Taighde, Idirphlé, Comhairle
Research, Dialogue, Advice

Boosting Ireland's Housing Supply:
Modern Methods of Construction

COUNCIL REPORT

No.166 September 2024

An Chomhairle Náisiúnta Eacnamaíoch agus Shóisialta
National Economic & Social Council

An Oifig Náisiúnta um Fhorbairt Eacnamaíoch agus Shóisialta
National Economic & Social Development Office NESDO

1. The main tasks of the National Economic and Social Council shall be to analyse and report on strategic issues relating to the efficient development of the economy and the achievement of social justice.

2. The Council may consider such matters either on its own initiative or at the request of the Government.

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4. The membership of the Council shall comprise a Chairperson appointed by the Government in consultation with the interests represented on the Council, and

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   - Three persons nominated by the Irish Congress of Trade Unions;
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8. The Council shall regulate its own procedure.

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Acknowledgements

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Abbreviations

ADP	Accelerated Delivery Programme
AHBs	Approved Housing Bodies
BIM	Building Information Modelling
BTP	Beneficiaries of Temporary Protection
CAR	Contractors All Risk
CSG	Construction Sector Group
DCC	Dublin City Council
DETE	Department of Enterprise, Trade and Employment
DfMA	Design for Manufacturing and Assembly
DfR	Design for Reuse
DHLGH	Department of Housing, Local Government and Heritage
D-KOP	Design kit of parts
DPENDR	Department of Public Expenditure, NDP Delivery and Reform
ESG	environmental, social, and governance
EU	European Union
HFA	Housing for All
ICF	Insulating Concrete Formwork
ICNF	Infrastructure, Climate and Nature Fund
IDA	Industrial Development Authority
LDA	Land Development Agency
MMC	modern methods of construction
NESC	National Economic and Social Council
NSAI	National Standards Authority of Ireland
PMV	pre-manufactured value
OSM	offsite manufacturing
SMEs	small and medium enterprises
TGD	Technical Guidance Documents
R&D	research and development
UK	United Kingdom
VBC	Volumetric Building Companies

MMC Roadmap
Roadmap for Increased Adoption of Modern Methods of Construction in Public Housing Delivery

Executive Summary

Introduction

The need to boost housing supply has led Irish policy-makers, the construction sector and housing market interests to become increasingly focused on modern methods of construction (MMC). As an umbrella term, 'MMC' refers to technological advances, new product developments and building systems being delivered through increased digitalisation and emerging technologies. Materials and systems used in buildings must comply with the Building regulations and be fit for their intended use and conditions in which they are to be used. The distinct characteristic of MMC is the offsite manufacture (OSM) of buildings and their components in a factory setting and their follow-on transportation, onsite assembly and fabrication.

This report investigates the potential of MMC to significantly boost housing supply. It highlights progress under the MMC roadmap, an important and ambitious State policy designed to achieve greater adoption of MMC, which is of a high quality and complies with Building Regulations, in public housing delivery and in the housing system more widely.

Drawing on primary research, investigation and dialogue among key stakeholders, the report examines the benefits and challenges associated with MMC. It finds that greater adoption of MMC for residential development can be a 'game changer' for the Irish housing system, as it can drive higher productivity gains, substantially increase housing supply, and help meet the environmental goal of decarbonising housing – both new and existing stock.

Three Development Opportunities

The report identifies three potential development opportunities that can deliver positive transformation and result in a more productive, cost-effective and environmentally sustainable construction sector in Ireland:

- Expand the use of MMC by established Irish homebuilders to capture its productivity and environmental benefits, especially for timber-based MMC.
- Increase inward investment by international MMC companies.
- Grow Irish MMC businesses to supply both domestic and export markets.

Five Key Challenges

The report identifies five key challenges to the development of MMC for housing in Ireland.

- **Insurance**: There is a need to work closely with underwriters and experts in relation to emerging and new technologies so that risks are understood, particularly in relation to fire safety and insulation.
- **Timber-based MMC**: Challenges relate primarily to fire safety, variation between regulatory authorities, and material strength standards for the use of timber in residential construction.
- **Housing typologies and procurement**: Issues that need to be addressed include better specified and designated standard housing typologies; the relationship between contractors and the offsite product manufacturers over critical issues of forward funding, risk and exposure; intellectual property; and the time and costs associated with National Standards Authority of Ireland (NSAI) certification.

- **Investment**: The finance model requires substantial upfront investment.

- **Perception and understanding**: MMC and its benefits are not fully understood and negative perceptions exist among consumers, developers, funders and insurers.

Six Lines of Action

The National Economic and Social Council identifies six lines of action to encourage greater adoption and use of MMC in housing among producers and to promote acceptance among users.

- **Institutional leadership:** Working through more resourced existing structures, develop new MMC initiatives to address impediments to greater adoption in housing supply and renovation; reinforce and strengthen increased supply pipelines of sufficient scale, particularly social and affordable housing; and enable greater State and market collaboration on critical development issues such as standards, housing typology, finance, transport and logistics, and skills and education.

- **Standards and innovation:** Use the Government's Capital Works Management Framework and procurement process to shape greater housing market adoption of MMC; and research the potential role of a collaborative approach between industry and research bodies for testing and performance requirements for innovative systems.

- **Targets:** Increase the targets and funding for new public housing using MMC under an expanded Social Housing Accelerated Delivery Programme (ADP);[1] set more binding targets around reduced carbon footprints; and assess the investment and development of the human resources required to meet revised targets among public housing delivery partners.

- **Innovative finance**: Consider the creation of a dedicated forward-funding arrangement for MMC in housing to lever increased investment in offsite manufacturing (OSM); guide environmental, social, and governance (ESG) investment towards MMC in housing using fiscal instruments and mechanisms; and expand the role of Ireland's credit union sector to deliver a dedicated aggregator structure to pool financing from Approved Housing Bodies (AHBs) for new MMC housing developments.

- **New employment opportunities**: Provide additional supports and incentives to facilitate further upskilling for MMC roles; increase co-ordination and additional resourcing of organisations' training programmes; and develop and fund more dedicated apprenticeship and internship options for MMC in housing.

