential; 60 levels and 259 apartments using an integrated structural and façade system	MMC can address constrained-site logistics; Hickory reports that its approach reduced the programme by up to 30%.
Pacific modular bridges	Transport infrastructure; prefabricated bridge systems	Whole-of-life resilience, speed and a wider delivery market can justify selection.
Timber-concrete bridge pilot	Transport infrastructure; modular composite system	Whole-asset lifecycle assessment is required; material substitution alone does not establish carbon benefit.

Sources: Wong Seng et al. (2021); Building and Construction Authority (2022b); Department for Education (2021); Mott MacDonald (2024); Buildoffsite (2019); Greystar (2018); Hickory (2022); World Bank (2023); Pilch, Antony and Kleiser (2024); Du et al. (2014). Project-reported performance is identified as such.

3.2 The Australian regulatory environment

The National Construction Code (NCC) is Australia's core technical framework for buildings. It does not exclude prefabricated, modular or off-site systems; performance-based pathways can accommodate innovative products and methods. The practical difficulty is demonstrating compliance across factory manufacture, transport, site assembly and final certification, particularly where evidence responsibilities are divided between designers, manufacturers, builders, certifiers and approval authorities. The ABCB's Prefabricated, Modular and Offsite Construction Handbook helps identify applicable NCC pathways and evidence needs, but it is guidance rather than a complete regulatory solution. Insurance, planning, licensing, consumer protection, mandatory inspections, warranties and chain-of-responsibility questions also influence whether a system is accepted (ABCB 2024; Gad et al. 2022).

National reform is moving towards greater consistency. The ABCB has been developing nationally consistent MMC definitions and a voluntary certification scheme for manufacturers. The proposed scheme is intended to improve confidence that manufactured systems satisfy NCC requirements and to clarify the relationship between factory and on-site assurance. These reforms respond directly to a recurring supplier problem: evidence accepted in one project or jurisdiction may need to be recreated elsewhere. Their effectiveness will depend on recognition by state and territory regulators, certifiers, insurers, financiers and procuring agencies, not merely publication at national level (ABCB 2025, 2026).

3.2.1 The NCC Modernisation Project and its reform directions

The broader NCC Modernisation Project is significant because it seeks a more coherent national building market, clearer code objectives and responsibilities, improved evidence and compliance, better digital access, and more responsive maintenance of the Code. For MMC, these directions are mutually reinforcing. Common terminology supports consistent specifications; clearer evidence pathways reduce repeated approval effort; digital product information improves traceability; and national recognition increases the addressable market for a certified system. The reform opportunity is therefore larger than a new definition of MMC: it is the development of an assurance system capable of following a product from design and factory production through installation and occupation (ABCB 2026).

Table 3.3. Australian regulatory and policy architecture relevant to MMC

Instrument or institution	Current role	Remaining implementation issue
National Construction Code	Provides technical and performance-based compliance pathways for building work.	Factory and site responsibilities, inspection points and evidence acceptance are not always interpreted consistently.
ABCB off-site construction handbook	Explains how the NCC applies to prefabricated, modular and off-site construction.	Guidance does not resolve every planning, insurance, finance, licensing or consumer-protection issue.
National MMC definitions and voluntary certification	Aims to improve common terminology, manufacturer assurance and national confidence.	Impact depends on adoption and recognition across jurisdictions and market institutions.
National Housing Accord	Sets an aspirational target of 1.2 million well-located homes over five years from 1 July 2024.	An aggregate housing target does not automatically become a committed or standardised MMC pipeline.
Future Made in Australia - National Interest Framework	Provides a framework for targeting public support where investment can build national capability, resilience or net-zero advantage.	MMC manufacturing is not automatically a priority sector; relevance depends on demonstrated public value and sector assessment.
Built Environment Sector Plan and Australia's Circular Economy Framework	Connect emissions reduction, material efficiency, reuse and resource productivity to built-environment policy.	Broad objectives must become measurable specifications and lifecycle evidence to influence MMC selection.
Environmentally Sustainable Procurement Policy	Applies to Australian Government construction-services procurements at or above $7.5 million, including environmental plans and contract reporting.	Requirements must be weighted and verified if they are to influence supplier investment and delivery decisions.
National Sustainable Procurement in Infrastructure Guideline	Provides nationally agreed guidance for reducing embodied emissions through infrastructure procurement.	Application and capability may vary across agencies and jurisdictions.
Australian Skills Guarantee and National Skills Agreement	Link eligible major procurement to training targets and coordinate national vocational education and training reform.	Generic targets do not by themselves develop MMC-specific manufacturing, digital and assembly capability.
State and territory policy and procurement	Supports pilots, housing programs, digital engineering and local manufacturing.	Different requirements and short programs fragment demand and increase supplier transaction costs.

Sources: ABCB (2024, 2025, 2026); Australian Government (2024); DCCEEW (2024, 2025); Department of Employment and Workplace Relations (2023, 2024); Department of Finance (2024); Department of Infrastructure, Transport, Regional Development, Communications and the Arts (2025); Treasury (2023); Productivity Commission (2025); Infrastructure Australia (2025); Shou et al. (2026).

3.3 Policy settings

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Australian MMC policy is distributed across housing, productivity, manufacturing, infrastructure, climate, skills and procurement portfolios. The National Housing Accord creates housing-delivery urgency; the Future Made in Australia - National Interest Framework provides a basis for targeted capability investment; the Built Environment Sector Plan and Australia's Circular Economy Framework strengthen the case for lower-carbon, resource-efficient and reusable solutions; and the Australian Skills Guarantee and National Skills Agreement address workforce participation and capability. These instruments create multiple enabling signals but no single national MMC demand architecture. They also operate on different timelines and through different agencies. A supplier may therefore see strong strategic support but still face a short or uncertain order book (Australian Government 2024; DCCEEW 2024, 2025; Department of Employment and Workplace Relations 2023, 2024; Treasury 2023; Shou et al. 2026; Infrastructure Australia 2025).

A useful distinction is between supply-side and demand-side policy. Supply-side measures-grants, concessional finance, research, training and certification support-reduce the cost or risk of developing capability. Demand-side measures-mandates, framework pipelines, aggregated purchasing, outcome specifications and evaluation criteria-create opportunities to use that capability. Both are needed. Supply support without committed demand can create underutilised capacity, while demand without capability and assurance may produce limited competition or dependence on a small number of suppliers. Section 4 examines the investment and market consequences of this balance in detail.

Two Commonwealth procurement instruments show how broad policy can become an operational demand signal. The Environmentally Sustainable Procurement Policy has applied since 1 July 2024 to Australian Government construction-services procurements valued at $7.5 million or more, requiring environmental commitments to be carried through approaches to market and contracts. The National Sustainable Procurement in Infrastructure Guideline, approved in 2025 for use by Australian, state and territory agencies, provides a common approach to reducing embodied emissions through infrastructure procurement (Department of Finance 2024; Department of Infrastructure, Transport, Regional Development, Communications and the Arts 2025). Neither instrument gives MMC an automatic preference; each creates a route through which demonstrated lifecycle, circularity and carbon outcomes may become visible in procurement.

3.3.1 Private-market demand: the second, larger channel

Public procurement can establish standards and provide demonstration pipelines, but most housing and commercial development is delivered through private markets. Wider MMC adoption therefore also depends on planning approval, valuation, construction finance, warranty and insurance arrangements that recognise off-site production. Conventional progress-payment and security practices are commonly tied to materials installed on site, whereas MMC shifts expenditure to design, tooling and factory manufacture before installation. If lenders, valuers and insurers cannot assess or secure that work, technically viable projects may remain difficult to finance (Gad et al. 2022; Committee for Economic Development of Australia 2026).

Government can influence this channel through nationally recognised certification, planning consistency, consumer-protection clarity and finance settings, but it cannot substitute for a viable private business model. The institutional objective is to make compliant MMC products understandable and financeable without weakening safeguards. Detailed financing mechanisms belong in Section 4; for this section, the key finding is that regulatory reform must address the full approval and assurance ecosystem rather than public procurement alone.

Collins House in Melbourne provides a concise Australian private-market example. The constrained-site residential project comprises 60 levels and 259 apartments and used Hickory's integrated structural, façade and fit-out system. Hickory reports that this approach reduced the construction programme by up to 30 per cent (Hickory 2022). The example does not establish a universal time saving, but it shows how a private developer may adopt MMC to address site access, sequencing and delivery constraints.

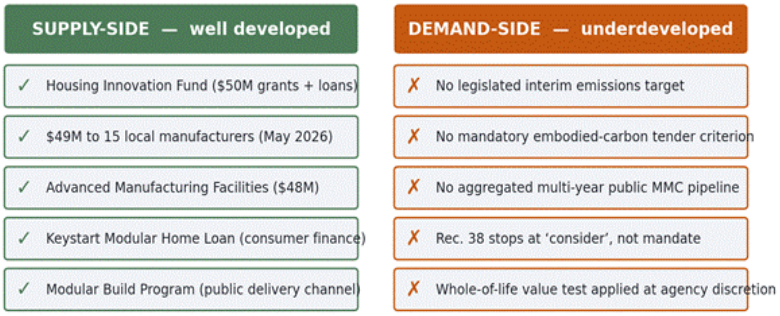
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3.4 Western Australian institutional setting

Western Australia illustrates an active but incomplete MMC policy mix. Its regional housing needs, resources-sector experience and advanced-manufacturing capability create strong applications for off-site construction. Procurement, sustainability, local-content and workforce instruments can recognise aspects of MMC value, but demand remains dispersed across agencies and programs. As in other Australian jurisdictions, support for manufacturing capability does not itself create a coordinated multi-year order pipeline.

Figure 3.2 uses Western Australia to illustrate a wider institutional risk: capability and manufacturing support may develop faster than coordinated, durable demand.

Figure 3.2. Western Australia's MMC settings: capability support and demand-side limitations



Note: Developed by the research team. Funding values and policy settings reflect the evidence and announcements available at the review date and should be read with the sources cited in Section 3.4 and Table 3.4.

The Procurement Act 2020 (WA), Western Australian Procurement Rules and related local-content, Aboriginal procurement and workforce policies allow economic, social and environmental considerations to inform purchasing. They can recognise traceable local manufacture, participation and training outcomes, but their practical influence depends on tender weightings, evidence requirements and post-award monitoring (Parliament of Western Australia 2020; Department of Treasury and Finance 2025a; Department of Energy and Economic Diversification 2025; Department of Training and Workforce Development 2025).