- **Positive promotion**: Showcase examples of quality MMC housing typologies, particularly mid- and high-rise apartments with efficient circulation including deck-access; deliver new promotional materials to challenge stigmas attributed to prefabrication; make clear that temporary use does not mean poor quality; and, request study and report by Dublin City Council on recent 'volumetric' housing schemes in Dublin 8 and 20, where the reception to them is considered to be positive.

[1] Housing for All Priority Action 4.3

Chapter 1

Introduction

> *Recognising that the conditions for systemic transformation are in place, possible futures for modern housing must now be made desirable, viable and highly probable – for the common good. For when we are making housing, we are making the future.*
>
> *Hill & Mazzucato (2024)*

The provision of high-quality affordable housing and the creation of sustainable communities is a basic human need that the National Economic and Social Council (NESC) has championed and sought to support through its work on housing. This focus must be an integral part of how we decarbonise and reduce our impact on nature and biodiversity, while meeting the needs of Irish society for additional housing, over the coming decades.

This report focuses on the role of modern methods of construction (MMC) in stepping up efforts to boost the supply of quality affordable homes and in responding to the need for urgent and ambitious action on climate and biodiversity.

Significant numbers of new homes are currently being built in Ireland. The Government's Housing for All target of 29,000 units was exceeded in 2023, with 32,695 units completed, while over 41,000 dwellings were approved for planning in 2023. There is evidence that substantially more homes need to be built each year. Analysis from the Economic and Social Research Institute (Bergin & Egan, 2024) presents a range of scenarios for future structural (demographic) housing demand. It considers a range of population projections based on mortality, fertility and various international migration assumptions. Taking an average across all scenarios examined, the analysis finds that structural housing demand is projected to be around 44,000 units per year from 2023 to 2030, and around 40,000 units per year over the 2030–2040 period. This forecasted structural housing demand is in addition to estimates of what is often referred to as 'pent-up' demand i.e. ineffective and unmet housing demand. The Housing Commission (2024) estimates that eliminating pent-up demand for housing by 2034 would require increasing annual completions by an average of 50 per cent.

The need for a significant increase in where and how we build homes is also highlighted in the National Planning Framework, which includes commitments to more compact growth, more sustainable patterns of development, and greater mobility (Government of Ireland, 2018). Government approved the draft First Revision to the National Planning Framework for public consultation in mid-July 2024. Following conclusion of the consultation period in September 2024, newly revised national planning objectives for compact growth and sustainable development will be accompanied by the adoption of new targets in relation to housing supply under Ireland's national housing policy, as laid out in Housing for All - a New Housing Plan for Ireland (Government of Ireland, 2021b).[2]

The residential construction sector is responsible for approximately 10 per cent of Ireland's greenhouse gas emissions and is required to reduce emissions by 40 per cent from 2018 levels by 2030 (EPA, 2023). Ireland's Climate Action and Low Carbon Development (Amendment) Act (Government of Ireland, 2021a) includes the ambition of achieving net zero carbon by 2050 and a 50 per cent reduction in carbon emissions by 2030.

In light of the clear need for increasing the scale of housing provision, as well as the need to avoid compromising on the quality of living space, placemaking (the participatory planning and design process of creating areas that are attractive, safe, inclusive and well-connected) and environmental impact, NESC carried out a forensic examination of the potential role of MMC in housing.

[2] Public consultation on the draft and associated environmental reports is open until 12 September 2024.

1.1 Structure of the Report

The report is structured as follows:

- Chapter 2: MMC: An Overview
  Defines and gives examples of MMC, notes benefits of MMC and wider forces influencing its development and includes a focus on recent experience in the UK.

- Chapter 3: Current Policy and Support for MMC
  Reviews the Irish MMC roadmap and supporting structures, notes public housing outputs with MMC, the role of timber in MMC and the National Demonstration Park for MMC.

- Chapter 4: Three Developmental Opportunities and Five Challenges
  Reviews development opportunities for MMC in traditional construction, international inward investment and entreprenurial growth for domestic and international markets, and details five challenges to the continued development of MMC for housing in Ireland, namely: insurance; timber-based MMC; standard housing typology and procurement; investment, and perceptions and understanding of MMC.

- Chapter 5: Conclusions and Recommendations–Six Lines of Action.
  Concludes on role of MMC for housing in Ireland as a significant driver of increased supply of quality homes; decarbonised new housing supply and new employment opportunities and identifies six lines of action to help further the expansion of MMC in Irish housing, namely: institutional leadership, standards and innovation, targets, innovative finance, new employment opportunities and positive promotion.

Box 1.1 provides an overview of the methodology used in the preparation of this report.

Box 1.1: Overview of Primary Research

Primary research was undertaken in the form of semi-structured interviews (n = 22) conducted in Q4 2023 and Q1 2024 with chief executive officers and senior managers from the construction industry, across the design, manufacturing, contracting and other sectors involved in the production and use of MMC in housing.

The following formal policy roundtables and engagements in Ireland were also consulted:

- Department of Enterprise, Trade and Employment (DETE);
- Department of Housing, Local Government and Heritage (DHLGH);
- MMC Ireland;
- Construction Industry Federation;
- Local Government Management Agency;
- Enterprise Ireland;
- National Standards Authority of Ireland (NSAI);
- Ireland Strategic Investment Fund;
- Fairway Advisers;
- Credit Union Approved Housing Body Fund;
- Irish Institutional Property;
- SOLAS;
- Laois and Offaly Education and Training Board;
- Coillte;
- Housing Alliance; and
- Irish Green Building Council.

International engagement in the United Kingdom (UK):

- UK Collaborative Centre for Housing Evidence at Glasgow University;
- HLM Architects; and
- Akerlof Consultancy Ltd.

International engagement in Austria:

- Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology; and
- winnovation consulting gmbh.

Chapter 2

MMC: An Overview

2.1 Introduction

This chapter defines modern methods of construction (MMC) and the various types of activity they include. It outlines the potential benefits of adopting MMC in housing, the wider forces shaping MMC development, and the key challenges facing the sector.

Finally, the chapter summarises the recent experience with MMC in the United Kingdom (UK), which is often seen as a cautionary tale for governments seeking to support the expansion of the sector.