Environmental policy is also entering infrastructure procurement through the Transport Sustainable Infrastructure Policy, related lifecycle guidance and Main Roads Western Australia's sustainability and net-zero initiatives. These instruments can recognise embodied carbon, circularity and whole-of-life performance, although MMC suppliers must demonstrate improvement against relevant baselines rather than receive an automatic preference (Department of Transport and Major Infrastructure 2024; Main Roads Western Australia 2025).

Infrastructure WA's State Infrastructure Strategy recommends program procurement for similar projects, consideration of off-site and modular techniques where beneficial, and cross-agency coordination to identify aggregation opportunities. This reflects the international demand-signal lesson, but a recommendation to consider MMC remains weaker than an aggregated pipeline with common technical requirements (Infrastructure WA 2022).

Supply-side measures, including the $50 million Housing Innovation Fund and support for advanced housing and infrastructure manufacturing facilities, can reduce establishment and scaling barriers. Their lasting value depends on complementary demand, transparent market access and evidence that public or private pipelines can use the resulting capacity (Department of Energy and Economic Diversification 2026; Government of Western Australia 2026).

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Table 3.4. Western Australian instruments and their relevance to MMC

Instrument	Policy function	MMC relevance and unresolved question
Procurement Act 2020 and WA Procurement Rules	Best-value and public-procurement governance	Can economic, social and environmental MMC benefits be given material evaluation weight in practice?
Buy Local, industry participation and Aboriginal procurement	Local content and participation	Can factory-based local value and regional participation be measured consistently without unduly narrowing competition?
Priority Start	Apprenticeship and training requirements	Can a predictable pipeline support sustained MMC-specific training rather than project-by-project compliance?
Transport Sustainable Infrastructure Policy and guidance	Carbon, circularity and whole-of-life procurement	What supplier data are sufficiently reliable for tender evaluation and post-award reporting?
State Infrastructure Strategy	Program procurement and cross-agency coordination	Will recommendations translate into aggregated, compatible demand across asset programs?
Housing Innovation Fund and manufacturing facilities	Supply-side investment support	Will supported capacity be matched by durable public and private demand?
Modular social and regional housing programs	Public demonstration and delivery	Can separate programs develop into repeatable platforms with common assurance and interfaces?

Sources: Parliament of Western Australia (2020); Infrastructure WA (2022); Department of Transport and Major Infrastructure (2024); Department of Energy and Economic Diversification (2025, 2026); Department of Treasury and Finance (2025a); Department of Training and Workforce Development (2025); Government of Western Australia (2026).

3.5 The role of government in shaping MMC markets

The evidence positions government in several connected roles: regulator, public client, coordinator, investor and steward of public value. Regulation and assurance reduce uncertainty about what may be built. Procurement converts asset needs into demand. Coordination can align agencies and jurisdictions. Targeted investment can develop capability where private finance alone is insufficient. Public-value frameworks determine whether carbon, circularity, resilience, local participation and workforce outcomes affect selection. No single role is sufficient; the policy system must connect them.

Table 3.5. Government roles relevant to MMC adoption

Government role	Primary function	Implication for scalable MMC
Regulator and assurance steward	Set technical requirements, definitions, evidence and responsibility pathways.	Reduce repeated approval effort while maintaining safety, quality and consumer protection.
Public client	Specify outcomes, procure programs and monitor delivery.	Translate asset pipelines into contestable, repeatable demand and measurable non-price requirements.
Market coordinator	Align agencies, jurisdictions, standards and pipeline information.	Increase compatibility of demand and enlarge the market available to qualified suppliers.
Capability investor	Support research, certification, facilities, digital systems and skills.	Address genuine capability gaps while avoiding capacity that lacks a viable demand base.
Public-value steward	Balance cost, carbon, circularity, resilience, local industry and social outcomes.	Ensure MMC is selected for evidenced whole-of-life value rather than novelty or lowest upfront price alone.

Developed by the research team from the sources cited in Sections 3.1-3.4.

3.5.1 Matching the procurement route to project complexity

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Government's demand signal must be matched to the asset. High-volume, repeatable housing, classrooms or regional facilities may suit panels, frameworks, bulk purchasing or platform-based procurement. Complex hospitals, custodial facilities and infrastructure may require early contractor involvement or collaborative delivery to manage interfaces and bring specialist manufacturing knowledge into design. Complexity does not exclude MMC; it changes the appropriate engagement and risk-allocation mechanism. Section 5 assesses these procurement routes in detail. The institutional requirement is that policy should not prescribe one contractual model for every application (Wondimu et al. 2020; HM Government 2022).

3.6 Policy and regulatory constraints

Five recurring constraints limit the translation of policy support into scalable adoption.

- **Jurisdictional fragmentation.** Building regulation, planning, procurement and licensing are distributed across Commonwealth, state, territory and local institutions. Variation permits experimentation but increases repeated assurance and transaction costs for suppliers operating across borders.
- **Incomplete assurance pathways.** NCC guidance and proposed manufacturer certification are important advances, but responsibility across design, factory inspection, transport, assembly and final certification still requires practical alignment with insurance, warranties and consumer protection.
- **Policy-procurement gap.** Sustainability, productivity and innovation objectives do not influence suppliers unless they become specifications, evaluation criteria, contract obligations and monitored outcomes. Lowest-upfront-price evaluation can neutralise otherwise supportive policy.
- **Unbalanced policy mix.** Grants and facilities can develop supply, but without compatible demand they may produce underutilised capacity. Conversely, strong demand without capable and assured suppliers may restrict competition. Supply- and demand-side measures must be sequenced together.
- **Workforce and institutional capability.** MMC requires manufacturing, digital coordination, logistics, quality assurance and assembly skills, as well as informed clients, certifiers and evaluators. Policy effectiveness depends on capability across the full system, not suppliers alone.

Finance and valuation are also material constraints, particularly where off-site manufacture precedes conventional progress-payment milestones. Because those issues concern market structure, cash flow and supplier investment, they are developed in Section 4 rather than repeated here.

3.7 Synthesis and the Australian research gap

The international comparison and Australian evidence support a consistent conclusion: regulatory recognition and supportive policy are necessary, but scalable MMC requires their conversion into coordinated demand, usable assurance and measurable value. Australia has active reforms, substantial asset needs and growing supplier capability, yet policy remains dispersed across jurisdictions and portfolios. Western Australia illustrates both sides of this position-strong supply-side support and relevant procurement instruments, but no clearly aggregated multi-year MMC pipeline across public asset classes.

Procurement and demand certainty. The evidence shows that scalable MMC requires public asset pipelines to be translated into compatible, repeatable and contestable demand. Regulation and certification can reduce technical uncertainty, but they cannot compensate for fragmented purchasing, late system selection or short-term programs.

Non-price value and measurement. Policy increasingly recognises carbon, circularity, resilience, local participation and social value, but these objectives affect selection only when tender criteria, evidence

requirements and post-award measures are sufficiently clear and material. The Australian evidence remains limited on how consistently these mechanisms influence actual procurement decisions.

Workforce capability. Skills and participation policies provide a foundation for training, but generic targets do not necessarily develop the manufacturing, digital, logistics and assembly capabilities required for MMC. Durable demand and appropriately designed procurement are needed to justify sustained investment by employers and training providers.

The overarching gap is limited Australian empirical evidence connecting institutional settings to actual decisions by clients and suppliers. Existing literature identifies barriers and available policy levers, but provides less evidence on how regulation, pipeline certainty, non-price measurement and workforce commitments interact across housing, buildings and infrastructure. Closing this evidence gap would move the literature from a catalogue of supportive policies towards practical, evidence-based procurement and implementation guidance.

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4 MARKET STRUCTURE, INCENTIVES AND DEMAND SIGNALS

Modern Methods of Construction (MMC) require a different commercial environment from conventional project-based construction. Manufacturers commit capital to factories, tooling, automation, digital systems and specialised workforces before the volume and timing of future orders are fully known. Their ability to recover those fixed costs depends on repeatable demand, factory utilisation and a sufficiently stable order book. Market structure, demand signals and access to finance therefore shape MMC adoption as directly as technology, design or regulation (Wuni and Shen 2020; Saad, Dulaimi and Zulu 2023b).

This section examines the commercial conditions affecting supplier investment in Australia. It distinguishes broad construction demand from effective demand for manufactured solutions; considers how procurement pipelines and purchasing commitments influence investment; and assesses the interaction between incentives, financing and market risk. Section 3 addresses the policy and institutional settings that create these signals, while Section 5 examines the procurement and contractual mechanisms through which they can be implemented.

4.1 Market Structure of the Australian MMC Industry

Australia has substantial demand for housing, buildings and infrastructure, but that demand is distributed across jurisdictions, agencies, private developers and individual projects. Infrastructure Australia forecasts $1.14 trillion of construction activity over 2024-25 to 2028-29, including a $242 billion major public infrastructure pipeline; however, an aggregate pipeline does not indicate how much work will be suitable for MMC, use compatible technical requirements or proceed in a sequence that supports continuous manufacture (Infrastructure Australia 2025). The central market issue is therefore not a lack of construction need, but the limited conversion of that need into contestable, repeatable demand for industrialised solutions.

4.1.1 Market maturity and industry characteristics

Australian interest in MMC has grown in response to housing shortages, weak construction productivity, workforce constraints and decarbonisation objectives. National and state programs increasingly refer to prefabrication, modular delivery and Design for Manufacture and Assembly (DfMA), and public housing has provided an important demonstration market. Nevertheless, the industry remains at an early stage of industrial maturity. Uptake is uneven across sectors and jurisdictions, and many initiatives remain pilots or short programs rather than enduring purchasing systems (Productivity Commission 2025; Soltani et al. 2025a; Sharam et al. 2026).

This position differs from mature industrialised-construction markets, where sustained demand has enabled firms to standardise products, improve production learning and invest over longer horizons. Australia has capable manufacturers and specialist suppliers, but limited common platforms, inconsistent client requirements and fluctuating pipelines constrain the transition from successful projects to repeatable production. Market maturity should therefore be assessed through the interaction of demand continuity, supplier depth, product assurance, standard interfaces and access to capital rather than by counting modular projects alone.