2.2 Defining MMC

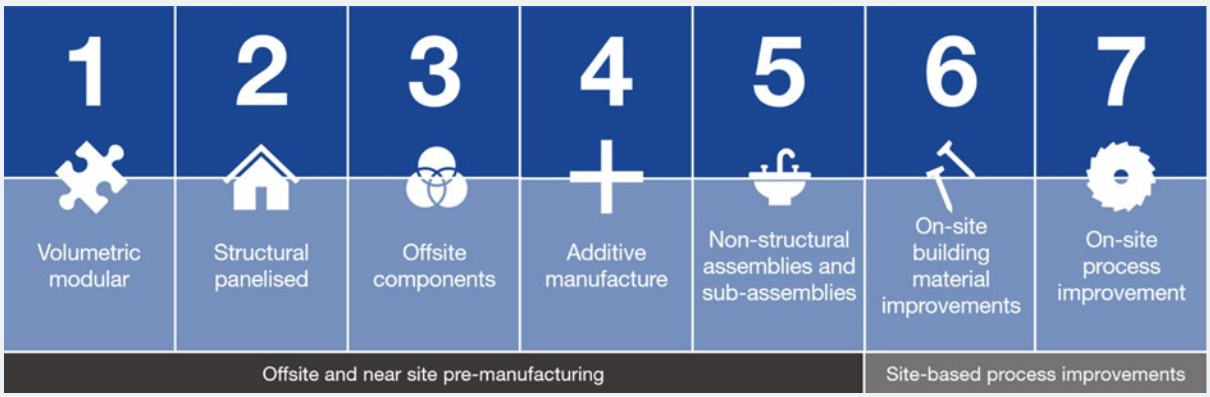
'MMC' is an umbrella term that refers to technological advances, new product developments and building systems delivered via increased digitalisation, and innovative emerging technologies in the construction sector.

The distinct characteristic of MMC is the offsite manufacture (OSM) of buildings and their components in a factory setting and their follow-on transportation, assembly and installation onsite. MMC manufacturing and assembly encompasses well-established commercial, industrial, office, healthcare and educational building uses, as well as new residential development and retrofitting.

The MMC definition framework adopted by the UK Government in 2019, and by Ireland in 2023 is useful in helping to clarify the various types of MMC (Farmer, 2019; DHLGH, 2023c). This has since become more widely adopted by the construction industry and policy decision-makers and provides a standard for industry categorisation. The framework identifies the following seven MMC categories, also illustrated in Figure 2.1:

- **Category 1:** Pre-manufacturing. 3D primary structural systems, i.e. volumetric homes.
- **Category 2:** Pre-manufacturing. 2D primary structural systems, i.e. wall panels.
- **Category 3:** Pre-manufacturing. Non-systemised structural components, i.e. timber roof structures, floor slabs and staircases.
- **Category 4:** Pre-manufacturing. Additive manufacturing and/or 3D printing.
- **Category 5:** Pre-manufacturing. Non-structural assemblies and sub-assemblies, i.e. volumetric podded assemblies such as whole bathrooms or kitchens.
- **Category 6:** Traditional building product-led site labour reduction and productivity improvements.
- **Category 7:** Process-led site productivity improvements i.e. the use of drones, workforce robotics and lean construction techniques.

Figure 2.1: Offsite and Near-Site Pre-Manufacturing and Site-Based Building Processes

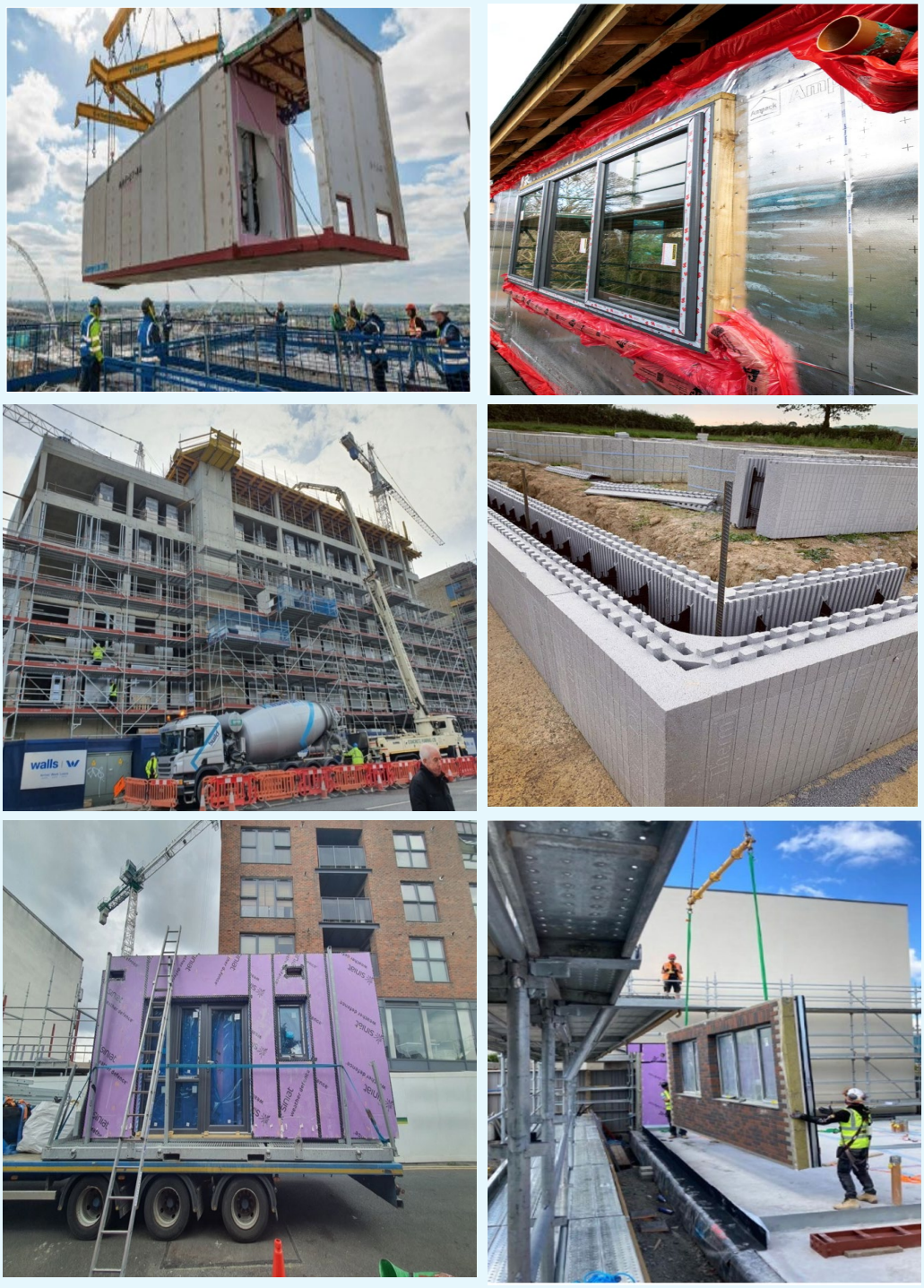


Source: Hilier, 2020.

Figure 2.2 illustrates building examples using offsite and near-site pre-manufacturing.

- **Top left:** MMC Category 1. 3D volumetric housing being assembled onsite in Wembley, London.
- **Top right:** MMC Category 2. Timber Frame Closed Panellised system with a rendered block outer leaf being built onsite. The foil-faced breather membrane is factory-fitted to the timber frame and red cavity barriers are being installed at all required locations and junctions.
- **Middle left:** MMC Category 5. Bathroom, kitchen and utility pods being installed onsite in Grand Canal Place, Dublin 8.
- **Middle right**: MMC Category 6. Insulated concrete formwork walls. The external wall of an Irish house under construction onsite using insulated concrete formwork. The builders will fill the gap between the two layers of insulation with reinforced concrete.
- **Bottom left and right**: MMC Category 2. Light Gauge Steel Frame Closed Panellised system. This category uses flat panel units such as panelised walls, which can be made from a range of materials. In this example in Pim Street, Dublin 8, the windows, insulation and cladding of the wall panels were installed in the factory and the panels were assembled onsite.

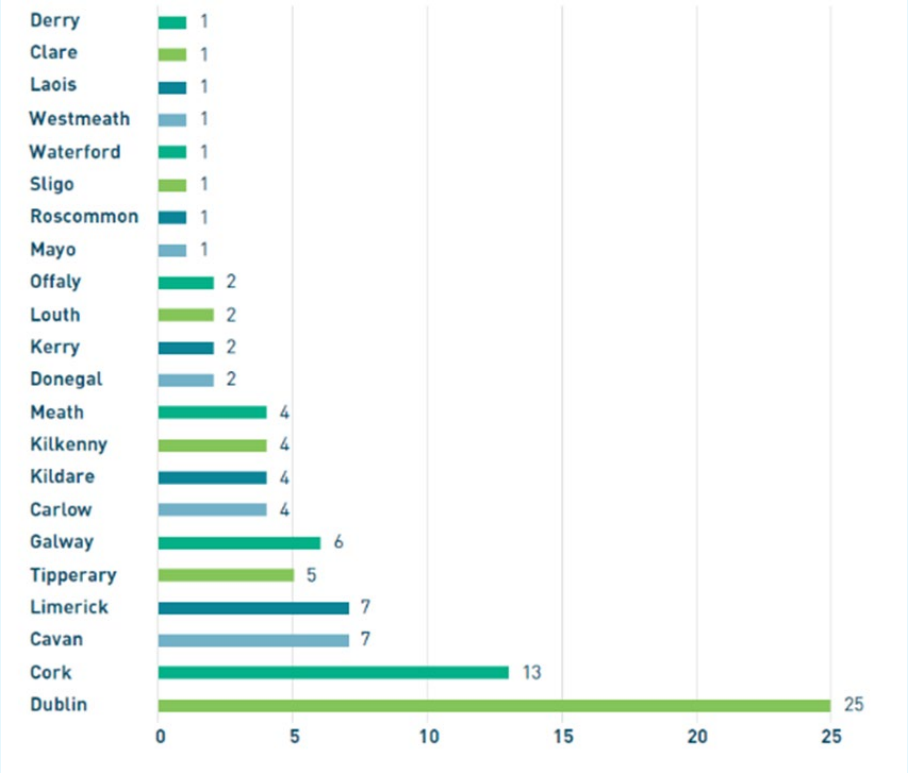
Figure 2.2: Building Examples of Offsite and Near-Site Manufacturing



In 2022, there were approximately 100 OSM companies with facilities in Ireland that were manufacturing and supplying clients, domestically and to a mainly European international customer base (CPS, 2022). These include various MMC category 2D, 3D, sub-assemblies and bespoke volumetric solutions. A substantial focus of MMC capacity from Irish OSM is on non-residential construction, with just 27 of these 100 OSM companies providing complete MMC housing solutions to the Irish construction sector (see Figures 2.3 and 2.4).

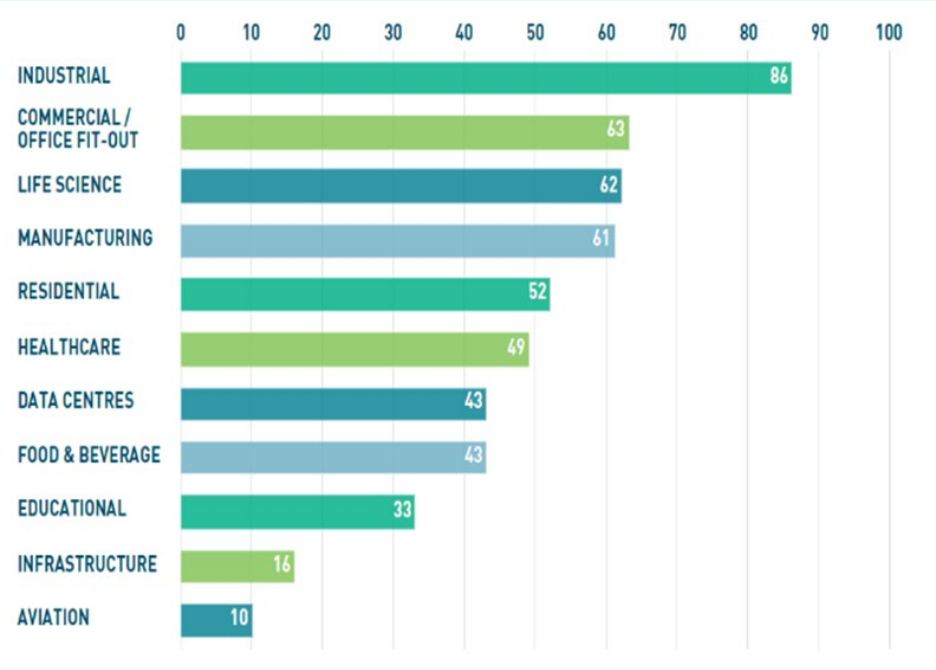
Enquiries for certification for MMC in housing from offsite manufacturers have increased, with the number almost doubling in 2024 compared with 2023, as well as an increased capacity within the MMC sector overall (NSAI, 2024). The National Standards Authority of Ireland (NSAI) also reports an increase in the number of certified clients operating within the residential sector using MMC Categories 1, 2, 3 and 4, and those that allow for maximum building heights of 10, 20, 6 and 3 storeys, respectively (NSAI, 2024).