4.1.2 Supply-side characteristics

The MMC supply chain includes volumetric and panel manufacturers, precast concrete and engineered-timber suppliers, specialist designers, digital integrators, logistics providers, installers, contractors and certifiers. Off-site production increases the need for early coordination because design decisions, interfaces and production information must be resolved before manufacture. Weak integration or late design change can interrupt production, create rework and transfer project uncertainty into the factory (Wuni and Shen 2023; Nesarnobari et al. 2025).

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The Australian supplier base is also weighted towards small and medium-sized enterprises. These firms can be innovative and responsive, but they generally have less capacity to absorb prolonged underutilisation, delayed payment or the cost of maintaining multiple proprietary systems. Evidence from the Australian housing industry identifies fragmented demand, constrained finance and uneven business capability as barriers to scaling prefabricated production (Wells et al. 2026; Sharam et al. 2026). Supplier capability is therefore not simply a technical attribute: it depends on whether firms can finance, operate and continuously improve productive capacity across market cycles.

4.1.3 Demand-side characteristics

Housing shortages and public infrastructure plans create strong underlying demand, but manufacturers respond to executable orders rather than policy targets. Effective MMC demand requires projects with suitable typologies, compatible specifications, predictable timing and a credible route to contract. A large announced housing target may therefore provide only a weak investment signal if projects are procured separately, designs are bespoke or delivery dates repeatedly change (Pan, Gibb and Dainty 2012; Infrastructure Australia 2025).

Private demand is equally important because most housing and commercial development is not directly procured by government. Its conversion to MMC is affected by development feasibility, planning, valuation, lending, insurance and buyer acceptance. Cyclical development conditions and conventional finance practices can amplify pipeline volatility. Public programs can provide demonstration and base demand, but a scalable industry ultimately requires public and private channels capable of using assured products and repeatable systems.

4.1.4 Implications for MMC adoption

The market structure creates a coordination problem. Individual clients may prefer to preserve project flexibility and competition, while manufacturers require earlier technical decisions and greater confidence in future volume. Suppliers may hesitate to invest until demand is visible, yet clients may hesitate to commit work until sufficient competitive capacity exists. This circularity helps explain why technically successful pilots do not necessarily develop into a self-sustaining market.

Table 4.1. Market characteristics and implications for MMC investment

Market characteristic	Effect on suppliers	Implication for clients and policy
Fragmented project demand	Short order books and limited production planning	Identify compatible demand across programs and agencies.
High fixed manufacturing costs	Returns depend on utilisation and repeat volume	Consider continuity and sequencing, not project price alone.
SME-dominated supplier base	Limited capacity to absorb delay, redesign and cash-flow shocks	Use proportionate assurance, risk and payment arrangements.
Bespoke requirements	Repeated engineering, certification and tooling costs	Standardise interfaces and performance requirements where appropriate.
Public-private demand split	Public programs alone may not sustain capacity	Develop assurance and finance settings that enable wider market use.
Cyclical and uncertain pipelines	Conservative investment and incremental expansion	Publish credible pipelines and communicate material changes.

Sources: Developed by the research team from Pan, Gibb and Dainty (2012), Wuni and Shen (2023), Infrastructure Australia (2025), Nesarnobari et al. (2025), Sharam et al. (2026) and Wells et al. (2026).

4.2 Market Signals and Demand Certainty

Market signals affect whether suppliers interpret future work as sufficiently credible to justify investment. Their strength depends on specificity, durability and commitment. General policy support is weaker than a published pipeline; a pipeline is weaker than a funded program with common requirements; and even a funded program may remain uncertain until procurement timing, work packaging and purchasing arrangements are clear. Demand certainty does not require government to

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guarantee a manufacturer's revenue, but it does require information and commitments that are enough to influence rational investment decisions (Winter, Scheepbouwer and van der Walt 2026).

4.2.1 Sources of market signals

Signals originate from housing and infrastructure plans, budgets, planning approvals, procurement forecasts, framework panels, developer pipelines and major-contractor sourcing strategies. Suppliers also interpret less formal information, including the consistency of client specifications, the frequency of cancelled or deferred procurements and whether earlier pilots generated repeat work. A large number of announcements can therefore coexist with weak market confidence if the signals are inconsistent or lack an identifiable purchasing pathway.

Signal credibility is enhanced when clients disclose the likely scale, timing, typology, location and technical compatibility of future work, while clearly identifying which elements remain uncertain. This allows suppliers to assess addressable demand rather than assume that the complete construction pipeline is available to their system. Transparent pipeline information also supports competition by giving new and smaller suppliers time to form partnerships, seek finance and develop assurance evidence.

4.2.2 Pipeline certainty and demand continuity

For manufacturers, continuity is often more important than a single large order. Factory economics depend on balancing production across time; clustered projects may create temporary peaks followed by idle capacity, while frequently delayed projects interrupt workforce and supply planning. Pipeline quality should therefore be considered in terms of compatibility and sequencing as well as aggregate value. Infrastructure Australia's finding that the outer-year public infrastructure profile has strengthened provides a positive investment signal, but it does not by itself establish long-term certainty for MMC suppliers (Infrastructure Australia 2025).

Clients cannot remove all uncertainty, particularly where projects depend on approvals and annual budgets. They can, however, distinguish funded commitments from indicative opportunities, update pipelines consistently and aggregate repeatable components or asset types. Program-level demand can preserve competition by establishing open performance requirements and standard interfaces, then competing individual projects or work packages among qualified suppliers.

4.2.3 Government procurement as a market signal

Government procurement can shape supply markets because the public sector is both a major client and a standard setter. Repeated purchasing, coordinated programs and framework arrangements can encourage suppliers to invest in systems that serve more than one project. Public procurement can also reduce first-mover risk by supporting demonstration, assurance and transparent performance evaluation (OECD 2017; Saad, Dulaimi and Gorse 2023a; van de Waerdt et al. 2024).

The strength of this signal depends on implementation. Isolated pilots test feasibility but rarely justify factory expansion. Conversely, an overly prescriptive commitment to a proprietary product can narrow competition and create dependency. The more transferable approach is to aggregate demand around asset typologies, outcome requirements and compatible interfaces while retaining contestability at supplier or work-package level. Section 5 considers the procurement routes and contractual mechanisms capable of applying this principle.

4.2.4 Current limitations and implications

Australian signals remain dispersed across jurisdictions, sectors and funding cycles. Program announcements are not always supported by common technical requirements or coordinated procurement schedules, and private demand remains sensitive to feasibility and finance. The result is an expectations gap: clients may see a large pipeline, while suppliers see only a smaller and uncertain addressable market. Closing this gap requires credible information, repeat purchasing opportunities and disciplined pipeline management rather than promotional support alone.

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4.3 Incentives and Financing Mechanisms

Demand visibility is necessary but not sufficient. MMC shifts expenditure towards design development, certification, tooling, materials and factory production before installation and before conventional site-based payment milestones. Suppliers must therefore finance both long-lived productive assets and project-specific working capital. The viability of investment depends on how demand, payment, security, valuation and risk allocation operate together (Kurup, Pless and Grosskopf 2024).

4.3.1 Capital investment requirements

Factories, automated equipment and digital production systems involve fixed and partly irreversible costs. Their economic value depends on sustained throughput and the ability to reuse product knowledge across projects. Investment may be incremental-improving existing precast, timber or steel facilities-or transformative, involving new volumetric lines and platform systems. In both cases, low utilisation raises unit costs and can erase the anticipated productivity advantage (Feldmann 2022; Olawumi et al. 2022).

4.3.2 Financing challenges

Project finance and payment practices commonly recognise work incorporated into the site, whereas MMC manufacturers incur substantial costs before delivery. Lenders and clients may be concerned about title to off-site materials, vesting, security, insolvency exposure, quality verification and the recoverability of unfinished products. These concerns are legitimate, but applying conventional milestones without adaptation can transfer disproportionate working-capital pressure to suppliers.

The financing challenge is particularly acute for SMEs and for projects using a new system for the first time. A United States modular-housing study found that developers' equity requirements could be materially higher where lenders perceived unfamiliar construction and completion risks (Kurup, Pless and Grosskopf 2024). Australian evidence similarly identifies finance, valuation and payment timing as barriers to wider prefabrication (Zhang et al. 2022; Wells et al. 2026). Appropriate responses may include verified factory milestones, vesting and security arrangements, advance payments against safeguards, and facility finance linked to credible multi-project demand. Detailed contract drafting belongs in Section 5.

4.3.3 Government incentives and industry support

Government support can reduce entry costs through grants, concessional finance, assurance support, skills programs, research partnerships and co-investment in advanced manufacturing. Relevant Australian mechanisms include the Housing Australia Future Fund, which supports social and affordable housing demand; the National Reconstruction Fund, which can provide debt, equity and guarantees for eligible manufacturing investment; and the NSW Housing Innovation in Construction Fund and Modern Methods of Construction Industry Expansion Program, which are directed more specifically towards MMC capability and market expansion (Housing Australia 2026; National Reconstruction Fund Corporation 2026; NSW Government 2026a, 2026b). These mechanisms perform different functions, but each can address constraints that an individual project may be unable to resolve alone.

However, supply-side assistance can create stranded or underutilised capacity if it is not connected to an addressable market. International experience reviewed in Section 3 shows that incentives are most effective when combined with technical standardisation, public-sector demand and workforce development. Support should therefore be assessed against additionality, market need, access conditions and the likelihood that capability can serve multiple clients rather than becoming dependent on continuing grants.

4.3.4 Implications for supplier investment

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Supplier investment reflects the combined effect of expected demand, financing capacity and downside exposure. Improving only one element may have limited impact: a grant cannot compensate for an empty order book, and a strong pipeline cannot be converted into production if working capital is unavailable. The appropriate policy mix will vary by technology and market maturity, but support should progressively move firms towards commercially sustainable, contestable demand rather than permanent reliance on subsidy.

Table 4.2. Financial and market-support mechanisms for MMC

Mechanism	Primary contribution	Key limitation or safeguard
Published and coordinated pipeline	Improves visibility and investment planning	Must distinguish funded work from indicative opportunities.
Program or framework procurement	Creates repeat opportunities and common interfaces	Maintain contestability and avoid proprietary lock-in.
Factory-stage payment	Aligns cash flow with the timing of production	Require verification, vesting, security and quality evidence.
Grant or concessional finance	Reduces entry and capability-development costs	Link support to additionality and credible market use.
Assurance and certification support	Reduces repeated approval and lender uncertainty	Recognition must extend across relevant jurisdictions and institutions.
Research, skills and digital support	Builds productivity and absorptive capability	Benefits depend on sufficient work to retain and apply capability.

Sources: Developed by the research team from OECD (2017), Feldmann (2022), Zhang et al. (2022), Kurup, Pless and Grosskopf (2024), Infrastructure Australia (2025) and Wells et al. (2026).

4.4 Investment Risks and Market Failures

MMC investment is exposed to demand volatility, design change, approval delay, site-readiness failures, logistics disruption, input-price escalation and counterparty insolvency. Fixed facilities and specialised workforces make prolonged underutilisation particularly damaging. Supply-chain studies consequently identify uncertainty and coordination failure-not only technology-as central threats to off-site construction resilience (Tennakoon et al. 2025; Nesarnobari et al. 2025).

Several market failures can reinforce one another. Clients may not account for the wider value of faster delivery, reduced disruption or manufacturing capability; suppliers may be unable to capture the return from investments that benefit later projects; fragmented clients may each wait for others to create market volume; and lenders or insurers may price unfamiliarity rather than evidenced performance. Information asymmetry can also prevent clients from distinguishing robust suppliers and systems from high-risk offerings. These conditions can produce underinvestment even where MMC would create net public value.

Evidence from Sweden illustrates that market maturity alone does not eliminate this problem. Lindblad (2019) found that short-term priorities, limited knowledge and features of public procurement could restrict the long-term development of sustainable timber construction. The example reinforces the need for procurement settings that recognise longer-term market and sustainability outcomes without prescribing a particular proprietary solution.

Intervention nevertheless creates its own risks. Poorly targeted grants can support capacity without demand; guarantees can socialise losses; mandated solutions can narrow competition; and long commitments can reduce flexibility where technology or need changes. The policy objective is therefore not to remove normal commercial risk or guarantee individual firms. It is to correct coordination, information and financing barriers through transparent pipelines, proportionate assurance, outcome-based procurement and risk allocation to the party best able to manage it.

4.5 Summary and Research Gap

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The evidence indicates that Australia's principal MMC challenge is converting substantial construction need into dependable demand for repeatable manufactured solutions. The supplier market contains relevant technical capability, but fragmented procurement, bespoke requirements, uneven pipelines and conventional financing practices limit utilisation and weaken incentives for long-term investment. Demand certainty should therefore be understood as a spectrum of credible information and commitments, not as an absolute government guarantee.

For Research Question 1, the literature identifies coordinated pipelines, program procurement, frameworks, common interfaces, early engagement and manufacturing-aligned payment as promising mechanisms. What remains weakly evidenced in Australia is which combinations materially change investment decisions, how much commitment is necessary, and how certainty can be improved without compromising competition, probity or client flexibility.

For Research Question 2, non-price criteria can strengthen demand for MMC only when they recognise measurable project and whole-of-life outcomes rather than rewarding the method itself. The unresolved issue is whether carbon, resilience, local capability, delivery certainty and social value are given sufficient and consistent weight to influence supplier investment. Section 6 examines these measures in detail.

For Research Question 3, predictable demand may enable suppliers to retain skilled workers, invest in apprenticeships and develop digital and manufacturing capability. However, limited empirical research connects the duration and quality of a procurement pipeline with actual workforce-investment decisions. The overarching research gap is therefore empirical: how market signals, finance, procurement and workforce commitments interact in real Australian supplier decisions across housing, buildings and infrastructure.

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5 PROCUREMENT STRATEGIES AND CONTRACT ARRANGEMENTS

Modern Methods of Construction (MMC) do not require one universally preferred procurement model. They require procurement and contracting decisions that recognise manufacturing lead times, early design commitment, interfaces between factory and site, off-site payment, product assurance and the value of repeat demand. The objective is not to maximise MMC use for its own sake, but to select the method where it improves project and whole-of-life outcomes (Cabinet Office 2022; Saad 2023).

This section reviews the procurement strategies and compensation arrangements most relevant to MMC. It distinguishes: procurement strategy, which structures how the client engages the market and allocates delivery responsibility; contract arrangement, which determines payment and financial exposure; and supporting mechanisms such as early supplier involvement, factory-stage payment and incentives. These choices interact but should not be treated as interchangeable. Section 4 addresses market demand and financing; Section 6 addresses non-price evaluation criteria.

Selection should respond to the maturity of the brief, likelihood of change, schedule and whole-of-life priorities, market capacity, project complexity, client capability and the parties' ability to manage risk. For MMC, four additional questions are important: whether the approach engages manufacturers and key suppliers early; enables design integration and innovation; provides sufficient commercial confidence for capital and capability investment; and can support repeatable delivery across projects or programs. The assessments below are qualitative and conditional. A model's effect depends on its implementation, not its label alone (Rahmani, Maqsood and Khalfan 2017; Infrastructure NSW 2026).

The Construction Industry Institute's owner decision-support tool similarly links project objectives to the selection of delivery and contract strategies (CII 2003a, 2003b). Although it was not developed specifically for MMC or the Australian institutional context, it demonstrates the value of a structured and documented selection process rather than choosing a familiar model by default. Consistent with Walker et al. (2008), that process should define the client's strategic objectives, identify and validate a suitable delivery model, establish requirements and partner-selection criteria, and then select the delivery partner.

5.1 Procurement strategies

Procurement strategy determines when designers, contractors, manufacturers and specialist suppliers influence the solution. MMC decisions made after design completion can be costly because module dimensions, structural grids, logistics, tolerances, services and certification pathways may already be fixed. Early engagement is therefore generally more consequential for MMC than the formal name of the delivery model (HM Government 2022; Cabinet Office 2022).

5.1.1 Design-bid-build

Under design-bid-build, the client appoints the designer and subsequently tenders the completed design to a contractor. The model offers clear separation of design and construction and may preserve price competition, but it provides limited opportunity for manufacturers to influence system selection before design is fixed. It can support MMC where the client and designer already possess strong manufacturing knowledge, specify interoperable performance requirements and undertake early market engagement. Otherwise, late substitution may cause redesign, constrain competition to systems compatible with the completed design, or leave suppliers carrying interface risk (Walker and Rowlinson 2008; Saad 2023).

5.1.2 Design and construct

Design and construct places design and construction responsibility with one contractor and can enable earlier integration of construction and manufacturing knowledge. Its MMC value depends on when the contractor and manufacturer are appointed and how much design freedom remains. A single-stage

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price competition after substantial design development may reproduce the limitations of design-bid-build. Two-stage selection, early contractor involvement or performance-based requirements can provide greater opportunity to optimise the product, logistics and assembly strategy before price and risk are finalised (Rahmani, Maqsood and Khalfan 2017; Infrastructure NSW 2026).

5.1.3 Construction management

Construction management and managing-contractor approaches allow construction expertise and work-package planning to inform design while the client retains greater influence over procurement. They can facilitate direct engagement with manufacturers and early packaging of enabling, factory and site works. Their effectiveness depends on a capable client, disciplined interface management and clarity over who warrants design integration, product performance and completion. They create flexibility for novel MMC solutions but do not, by themselves, provide manufacturers with repeat demand or investment certainty (Migliaccio and Shrestha 2022).

5.1.4 Alliancing and integrated project delivery

Alliancing and integrated project delivery (IPD) use integrated governance, open-book cost information and shared performance incentives to support best-for-project decisions. They are well suited to complex or uncertain projects where early joint development can resolve manufacturing, logistics and site interfaces. Their collaborative features may protect innovation from adversarial risk transfer, but their transaction costs and client capability requirements can be disproportionate for routine projects. A project alliance also supports scalability only if learning, specifications and supplier relationships are deliberately transferred across a program (Lahdenperä 2012; Walker 2025).

NASFA et al. (2010) distinguish three levels: typical collaboration without contractual requirements; enhanced collaboration supported by selected contractual obligations; and required collaboration established through a multi-party agreement. This spectrum is useful for MMC because it allows clients to adopt integration practices proportionate to project complexity and capability rather than treating full multi-party IPD as the only collaborative option. At program level, Integrated Program Delivery and Strategic Integrated Program Delivery extend these principles across related projects so that learning, relationships and common systems can be retained (Walker et al. 2024).

5.1.5 Public-private partnership

A public-private partnership integrates financing, design, construction and often long-term operation through a private project vehicle established under a concession arrangement (Li and Akintoye 2003). Long-term performance obligations can encourage whole-of-life consideration of quality, maintenance and replacement. However, PPPs are frequently large and bespoke; financing and completion-risk requirements may favour proven systems and discourage unfamiliar suppliers. MMC can be enabled through output requirements, early market testing and bankable assurance evidence, but the model does not automatically create cross-project standardisation or an accessible pipeline for smaller manufacturers.

5.1.6 Framework and program procurement

Frameworks, panels and program procurement establish arrangements for a series of projects or repeat asset types. When supported by a credible pipeline, common interfaces and transparent work-allocation rules, they can provide a strong link between procurement and MMC scalability, although this potential is not necessarily realised in conventional framework arrangements. They allow suppliers to plan capacity, reuse designs and improve through production learning. Poorly designed frameworks may provide no guaranteed work, lock in proprietary systems or concentrate opportunity among incumbents. Their value therefore depends on pipeline credibility, contestability, performance management and periodic opportunities for market entry (Mosey 2019; HM Government 2022; van de Waerdt et al. 2024).

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Table 5.1. Indicative MMC enablement of procurement strategies

Procurement strategy	Supply-chain engagement	Innovation and collaboration	Investment enablement	Scalability
Design-bid-build	Low	Low	Low	Low
Design and construct	Medium	Medium	Low	Low
Construction management / managing contractor	Low	Low	Low	Low
Alliance / IPD	High	High	Medium	Medium
Public-private partnership	High	Medium	High	High
Framework / program procurement	Medium	Low	Low	Low

Note: Ratings are an initial qualitative assessment developed by the research team from the cited literature and should be validated through the project's empirical stages. They reflect the typical performance of each procurement strategy rather than its best-case potential. Actual MMC enablement will depend on how the strategy is implemented, including the timing of supplier engagement, pipeline credibility, risk allocation, common technical interfaces and work-allocation arrangements. In particular, framework/program procurement may offer stronger investment and scalability outcomes where it provides a credible pipeline of repeat work.