Figure 2.3: Geographic Distribution of Irish OSM Suppliers of MMC, 2022



Source: CPS, 2022.

Figure 2.4: Distribution of Irish OSM Suppliers of MMC, by Sector, 2022



Source: CPS, 2022.

2.3 Benefits of MMC

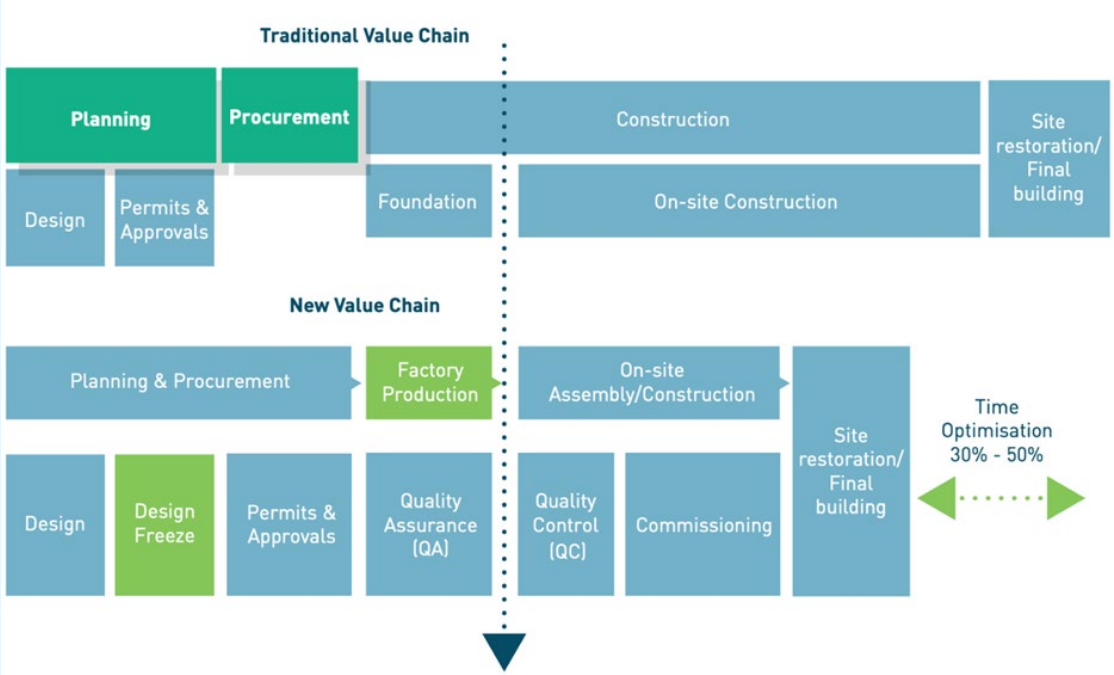
MMC in housing is driven by innovation in construction processes for the manufacturing and assembly of homes, resulting in improvements in costs, carbon use and technical quality.

The scope to reduce costs for housing is linked to improvements in the speed of construction; reductions in handover time; increases in productivity; improvements in building quality; greater certainty on projects; reductions in waste; enhanced sustainability; and reduced environmental impacts (Blismas & Wakefield, 2009; Reddy, 2020; Shibani *et al.*, 2021; Zhang *et al.*, 2018). In Ireland, research conducted by EY in 2021 under Project Ireland 2040 and the work of the Construction Sector Group's (CSG) Innovation and Digital Adoption Sub-Group, and carried out for Enterprise Ireland, found that an MMC approach to building has the potential to reduce construction costs by 20 to 40 per cent, advance improvements in quality and energy efficiency, and increase the speed of delivery of new homes. These innovations could achieve a 20–60 per cent reduction in construction programme time. Other studies suggest that MMC has the potential to address deficiencies in the design value of new housing (White *et al.*, 2020), as well as contributing to an increased output of social housing (Welsh Government, 2020).

These studies illustrate the potential benefits of MMC in housing. Nonetheless, interviewees noted that, for the most part as a direct result of the current levels of adoption of MMC in use for housing supply in Ireland and the consequential constraints in investment for MMC adoption at scale, the scope of available cost reductions for residential development in Ireland is not fully evident. However, with development for sectors where MMC is more established in Ireland (e.g. pharmaceutical manufacturing; life sciences; data centres; education, including new schools, school extensions and rebuilds; and health, including hospitals and laboratories), construction cost reductions and efficiencies are being realised. In these sectors, interviewees confirmed that reduced construction costs, more efficient project scheduling, more predictable building times and costs, reduced building maintenance costs, and increased sustainability are all established as short- to medium-term value chain benefits of MMC adoption. Figure 2.5 illustrates how MMC can

deliver tangible improvement over traditional processes, particularly the significant time optimisation difference of between 30 and 50 per cent.

Figure 2.5: Comparison of MMC New Value Chain and Traditional Construction Value Chains



Source: CPS, 2022.

Several studies also suggest that volumetric, factory-based construction processes can halve their carbon emissions (Kechidi & Bank, 2023). The successful deployment of cost-effective, emission-reduction strategies in MMC often requires wider use of timber.