5.2 Contract arrangements

Contract arrangements shape behaviour through the basis of payment, exposure to cost change and the treatment of savings, overruns and uncertainty. They must also address title to off-site goods, vesting, inspection, insurance, security, design responsibility, logistics and payment timing. These provisions may be more important to an MMC supplier than the headline pricing label (Cabinet Office 2022; Saad 2023).

5.2.1 Lump sum and guaranteed maximum price

Lump-sum and guaranteed-maximum-price (GMP) arrangements provide an agreed price or ceiling and can create budget discipline where scope and interfaces are mature. If used before the manufactured solution is sufficiently developed, they may cause suppliers to price uncertainty, resist beneficial change or transfer risk down the chain. They can nevertheless support MMC when preceded by collaborative development, supported by clear design-freeze rules and paired with verified factory milestones. A GMP may retain more transparency than a conventional lump sum, but incentives are needed if savings or wider project benefits are to be shared.

5.2.2 Cost-reimbursable and time-and-materials

Cost-plus and time-and-materials arrangements reduce supplier exposure where scope, quantities or production methods remain uncertain. They can support prototypes, early works and first-of-kind development because parties can refine the solution without embedding large contingencies. Their weakness is limited inherent pressure on cost and productivity. Open-book reporting, target costs, painshare/gainshare, performance measures and transition to a firmer price after design maturity can improve value for money (Lahdenperä 2012; Walker 2025).

5.2.3 Unit-price arrangements

Unit prices pay agreed rates for defined components or outputs while allowing quantities to vary. They can be particularly useful for repeatable manufactured elements, provided units, interfaces, indexation, minimum volumes and quality requirements are clearly defined. Unlike a one-off lump sum, a program of unit-priced work can support production learning and capacity planning. Conversely, uncertain quantities or frequent specification changes weaken the investment signal and may leave the supplier carrying unrecovered tooling or mobilisation costs.

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Table 5.2. Indicative MMC enablement of contract arrangements

Contract arrangement	Supply-chain engagement	Innovation and collaboration	Investment enablement	Scalability
Lump sum	Low	Low	Low	Low
Guaranteed maximum price	Low	Low	Low	Low
Cost-plus / target cost	Medium	High	Medium	Medium
Time and materials	Medium	High	Medium	Medium
Unit price	Low	Medium	Low	Low

Note: The common four-factor structure permits direct comparison with Table 5.1. The ratings retain the research team's initial assessment of the arrangements in their conventional form. Suitability can improve through early engagement, verified factory milestones, balanced risk allocation, credible volumes, open-book governance, target-cost incentives and painshare/gainshare. The assessment concerns compensation and risk settings, not the complete delivery model.

5.3 Integration and collaboration for novel approaches

MMC often requires a hybrid approach combining established construction procurement with manufacturing disciplines. The central requirement is a connected process from brief and system selection through design, certification, production, logistics, assembly and handover. Procurement should therefore identify critical suppliers early, establish decision gates and protect information continuity across organisational boundaries (Mosey 2019; Cabinet Office 2022).

The integration and collaboration elements identified in the original review remain relevant: a united project structure; joint responsibility and accountability; appropriate incentives; integrated governance and decision-making; open discussion; shared learning; behavioural commitments; trust; collaborative dialogue; a supportive project ambience; and shared values and motivation. These elements should be treated as design principles that can be incorporated proportionately into different procurement strategies, rather than as features available only through a full alliance or IPD agreement (Walker 2025).

Early involvement should be purposeful rather than consultative only. Manufacturers and logistics specialists need sufficient access to influence grids, tolerances, module dimensions, lifting, transport, temporary works and site readiness before irreversible design decisions. Interactive tendering and two-stage processes can test these matters while preserving probity and competition. Clients also need the technical capability to evaluate alternatives and avoid premature commitment to a proprietary system (Infrastructure NSW 2026).

Risk should be allocated to the party best able to manage it. Manufacturers can manage factory productivity and quality controls, but cannot efficiently price uncontrolled client design change, unavailable sites or uncertain approvals. Contracts should coordinate design freeze, change control, interface responsibility, inspection, title, vesting, payment and delay consequences. Where the client seeks innovation beyond minimum requirements, transparent incentives can align benefits and risks rather than expecting suppliers to fund experimentation through a fixed price (Infrastructure NSW 2023a; Walker 2025).

For repeat programs, integration must extend beyond the individual project. Common performance requirements, interoperable interfaces, structured learning and supplier-development arrangements allow knowledge to be reused without eliminating competition. Digital models and product data can support this continuity, but commercial provisions must clarify ownership, access and reuse. The preferred solution is therefore rarely a procurement label in isolation; it is a coherent package of engagement timing, delivery responsibility, payment, risk, assurance, incentives and program governance.

5.4 Summary and research gap

The literature indicates that MMC is most strongly enabled when procurement engages manufacturers before key design decisions, aligns payment with off-site production, allocates interface risks rationally

and provides opportunities for repeat work. Design and construct, managing-contractor, alliance/IPD, PPP and framework approaches can each support these conditions in different circumstances. None is inherently sufficient, and conventional approaches can also accommodate MMC when deliberately adapted.

For Research Question 1, the key gap is not a shortage of procurement labels but limited Australian evidence about which combinations of early engagement, pipeline commitment, standardisation, payment and risk allocation change supplier investment and project outcomes. Comparative empirical work is needed across housing, buildings and infrastructure, including the capability and governance demands placed on public clients.

The section also connects to Research Questions 2 and 3. Procurement models determine whether non-price value can influence system selection and whether suppliers have sufficient continuity to invest in manufacturing and workforce capability. Sections 6 and 7 examine those mechanisms and measures in detail.

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6 NON-PRICE PROCUREMENT CRITERIA AND MEASUREMENT APPROACHES

Lowest-price tendering can disadvantage Modern Methods of Construction (MMC) because it rarely recognises the value created through faster delivery, factory-controlled quality, improved safety, reduced waste, lower carbon and longer-term manufacturing capability. MMC may also require earlier expenditure on design, tooling and factory production than conventional site-based construction. Non-price criteria allow clients to assess these differences and select the most advantageous offer rather than the lowest initial price alone (Assaf et al. 2023; Tennakoon et al. 2026).

For MMC, non-price criteria perform two related functions. They test whether suppliers possess the manufacturing, digital, logistics and assurance capabilities needed to deliver the proposed system; and they communicate which wider outcomes the client will reward. To be effective, a criterion must be relevant, measurable, proportionately weighted and capable of verification after award. Aspirational requirements without a baseline, evidence standard or reporting method are unlikely to influence tender selection or subsequent performance.

The literature remains under-developed. Assaf et al. (2023, p. 1) observe that 'hardly any study has gone beyond identifying the procurement issues in OSC techniques'. Reviews also find that conventional selection criteria overlook important off-site characteristics and that decision tools are not yet calibrated to industrialised delivery (Zhao, Ying and Tookey 2022; Tennakoon et al. 2026). This section therefore combines peer-reviewed evidence with government and industry frameworks. It identifies an MMC-specific taxonomy, compares operational examples, assesses Australian practice and examines supplier data readiness. Section 2 addresses MMC benefits generally; this section focuses on how those benefits can be evaluated at tender stage and monitored after award.

6.1 Taxonomy of Non-Price Criteria Relevant to MMC

Five overlapping categories emerge from the literature: environmental; social; quality and safety; delivery; and innovation and technology. The categories should not be treated as a checklist in which every criterion receives equal weight. Selection should respond to the asset, procurement strategy, market maturity and outcomes sought. Table 6.1 distinguishes evidence that can be assessed during tendering from measures that can be verified during delivery. This distinction is important because claimed capability is not the same as achieved performance.

Table 6.1. Taxonomy and measurement of non-price procurement criteria for MMC

Category and criterion	Tender-stage evidence	Post-award measure	Evidence base
Environmental - pre-manufactured value (PMV)	Proposed PMV calculation, system breakdown and method	Verified proportion of value delivered through pre-manufacturing	Farmer 2016; Homes England 2021; Akerlof 2026; Offsite Hub 2023
Environmental - upfront carbon	A1-A5 baseline, reduction commitment and EPD/data plan	Carbon measured at agreed project stages against the baseline	Infrastructure NSW 2024; Kadefors et al. 2021
Environmental - waste and circularity	Waste forecast; material-efficiency and design-for-disassembly plan	Waste intensity, recovery rate and evidence of reusable components	Wang et al. 2024; Meng et al. 2025
Environmental - whole-of-life value	Whole-life cost/carbon assumptions and maintenance strategy	Updated cost, performance and asset-information records	RICS 2023; Infrastructure NSW 2024
Social - local and community value	Local manufacturing, Indigenous participation and regional employment plan	Employment, expenditure, participation and benefit outcomes	NSW Treasury 2021; LHC 2022

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Category and criterion	Tender-stage evidence	Post-award measure	Evidence base
Social - workforce development	DfMA training, apprenticeship & capability-development commitments	Training hours, completions, competencies and retention	Tennakoon et al. 2026; Q Shelter & Building 4.0 CRC 2025
Quality and safety - factory assessment	Facility capacity, ISO systems, traceability, inspection and quality controls	Defects, non-conformances, factory tests and production reliability	LHC 2022; Standards Australia 2025
Quality and safety - technical capability	DfMA, BIM, logistics and factory-to-site interface capability	Interface performance, approvals, installation quality & data completeness	Assaf et al. 2023; Building 4.0 CRC 2024
Quality and safety - WHS	System accreditation and method-specific risk controls	Leading indicators, incidents and exposure reduction	Ahn et al. 2020; LHC 2022
Delivery - time and certainty	Manufacturing and logistics schedule, capacity evidence and delivery-risk plan	Milestone reliability, installation rate and schedule variance	Cabinet Office 2022; Assaf et al. 2023
Innovation and technology - digital capability	BIM interoperability, common data environment and product-data plan	Model/data compliance, information quality and reuse	Building 4.0 CRC 2024; Meng et al. 2025
Innovation and technology - improvement	Proposed innovation, repeatability and learning plan	Benefits realised, standardisation and lessons transferred	Cabinet Office 2022; Meng et al. 2025

Note: Compiled by the research team from the cited academic and grey literature. Measures are indicative and require project-specific definitions, baselines, evidence rules and verification responsibilities.