MMC also offers a way to generate renewed interest in employment in construction, particularly under the megatrends of digitalisation and decarbonisation that expand the skills and competencies required. While the most recent Central Statistics Office Ireland labour force data shows an increase in construction employment of almost 9,000 over the year to Q1 2024, there remains the ongoing challenge of attracting and maintaining a construction workforce capable of meeting sectoral requirements. The issue is generally understood to reflect the relatively high average age of construction workers in Ireland, resulting levels of retirement, and a deficit in new younger recruits to the sector. Post-COVID-19 adjustments impacted activity and productivity levels, with some younger construction workers seeking a better work–life balance in other sectors. These challenges have exacerbated disruption in onsite construction, particularly for traditional construction methods. Increased cost of living from increased energy and transport costs have also affected onsite productivity.

The decline in new recruits to the sector is occurring at a time when demand for labour is growing. Findings from research led by the Technological University of the Shannon indicate that Ireland's construction industry will require up to 120,000 additional skilled construction workers and the reskilling of 164,000 construction workers by 2030, in order to deliver on Ireland's housing and climate targets (Government of Ireland, 2022; EGFSN, 2024; IGBC, 2023).

Under an examination of the implications of the housing market for Ireland's competitiveness, the National Competitiveness and Productivity Council investigated labour capacity constraints on residential development. In

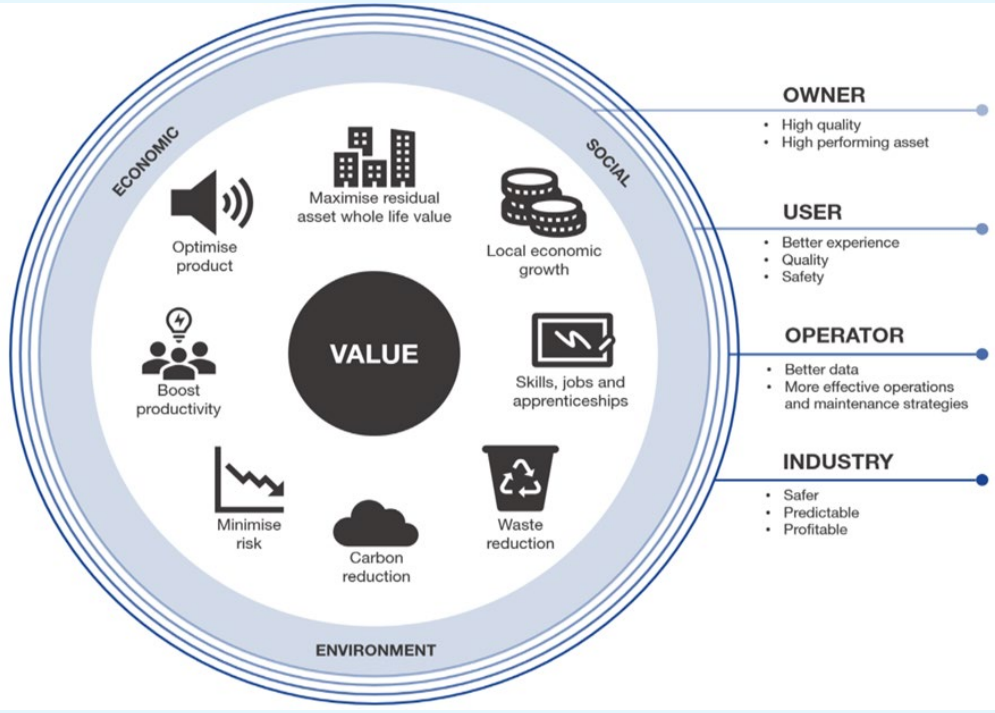
contrast to a noted reduction in graduate engineers, architects and town planners, it found an increase in construction and related apprenticeship numbers to more than 20,000 in 2023 (NCPC, 2024). This reflects positively on the successful initiatives of construction sector employers and the further education and training sector to encourage new entrants. To reduce labour market pressures impacting housing delivery, the National Competitiveness and Productivity Council also calls for the accelerated adoption of MMC in housing.

In addition, the National Investment Office of the Department of Public Expenditure, NDP Delivery and Reform, working with the CSG Innovation and Digital Adoption Sub-Group, publishes an annual construction-sector performance and capacity report. Its June 2024 report confirmed that construction output is forecast to grow by 4.4 per cent in 2024 and that Irish construction-sector labour productivity increased by 1.0 per cent in 2023 relative to 2022 (DPENDR, 2024). Nonetheless, overall construction-sector labour productivity is confirmed as having declined by 9.5 per cent from its peak in 2018. The report emphasises that collaboration between the public and private sector is required in order to increase the efficiency and productivity of the construction sector, and notes that 'further adoption of MMC in Ireland has the potential to greatly enhance productivity in the construction and built environment sector' (DPENDR, 2024: 30).

This is confirmed by the Expert Group on Future Skills Needs (EGFSN, 2024) that finds the adoption of MMC is crucial for the construction industry to accelerate the delivery of housing, alleviate labour shortages, and improve productivity. Encouraging new entrants into the construction sector and upskilling/retraining the current labour force is recommended to support transitioning to offsite construction. This should enable the 'visibility of broadened construction careers, offering increased access for the regional labour force and new pathways for female entrants' (EGFSN, 2024: 12).

In conclusion, MMC has the potential to deliver beneficial outcomes, and is doing so in many sectors. Figure 2.6 summarises the range of achievable and demonstrable benefits and advantages of MMC for housing in Ireland.

Figure 2.6: Economic, Social and Environmental Benefits of MMC in Housing



Source: Hilier, 2020.

2.4 Wider Forces Influencing the Development of MMC

Multiple factors affect whether a given real estate market is likely to embrace MMC in housing (Bertram *et al.*, 2019; McKinsey & Company, 2020). The two biggest determinants are real estate demand and the availability and relative costs of skilled construction labour. In regions such as the West Coast of the United States, the southern part of the UK, Australia's East Coast and Germany's major cities, labour shortages and large-scale unmet demand for housing is making the MMC model particularly relevant to new housing supply.

However, the MMC sector can also be affected by the wider, changing, geopolitical context. Events such as armed conflict in Europe and the Middle East, destabilised and displaced populations, an energy crisis, price inflation and a cost-of-living crisis continue to cause disruption and drive restructuring in global manufacturing supply chains across advanced economies.