6.1.1 Environmental Criteria

Environmental criteria should distinguish the construction method from the outcome achieved. A high level of prefabrication does not automatically guarantee lower carbon or waste: results depend on materials, factory energy, transport, design efficiency and end-of-life assumptions. Wang et al. (2024), drawing on 59 building cases, nevertheless found substantial waste-reduction potential from modular and off-site approaches. Tender evaluation should therefore seek a project-specific forecast and method, followed by measurement against an agreed baseline, rather than award points for the MMC label alone.

Australia's most developed relevant instrument is Infrastructure NSW's Decarbonising Infrastructure Delivery Policy. It requires upfront-carbon quantification at business case; planning, design and procurement; and project completion, with data quality increasing as design develops (Infrastructure NSW 2024). This provides a basis for tender-stage carbon commitments and post-award verification. However, carbon must receive sufficient weighting and be assessed by competent evaluators if it is to affect selection; international infrastructure experience shows that weakly weighted or poorly specified carbon criteria may function mainly as signals of ambition (Kadefors et al. 2021).

Pre-Manufactured Value emerged from the policy direction established by Farmer's (2016) Modernise or Die review and expresses the share of gross construction cost attributable to pre-manufacturing. Homes England's Affordable Homes Programme has used a PMV score of at least 55% as an MMC benchmark, while some UK framework requirements have required at least 70% of construction cost to arise from pre-manufacturing (Homes England 2021; Offsite Hub 2023). These thresholds provide concrete demand signals, but PMV measures the extent of pre-manufacturing rather than its environmental, social or quality outcomes. Its calculation is not yet consistently standardised and may encourage optimisation of the score rather than overall value if used alone (Akerlof 2026; Offsite Hub 2023). No Australian equivalent was identified. Any local measure should define inclusions, calculation responsibility and assurance, and should sit within a balanced scorecard.

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6.1.2 Social Criteria

Social criteria can recognise local manufacturing, regional employment, Indigenous participation, workforce inclusion and skills development. These outcomes are especially relevant to MMC because employment and training may occur at a factory distant from the construction site. Criteria framed only around site-based labour can therefore miss a material part of MMC's social contribution. Tender requirements should identify the geographic and beneficiary boundaries, distinguish new commitments from business-as-usual activity, and require reporting that can be attributed to the contract.

International frameworks demonstrate that social value can be given material weight alongside technical capability and price. The UK's Public Services (Social Value) Act 2012 established the legislative foundation, and Procurement Policy Note 06/20 introduced a minimum 10% social-value weighting for relevant central-government procurement. The Procurement Act 2023 subsequently replaced 'most economically advantageous tender' with 'most advantageous tender', clarifying that price need not take precedence over non-price factors (Cabinet Office 2020; UK Government 2025). The LHC NH3 framework allocated 15% to regional and social value (LHC 2022).

Australian instruments also demonstrate material non-price weighting. The South Australian Industry Participation Policy requires at least 15% weighting for procurements above $550,000 and 20% above $10 million, while the NSW Industry Policy sets a target of at least 50% local content for future rolling stock by 2035 (Office of the Industry Advocate 2023; NSW Government 2025). These are not MMC-specific requirements, but they show how measurable local-industry outcomes can influence evaluation. Social and Indigenous procurement instruments still require adaptation to factory-based employment, DfMA training and sustained regional manufacturing capability (NSW Treasury 2021). Detailed workforce mechanisms and indicators are addressed in Section 7.

6.1.3 Quality, Safety, and Technical Capability Criteria

Factory assessment is the clearest criterion that distinguishes MMC from conventional construction. It examines whether the proposed facility has sufficient capacity, accredited systems, production controls, traceability, inspection arrangements and evidence of reliable output. The LHC NH3 framework allocated 15% to factory assessment and required relevant ISO certifications (LHC 2022). Australian prequalification or supplier lists may identify product categories, but they do not substitute for a project-specific assessment of capacity, assurance and interfaces.

Technical capability should cover DfMA, BIM and product-data maturity; design freeze and change control; certification; logistics; lifting and installation; and responsibility across the factory-to-site interface. These are commonly overlooked when criteria are inherited from conventional construction (Assaf et al. 2023). WHS should also move beyond generic pass/fail compliance where evidence supports meaningful differentiation. Off-site production can reduce exposure to falls, weather and congested-site activities, but it introduces manufacturing, lifting, transport and repetitive-task risks that still require method-specific assessment (Ahn et al. 2020).

6.1.4 Delivery and Innovation Criteria

Delivery criteria should test both speed and certainty. A tenderer's proposed manufacturing rate is meaningful only when supported by facility capacity, supply-chain commitments, logistics planning, approvals and site-readiness assumptions. Suitable measures include milestone reliability, installation rate and schedule variance. Innovation criteria can assess digital interoperability, platform reuse, design for disassembly and continuous improvement, but should avoid rewarding novelty without a defined benefit. Performance-based questions, demonstrations and evidence from comparable production systems are generally more informative than broad innovation narratives.

6.2 International Frameworks: Operationalising Non-Price Criteria for MMC

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The United Kingdom provides the most developed examples identified in the review. The LHC MMC New Homes Framework NH3 is particularly useful because it makes the evaluation architecture visible: 20% price and 80% non-price, comprising technical capability (50%), factory assessment (15%) and regional/social value (15%) (LHC 2022). The Construction Playbook complements this project-level example through expectations for early market engagement, outcome-based specifications, benchmarking, whole-life value and MMC adoption (Cabinet Office 2022). Homes England's use of PMV illustrates a quantitative adoption threshold, although PMV's definitional limitations remain relevant.

These instruments should not be copied without adaptation. Their value lies in the design principles they illustrate: materially weighted criteria; MMC-specific capability assessment; minimum assurance requirements; comparable evidence; and measures that continue after contract award. Table 6.2 contrasts these examples with the more fragmented Australian position.

Table 6.2. Selected procurement frameworks relevant to MMC non-price evaluation

Framework	Evaluation approach	MMC relevance	Transferable lesson
LHC NH3, UK	20% price; 80% technical, factory and social value	Explicit factory assessment and MMC technical capability	Give distinctive MMC capabilities material weight and verify the proposed facility
Construction Playbook, UK	Whole-life value; outcome specifications; benchmarking; social value	Supports early engagement, standardisation and MMC adoption	Connect policy expectations to procurement processes, data and accountability
Homes England AHP, UK	PMV threshold and programme-level MMC expectations	Creates a measurable adoption signal across repeat housing	Use a consistent metric, but define it carefully and combine it with outcome measures
Decarbonising Infrastructure Delivery Policy, NSW	Mandatory upfront-carbon measurement at three project stages	Can evidence MMC's carbon performance where baselines and data are sound	Carry tender commitments into contract reporting and completion verification
Queensland Best Practice Principles under QPP 2023 (historical comparator)	WHS, industrial relations and workforce requirements for major projects	Relevant foundations but not MMC-calibrated; the setting changed under QPP 2026	Adapt general requirements to factory work, DfMA skills and off-site risk profiles
NSW SCM5862 MMC Procurement List	Registration by MMC category and capability	Improves market visibility but does not itself provide weighted performance scoring	Separate supplier registration from tender evaluation and contract assurance

Note: Weightings and requirements vary by procurement. The Queensland entry records the QPP 2023 setting as a historical comparator; current application should be checked against QPP 2026. The table identifies transferable design principles rather than prescribing a universal scoring model. Sources: LHC (2022), Cabinet Office (2022), Infrastructure NSW (2024), Queensland Government (2023) and NSW Government (2024).

6.3 Non-Price Criteria in Australian MMC Procurement: Status and Gaps

Australia has many relevant components-carbon measurement, social procurement, local participation, WHS, value-for-money guidance and emerging MMC supplier initiatives-but no integrated, operational and publicly documented MMC-specific evaluation model was identified. The NSW SCM5862 MMC Procurement List is a useful market-access mechanism, but registration does not replace project-specific weighted evaluation or post-award assurance. The principal gap is therefore not an absence of sustainability policy. It is the absence of a coherent translation from policy objectives into weighted tender criteria, evidence requirements, contractual measures and verification (NSW Government 2024).

A separate systematic review of off-site supply-chain uncertainty identifies inconsistent demand and project-based procurement among the conditions affecting resilience (Tennakoon et al. 2025). This complements the later procurement-strategy review (Tennakoon et al. 2026): the two studies are distinct and are retained under their final publication years rather than their earlier online or manuscript dates.

Table 6.3 summarises the status of the principal criteria. It retains the distinctions in the original review while avoiding repetition of the evidence already presented in Tables 6.1 and 6.2.

Table 6.3. Status and priority gaps in Australian MMC non-price procurement

Criterion	Current Australian position	Priority gap
PMV / extent of pre-manufacturing	No nationally accepted metric identified	Define calculation, scope, assurance and relationship to outcomes
Factory assessment	NSW SCM5862 MMC Procurement List provides supplier registration, not scored factory assessment	Score facility capacity, quality systems, traceability and delivery resilience
DfMA, BIM and interface capability	Recognised in guidance but inconsistently evaluated	Develop comparable evidence requirements and technical evaluation capability
Upfront carbon	Measurement framework established for relevant NSW infrastructure	Translate baselines and commitments into weighted award and contract measures
Waste, whole-life value and circularity	General sustainability/value-for-money provisions; Tweed Shire Council (2024) provides a local waste-criteria example	Create consistent MMC-relevant baselines and attributable performance measures
WHS and quality	Mature, generally method-neutral requirements; Queensland's QPP 2023 Best Practice Principles provide a historical example	Differentiate credible MMC advantages while assessing new factory/logistics risks
Delivery speed and certainty	Common policy rationale, rarely a transparent MMC score	Test capacity and assumptions; monitor milestone reliability and schedule outcomes
Social and local value	State and agency instruments exist	Recognise factory-based, regional, Indigenous and supply-chain outcomes
Workforce transition	General apprenticeship and participation requirements	Link procurement commitments to DfMA competencies, training completion and retention
Digital, innovation and circular design	Guidance and pilot activity rather than consistent scoring	Specify interoperable data, measurable benefits and reuse requirements

Note: 'Current position' summarises the instruments reviewed and does not imply uniform practice across Australian jurisdictions or agencies. The empirical stages should test feasibility, proportionality and supplier impacts.