Supranational strategies – for example, the European Commission's Green Deal Industrial Plan – have been established in response to changing geopolitics. These include decoupling and derisking initiatives that can favour the domestic reshoring of manufacturing based abroad (Yeung, 2023). This has led high-tech manufacturing firms and construction industry associations in advanced economies to engage with European Union (EU) economic decision-making in an effort to support the green transition and shape negotiations on the EU's network of Free Trade Agreements and other forms of co-operation with partners. For example, under the Green Deal Industrial Plan, the EU is exploring the creation of a Critical Raw Materials Club to bring together raw-material consumers and resource-rich countries to ensure global security of supply through a competitive and diversified industrial base.

New Clean Technology/Net-Zero Industrial Partnerships are considered to be of significant importance to the EU's parallel Renovation Wave Strategy for existing buildings (European Commission, 2021). Under this strategy, the European Commission aims to at least double building renovation rates by 2031 and ensure that renovations lead to higher energy and resource efficiency. The objective is to enhance the quality of life for people living in and using the buildings, reduce Europe's greenhouse gas emissions, foster digitalisation and improve the reuse and recycling of materials. The Commission estimates that, by 2030, 35 million buildings could be renovated and up to 160,000 additional green jobs in the construction sector could be created.

2.5 The UK: A Cautionary Tale?

Recent international experience highlights the challenges of scaling up investment to increase the adoption of MMC in housing supply. In particular, the UK case is seen as a cautionary tale and it is important to accurately describe that experience to ensure that the correct lessons are drawn.

Inconsistent levels of demand in the UK housing sector and a lack of collaborative construction supply chains in expanding MMC practices were identified as major obstacles. This led the UK Government to clarify standards for MMC homes and provide certainty of demand for the supply chain. The need to introduce a bigger social housing programme and substantially increase funding for MMC homes overall was also recognised (UK Ministry of Housing Communities and Local Government, 2019).

In turn, significant direct public investment was provided by the government agency Homes England to selected MMC businesses in order to boost MMC supply. To secure 'pipeline demand', the UK Affordable Homes Programme makes funding available to housing associations using MMC through two routes:

- **Strategic partnerships**: These are long-term deals, under which partners must build at least 1,500 homes and deliver 25 per cent of those homes using MMC. Strategic partnerships with 35 organisations have been formed for the 2021–2026 programme, committing nearly GBP5.2bn in funding.
- **Continuous market engagement**: This route provides grants on a project-by-project basis and has a 'soft mandate' for 10 per cent of the homes to be built using MMC.

The MMC homes must be Categories 1 or 2 (noted in section 2.2) or have a pre-manufactured value (PMV) of 55 per cent or above. PMV measures how much of a project's gross construction cost is derived from pre-manufacturing; all seven MMC categories contribute to a higher PMV.

However, notwithstanding these interventions and stimuli, the UK construction industry had to absorb costs arising from the wider economic context following COVID-19, as well as the increases in UK interest rates from the autumn of 2022 onwards. Responding to demand for quick investor returns, firms began to pursue opportunities to increase short-term revenue by introducing new MMC components into supply chains for more traditional construction processes. Industry insight suggests that supply-side investment was inadequate to sufficiently reduce MMC component and material costs to become highly competitive with traditionally built housing. A 'crowding-in' scenario subsequently emerged whereby MMC businesses competed for a limited share of the traditional volume-building market that could adopt and deploy their categories of residential MMC. This contributed to company failures, including the collapse of two major MMC Category 1 businesses (Ilke Homes in July 2023 and House by Urban Splash in May 2022) and the closure of Legal & General's modular housing arm in May 2023.

The House of Lords' Built Environment Committee undertook a brief inquiry into MMC in early 2024 (UK House of Lords Built Environment Committee, 2024). It found that individual business decisions, insufficient order books and investor demands were primary causes of business failure in MMC for housing. The chief executive officer of modular housing company Modulous, which gave notice of intent to enter into administration in January 2023, noted at the inquiry how the challenges in producing relatively quick returns on investment for venture capitalist firms funding MMC businesses had become highly problematic: 'venture markets want to move very fast and the UK construction market doesn't' (Battersby, 2024).

Chapter 3

Current Policy and Support for MMC

3.1 Introduction

As outlined in Housing for All (Government of Ireland, 2021b), the requirements for a 'construction ecosystem' adjustment essential for the adoption of MMC in housing were recognised in the *Roadmap for Increased Adoption of Modern Methods of Construction in Public Housing Delivery* (DETE & DHLGH, 2023: 3).

The initiation of the MMC roadmap represents a real and concerted effort across Government to create the right environment for the adoption of MMC in housing in order to increase overall housing supply. By setting out detailed support measures and milestones under six thematic areas, the MMC roadmap adopts a developmental approach to enhancing delivery of a new demand pipeline for residential construction using MMC:

> *The move to progressing MMC represents a major public sector innovation and transformation initiative, working with private sector clients, design teams, manufacturers, and builders, that will continue to support change in how public housing is considered and procured.*
> *The move to MMC will help to reduce costs, drive faster delivery times, and increase construction sector productivity and sustainability, while maintaining high quality. It will support an increase in diversity in the construction workforce, and improve sustainability and circular economy outcomes, including onsite and offsite waste reduction.*
>
> *(DETE & DHLGH, 2023: 5)*

The MMC roadmap was developed by the Department of Enterprise, Trade and Employment (DETE) and the Department of Housing, Local Government and Heritage (DHLGH). This chapter provides a brief overview of its six thematic areas followed by an outline of the supporting structures and processes for MMC. Then it outlines the impact of MMC on the delivery of public housing; the potential contribution of timber-framed MMC housing; and the importance of the National Demonstration Park for Modern Methods of Construction in Mount Lucas, Co. Offaly.