Three priorities emerge. First, factory assessment is needed because production quality, capacity and traceability are determined substantially before components reach the site. Second, tender-stage commitments must be connected to post-award measures; otherwise, criteria may influence bid narratives without changing performance. Third, criteria should not unintentionally exclude capable SMEs through disproportionate certification, data or bidding requirements. Standardisation can reduce transaction costs, but thresholds and evidence burdens should remain proportionate to project risk and supplier maturity.

6.4 Supplier Data Readiness and Measurability

A recurring implementation constraint is the mismatch between the information clients seek and the data suppliers can reliably provide. Manufacturers may have strong production capability but limited

EPD coverage, inconsistent definitions of factory productivity or waste, and immature systems for reporting workforce and social outcomes. Clients may likewise lack benchmarks and evaluators able to compare different MMC systems. More criteria do not necessarily produce better decisions when evidence quality and assessment capability are weak.

A workable criterion should specify: the outcome and unit of measure; baseline and boundary; tender evidence; minimum requirement or scoring scale; weighting; data source and assurance; reporting frequency; ownership of verification; and consequences for performance. Where evidence is immature, a staged approach may combine minimum entry requirements with scored improvement commitments and contractually agreed reporting. Demonstrations, factory visits and structured clarification can supplement documents where permitted by the procurement process.

Criteria design and market development should proceed together. Common definitions, templates and digital data structures can reduce bidding costs and improve comparability. Supplier engagement can test whether proposed measures are available and proportionate before tender release. Capability-building support may be warranted where a desirable outcome-such as EPD adoption or DfMA training-cannot reasonably be demanded immediately across the market. However, transition arrangements should remain time-bound so that capability expectations progressively strengthen (Q Shelter & Building 4.0 CRC 2025; Standards Australia 2025).

6.5 Summary and Research Gaps

The evidence supports five categories of MMC-relevant non-price value: environmental; social; quality and safety; delivery; and innovation and technology. Within these categories, factory assessment, DfMA and interface capability, PMV or an equivalent adoption measure, upfront carbon, schedule certainty, workforce development and digital interoperability are especially distinctive. The UK provides operational examples, but Australia has not yet integrated its existing policy components into a transparent MMC-specific evaluation and monitoring model.

For Research Question 2, the central gap concerns operationalisation: which criteria should be used for different asset types, how they should be evidenced and weighted, and how tender commitments should be verified after award. Further work should also test whether an Australian PMV-type measure is useful or whether direct outcome measures provide a better signal; how factory capability can be assessed without restricting competition; and how carbon, social and workforce outcomes can be attributed consistently to MMC.

The section also connects to Research Questions 1 and 3. Procurement strategy determines when criteria are applied and whether suppliers can influence the solution, while pipeline certainty and contract settings affect suppliers' willingness to invest in the systems needed to report and improve performance. Workforce criteria must be linked to measurable capability development rather than general participation commitments. The empirical research should therefore examine criteria, evidence, weighting, supplier readiness and post-award governance as one connected system.

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7 WORKFORCE TRANSITION AND CAPABILITY DEVELOPMENT

Modern Methods of Construction (MMC) shift a significant share of work from project-specific site production towards repeatable, digitally coordinated manufacturing and assembly. The transition changes-not simply reduces-the workforce required. It involves structural changes and creates demand for DfMA, production, quality, digital, logistics and systems-integration skills, while retaining the need for conventional construction knowledge at interfaces, installation and commissioning (Building 4.0 CRC 2026; Solin, Gutierrez-Bucheli and Maxwell 2025; Tennakoon et al. 2025).

In this review, workforce transition includes individual skills, redesigned roles, organisational routines, supply-chain capability and the institutional arrangements that support learning. Three distinct problems should be separated: labour shortages, meaning insufficient people; skills gaps, meaning a mismatch between existing and required competencies; and organisational capability gaps, meaning an inability to combine people, processes, technology and governance consistently (CITB 2019). Training alone will not resolve all three.

This section addresses Research Question 3 through three linked questions: which capabilities constrain MMC adoption; which development pathways can address them; and how procurement can create incentives and conditions for sustained investment. Sections 4-6 address pipeline certainty, procurement mechanisms and non-price criteria in detail. Here, those mechanisms are considered only in relation to workforce outcomes.

7.1 Skills gaps

MMC capability is socio-technical. Competence must extend across designers, engineers, manufacturing personnel, installers, supervisors, logistics providers, procurement professionals, client teams and educators. The principal gaps identified in the literature are summarised in Table 7.1 and discussed below. Their significance varies by MMC typology, asset, project stage and maturity of the supplier.

7.1.1 From traditional construction roles to MMC-oriented capabilities

Conventional roles are often organised around sequential site activities and established trade boundaries. MMC requires earlier cross-functional decisions, standard components, manufacturing tolerances, traceability, production planning and controlled assembly. Workers may need hybrid competencies spanning construction and manufacturing, while professional teams need sufficient practical exposure to understand how design decisions affect factory and site performance. Limited experience can produce technically compliant designs that are inefficient or unbuildable in the selected production system (Marinelli et al. 2022; Tennakoon et al. 2025).

7.1.2 Technical, manufacturing and DfMA skills

DfMA capability is needed to coordinate system selection, modular grids, tolerances, interfaces, transport constraints, assembly, maintainability and design freeze. Manufacturing roles additionally require production engineering, quality control, inspection, tooling and continuous improvement. Site teams require safe lifting, positioning, connection, weatherproofing and commissioning skills. These capabilities should be developed together because productivity and quality depend on the whole design-manufacture-assembly system, not an isolated task (Shen, Wong and Too 2024; Nesarnobari et al. 2024).

7.1.3 Digital, data and automation capabilities

MMC relies on reliable information moving from design models into procurement, manufacturing, logistics, installation and asset records. Required capabilities therefore extend beyond software operation to information standards, model coordination, product data, common data environments, automated production, data assurance and cyber-aware collaboration. Investment in technology

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without corresponding process redesign, leadership and supplier onboarding can digitise fragmentation rather than remove it (Feldmann 2022; Solin, Gutierrez-Bucheli and Maxwell 2025).

7.1.4 Circular economy and sustainability capabilities

Circular and low-carbon MMC requires skills in material selection, whole-life carbon, environmental data, waste prevention, reversible connections, component recovery and design for disassembly. Factory workers and site teams also need practices that protect components and enable reuse. These requirements are emerging rather than uniformly established, and they should be aligned with measurable procurement outcomes rather than treated as generic sustainability awareness (Infrastructure Australia 2025; Jia and Luk 2026).

7.1.5 Supply-chain, logistics, procurement and commercial capabilities

Off-site manufacture makes production slots, transport, storage, lifting, site readiness and sequence interdependent. Logistics capability becomes a core delivery competence. Clients and commercial teams need complementary skills in outcome specifications, early market engagement, factory assessment, lifecycle value, title and vesting, off-site payment, interface risk and supplier-data evaluation. Weak client capability can prevent technically capable suppliers from being engaged or assessed appropriately (Nesarnobari et al. 2024; Saad 2023).

7.1.6 Managerial, collaborative and change capabilities

MMC adoption changes authority, workflows and organisational identity. Leaders must manage cross-functional decisions, standardisation, design freeze, learning across projects and tensions between project customisation and production efficiency. Collaborative planning, lean production, problem solving and change management are therefore workforce capabilities rather than optional cultural attributes (Li et al. 2024; Marinelli et al. 2022).

Table 7.1. Skills and capability gaps associated with MMC adoption

Capability area	Principal gap	Why it matters	Development priority
Technical and DfMA	Limited manufacturing, tolerance, quality and assembly experience	Constrains design optimisation and reliable production	Integrated design-factory-site learning
Digital and automation	Fragmented BIM, data, automation and interoperability capability	Breaks information continuity across production stages	Organisation-wide workflows, not software training alone
Circularity and sustainability	Limited carbon, material, disassembly and recovery skills	Weakens measurable whole-life and resource outcomes	Link technical training to project measures
Supply chain and logistics	Insufficient production, transport, lifting and sequence coordination	Creates delay, damage and interface risk	Joint planning across manufacturer, logistics and site teams
Procurement and commercial	Limited capability in factory assessment, value, payment and risk	Can discourage investment or select unsuitable solutions	MMC-specific client and commercial training
Managerial and collaborative	Weak integration, lean planning, change leadership and learning	Prevents repeatability and improvement across projects	Leadership and organisational capability building

Note: Compiled by the research team from Marinelli et al. (2022), Li et al. (2024), Nesarnobari et al. (2024), Solin, Gutierrez-Bucheli and Maxwell (2025), Tennakoon et al. (2025) and related sources.

7.2 Workforce development pathways

No single education pathway can cover the workforce transition. The literature identifies a portfolio of vocational, higher-education, short-course, workplace and supply-chain approaches. A global review

found uneven provision and relatively stronger institutional support in jurisdictions with established MMC policy; it also found that professional training is often more visible than pathways for trades and factory roles (Solin, Gutierrez-Bucheli and Maxwell 2025). Building 4.0 CRC (2026) further identified that limited organisations had invested in MMC-related training in Australia.

7.2.1 Vocational education, apprenticeships and entry pathways

VET, apprenticeships and traineeships provide practical routes into factory production, assembly, quality, logistics and digital work. Existing trade qualifications remain important, but delivery models should accommodate hybrid factory-site roles and exposure to the complete production cycle. Work-integrated learning, simulated production environments and placements with manufacturers can connect recognised competencies to real systems. Australia's Future of Housing Construction Centre of Excellence provides a relevant platform for developing such nationally transferable training (DEWR 2024c).

7.2.2 Higher education and professional development pathways

Engineering, architecture, construction management and procurement curricula need to integrate DfMA, industrialised production, digital coordination, logistics, sustainability and commercial interfaces. Continuing professional development is equally important because many current decision-makers completed their qualifications before MMC became a material policy and delivery issue. Multidisciplinary studios and factory-linked projects can reduce the separation between design education and production reality.

7.2.3 Certifications, short courses and micro-credentials

Short courses and micro-credentials can provide flexible, role-specific upskilling for existing workers and SMEs. Their value depends on recognised learning outcomes, assessment and connection to employer demand. The national online MMC course launched through Melbourne Polytechnic is a useful Australian example, but course participation alone is not evidence of workplace competence; assessment and application should be tracked (Melbourne Polytechnic 2026).

7.2.4 Organisational training and workplace learning

Firms also need workplace learning that integrates standard work, lean planning, quality, safety, digital processes and problem solving. Pilots can operate as structured learning environments where capability gaps are documented and addressed before scale-up. To avoid losing knowledge when teams disperse, organisations should capture lessons in product rules, training materials, data standards and communities of practice rather than relying only on individual experience (Li et al. 2024).

7.2.5 Supply-chain capability building and digital upskilling

Capability must extend beyond the lead contractor or manufacturer. Supplier-development programs can combine maturity assessment, digital onboarding, technical assistance, shared standards and improvement plans. SMEs may need proportionate requirements, staged compliance and access to common training because time, cost and administrative burden can otherwise exclude them. Support should build capability without shielding persistent underperformance.

Table 7.2. Workforce development pathways for MMC capability building

Pathway	Primary participants	Best suited to	Limitation to manage
VET, apprenticeships and traineeships	Entrants, trades, factory workers and installers	Practical production, assembly, quality and safety	Qualifications may not yet reflect hybrid factory-site roles
Higher education and CPD	Designers, engineers, managers, clients and procurement staff	DfMA, digital integration, lifecycle value and leadership	Curricula may remain discipline-based and theoretical

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Pathway	Primary participants	Best suited to	Limitation to manage
Short courses and micro-credentials	Existing workers, professionals and SMEs	Targeted or rapidly emerging capabilities	Participation may not demonstrate assessed workplace competence
Organisational/work place learning	Employees and project teams	Process change, lean production and applied learning	Knowledge may remain project- or firm-specific
Supply-chain capability building	Suppliers, subcontractors, manufacturers and logistics providers	Shared standards, digital onboarding and coordinated improvement	Requires investment by clients and lead organisations

Note: Pathways should be combined and aligned with occupational roles, recognised competencies, employer demand and repeated opportunities to apply learning.

7.3 Procurement as a workforce development lever

Education supply is necessary but insufficient when firms lack confidence that trained workers and new systems will be used. Procurement influences the business case for capability investment through demand visibility, evaluation criteria, engagement timing, contract duration, payment, risk and post-award accountability (Tennakoon et al. 2026). It is therefore both a capability that the MMC workforce needs to develop and a mechanism through which broader workforce capability can be developed (Building 4.0 CRC 2026).

7.3.1 From lowest price to value-based and social procurement

Value-based tendering can reward credible investment in MMC skills, apprenticeships, inclusion, decent work and supplier development (Mella 2023). Criteria should assess the quality, relevance and deliverability of a workforce plan rather than count promises. Section 6 distinguishes tender evidence from post-award measures. Workforce commitments should similarly identify baselines, target groups, competencies, timing, verification and consequences for non-delivery. Australia's Skills Guarantee and National Skills Agreement provide broader policy settings that procurement can connect to project delivery (DEWR 2024a, 2024b).

7.3.2 Demand aggregation, pipeline certainty and investment confidence

Repeat demand allows employers to recruit permanent workers, establish apprenticeships and justify training, digital systems and supervisory capability. A visible pipeline alone is insufficient if projects are incompatible, unsequenced or not credibly funded. Framework and portfolio procurement can strengthen the signal where work allocation is transparent and learning can transfer between projects (HM Government 2022; RICS 2018). Section 4 examines these market conditions in detail.

7.3.3 Early market engagement and collaborative procurement

Early involvement of manufacturers, installers and logistics specialists allows practical knowledge to inform design and creates opportunities for knowledge transfer to client and consultant teams. Two-stage procurement, ECI and collaborative delivery can support this process, but engagement should have defined decisions, outputs and safeguards for competition. Consultation that occurs after system-critical design decisions provides little capability benefit (Nesarnobari et al. 2024; Saad 2023).

7.3.4 Workforce requirements and social value clauses

Tender and contract documents may require workforce plans, apprenticeships, training hours, recognised competency outcomes, local or regional employment and participation by underrepresented groups. For MMC, measurement boundaries must recognise that benefits may arise at a factory remote from the site. Indicators should distinguish inputs, such as training hours, from outcomes, such as competency attainment, retention, progression and increased supplier capacity.

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7.3.5 Supplier capability development, risk allocation and payment arrangements

Clients can assess supplier maturity, agree improvement plans and support technical or digital development rather than selecting only firms that already possess every capability. Contract settings must reinforce this objective. Payment limited to site installation can create cash-flow pressure during factory production, while uncontrolled design change and poorly allocated interface risk can divert resources from training. Factory milestones, balanced risk and credible workload can improve investment confidence (Saad 2023).

7.3.6 Digital procurement, monitoring and continuous improvement

Digital systems can record commitments, evidence and outcomes, but technology does not itself create capability. Effective monitoring requires named owners, consistent definitions, proportionate assurance, review intervals and feedback into future procurement (HM Government 2022). Data should support improvement as well as compliance, including comparison of what training was delivered, what competence was gained and whether performance or capacity changed.

Table 7.3. Procurement mechanisms and workforce indicators

Procurement lever	Workforce mechanism	Indicative measures
Value-based evaluation	Rewards credible capability investment	Plan quality; assessed MMC competence; weighted workforce score
Pipeline and repeat programs	Supports sustained recruitment and training	Committed workload duration; permanent roles; apprentice commencements and retention
Early/collaborative engagement	Transfers production knowledge before design is fixed	Timing of manufacturer appointment; joint workshops; decisions influenced
Workforce and social clauses	Converts objectives into contractual commitments	Training hours and completions; competency attainment; inclusion and progression
Supplier development	Builds capability across firms and tiers	Maturity improvement; SMEs supported; improvement plans completed
Risk and payment settings	Protects capacity to invest during off-site production	Factory milestones; balanced risk; workforce investment maintained
Post-award monitoring	Verifies delivery and enables learning	Retention, productivity, quality and capacity outcomes; lessons reused

Note: Measures are illustrative. Projects should distinguish inputs, outputs and longer-term outcomes, establish baselines and avoid double counting across contracts or sites.

7.4 Summary and research gap

The literature demonstrates that MMC workforce transition spans technical, digital, sustainability, logistics, procurement and managerial capability. Multiple development pathways exist, but they are fragmented and are not consistently connected to recognised competencies, occupational roles or project demand. Procurement can strengthen this connection by recognising value, enabling early learning, creating demand continuity, supporting suppliers and verifying commitments.

Table 7.4 retains the original section's integrated mapping and restores a compact source trail for each row. Measurable outcomes are presented separately in Table 7.3 to avoid duplicating indicators in both tables. The mapping should be read as a set of hypotheses for empirical testing, not a prescriptive one-to-one allocation: most capability gaps require several pathways and procurement mechanisms acting together.

Table 7.4. Integrated mapping of capability gaps, development pathways and procurement levers

Capability gap	Priority pathways	Relevant procurement levers	Key sources
Practical MMC experience	Work-based learning, VET, placements and pilots	Early involvement, pilots and repeat pipelines	Marinelli et al. 2022; Solin et al. 2025; Tennakoon et al. 2025

Capability gap	Priority pathways	Relevant procurement levers	Key sources
DfMA and manufacturing	Factory training, cross-disciplinary education and certification	Manufacturer involvement, two-stage tendering and capability criteria	Shen et al. 2024; Solin et al. 2025; Nesarnobari et al. 2024; Building 4.0 CRC 2026
Digital and automation	BIM/data training, digital onboarding and organisational transformation	Information requirements, maturity assessment and shared platforms	Feldmann 2022; Solin et al. 2025
Circularity and sustainability	Carbon, materials, disassembly and recovery training	Lifecycle criteria, reporting and performance clauses	Infrastructure Australia 2025; Jia and Luk 2026; Mella 2023
Supply chain and logistics	Production/logistics planning and cross-functional learning	Pipeline coordination, early engagement and collaborative delivery	Nesarnobari et al. 2024; Tennakoon et al. 2025, 2026
Client and procurement capability	Commercial, factory-assessment and contract-management development	Value-based criteria, market engagement and post-award governance	HM Government 2022; RICS 2018; Saad 2023; Building 4.0 CRC 2026
Managerial and collaborative	Lean planning, leadership, coaching and communities of practice	Integrated governance and incentives for learning	Li et al. 2024; Marinelli et al. 2022
Industry transition capacity	Centres of excellence, educator development and SME support	Long-term frameworks, fair payment and supplier development	DEWR 2024a-c; Melbourne Polytechnic 2026; Solin et al. 2025

Note: Developed by the research team from the cited sources. The source column identifies principal support rather than an exhaustive bibliography. The empirical research should test relevance by MMC typology, occupation, project stage, organisation size and supply-chain tier.

For Research Question 3, the central evidence gap is not whether skills matter, but which procurement mechanisms generate measurable and durable workforce outcomes in Australia. Limited evidence shows how requirements translate into competency, retention, productivity, career progression or supplier capacity, particularly for SMEs and factory-based roles. Research should also examine possible adverse effects, including disproportionate compliance costs, displacement of smaller suppliers and training activity that is counted but not applied.

The empirical stages should therefore test: priority capabilities by MMC typology and role; responsibility for funding and delivery; the credibility of pipeline and contract signals; suitable tender and post-award indicators; and how benefits are attributed over multiple projects. This will connect workforce pathways to practical procurement design without implying that procurement alone can resolve structural labour and education-system constraints.

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8 CONCLUSION

This literature review confirms that MMC has considerable potential to improve the productivity, speed, quality, safety and sustainability of housing, building and infrastructure delivery. However, its adoption in Australia remains uneven and largely project-based. Key constraints include fragmented demand, inconsistent regulatory and procurement settings, limited manufacturing scale, uncertain risk allocation, inadequate recognition of non-price benefits and shortages in the digital, manufacturing and commercial capabilities required for industrialised delivery.

The review also demonstrates that procurement is a critical mechanism for addressing these barriers. More coordinated demand pipelines, early market engagement, collaborative delivery models, appropriate payment and risk arrangements, measurable non-price criteria and procurement-linked workforce requirements can provide stronger incentives for suppliers to invest in MMC capability. These findings reinforce the focus of SBEnrc Project 2.11.5 on procurement-led enablers, non-price valuation and workforce transition.

The next stages of the research will test and refine the findings in practical settings and translate them into procurement strategies, evaluation criteria, measurable indicators and action plans that support the scalable and sustainable adoption of MMC in Australia.

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