3.2 MMC Roadmap: Six Thematic Areas

These six thematic areas are identified as crucial to the more widespread adoption of a range of MMC categories in Ireland's residential construction sector:

- **Development and further rollout of procurement approaches**: This focuses on how the design and execution of public procurement can achieve desired objectives in relation to public housing delivery using compliant MMC, including design standardisation requirements.
- **Regulation and standards**: This includes the certification journey time and costs associated with the introduction of new innovative systems, skilled monitoring, site supervision, and a robust inspection regime for MMC, all of which are key to the success of procuring innovative building solutions.
- **Capital, finance and insurance**: This addresses barriers to access to finance for investment that would result in increased MMC capacity in Ireland.
- **Skills development**: This focuses on the skills transformation required within the sector and the availability of the necessary skillsets.
- **Industry competitiveness and capacity**: This includes manufacturing capability, research, development and innovation, and knowledge transfer to the industry and related professions.
- **Effective policy execution and communication**: This includes effective collaboration between policy-makers and the construction sector as well as building awareness and understanding of the benefits and opportunity for MMC in the construction industry, the public sector, and the general public itself.

The MMC roadmap is agnostic about category or type of MMC for housing; its focus is on creating the right conditions and environment for market competition within the existing supply chain in Ireland. The priority is performance-based requirements for MMC in housing and their iterative development under the mechanisms of public procurement, standardisation and certification that can set the bar for innovation and better incentivise the existing supply side. This is an incremental way to build the existing supply chain in Ireland and maintain momentum while de-risking ongoing investment.

3.3 MMC and Supporting Structures

Under Housing for All governance structures, the primary role in decision-making is delivered by the Cabinet Committee on Housing to which the Housing for All Secretary General Delivery Group reports. Under these structures, three working groups comprising interdepartmental and cross-agency representation are established on industry capability, public service delivery, and investment, respectively.

In addition, DETE leads the cross-department and cross-agency MMC Leadership and Integration Group responsible for ensuring co-ordination across a range of MMC entities and initiatives.

In parallel, the Department of Agriculture, Food and the Marine has established the Industry Steering Group on Timber in Construction.

The Built to Innovate initiative and the Construct Innovate technology centre (co-ordinated by the University of Galway) have been established under Enterprise Ireland and funded by the Department of Enterprise, Trade and Employment in support of Housing for All and Project Ireland 2040.

In relation to shaping MMC in housing, a number of other State bodies also have important roles: the National Standards Authority of Ireland (NSAI), the Office of Government Procurement, the Sustainable Energy Authority of Ireland, and SOLAS. Market actors including banks, insurance firms, architects, mortgage providers and institutional investors also play a pivotal role.

The MMC roadmap highlights that the resilience of business models in the MMC sector generally have been challenged and notes the role of Government in providing supports to address market failures. It also identifies the current Growth and Sustainability Loan Scheme[3] as being highly relevant to the MMC sector.

In addition, DHLGH is committed to publishing standardised approaches to the design of housing with the aim of reducing the cost of construction and supporting the adoption of MMC. Use of a standardised design approach is a critical consideration for the successful adoption of MMC. The DHLGH has engaged with stakeholders and industry representatives and has identified selected designs from its Design Manual for Quality Housing (2022) that have been adjusted to allow for ease of delivery utilising different MMC categories, including 2D and 3D systems.

In combination with recent policy in relation to planning and sustainable development of compact urban and rural settlements, this ensures increased focus on the renewal of existing settlements. The interaction between residential density, housing standards, and high-quality urban design and placemaking to support sustainable and compact growth can reinforce greater MMC adoption for housing (DHLGH, 2024a).

[3] The Growth and Sustainability Loan Scheme will make up to EUR500m in longer-term lending available to small and medium enterprises (SMEs). Loans of between EUR25,000 and EUR3m, with terms of up to 10 years and other attractive terms and conditions, will be made available through the scheme to eligible SMEs through participating finance providers, with unsecured loans of up to EUR500,000 available (DETE, 2024).

3.4 MMC and Public Housing

The MMC roadmap is currently delivering results driven by Housing for All investment in the Social Housing Accelerated Delivery Programme (ADP) for new social housing projects on local authority sites. These are being implemented under the leadership of the Local Government Management Agency Housing Delivery Coordination Office, together with respective local authorities, Approved Housing Bodies (AHBs), the Housing Agency and DHLGH.

DHLGH's approval of EUR94m to address legacy debts on land owned by local authorities was agreed in December 2022. Funding was contingent on local authorities developing social housing proposals that would commence construction by the end of 2024 and that committed to the use of MMC.

In alignment with the MMC roadmap, housing projects in the ADP will primarily use a Design and Build procurement approach as it encourages increased innovation and facilitates the adoption of MMC in the delivery of social housing. The design and build procurement approach is a method of housing delivery whereby the design-build contractor, working under a single contract, provides design and construction services. Adopting this delivery approach aims to reduce costs, drive faster delivery times, and increase construction-sector productivity and sustainability, while maintaining quality based on experience to date. In general terms, once performance standards (certification, durability, etc.) are met, under a design and build contract the contractor may propose the adoption of any MMC system and category.

Several local authorities have considerable experience in delivering homes through design and build forms of procurement. Projects have delivered MMC housing schemes utilising Light Gauge Steel Frame, Timber Frame, and Insulated Concrete Formwork. Since 2022, a total of 1,675 social homes have been progressed using design and build, with 774 social homes completed. A further 519 social homes were under construction onsite and 382 were at various stages of the design and approval process at the end of Q1 2024. The latest estimate in spring 2024 for the ADP is for 1,780 units to be completed in 35 sites across 13 local authority areas.

Additional to the ADP, the DHLGH is continuing with social housing public-private partnerships (PPPs). It has expanded the initial programme that delivered 1,500 social homes nationally across three bundles to new Bundles 4 and 5, specifically for the greater Dublin region. Led by Dublin City Council, these bundles aim to deliver 1,500 social homes on 18 sites across six local authorities. To allow for ease of adoption of MMC across these sites, the DHLGH engaged with the National Development Finance Agency (NDFA) during the early stages of design development and has agreed to a standardisation of internal layouts across these bundles.

Finally, it is important to note that the Land Development Agency (LDA) supports the use of MMC in the delivery of affordable housing and is confirmed in its view that 'standardisation [is] key to facilitating the increased use of MMC at the delivery stage' (LDA, 2023: 1). The LDA's *Apartment Typology Booklet* (LDA, 2023) is a key support for the development of MMC. It aims to intelligently utilise standardisation in design and construction to improve quality, reduce cost, increase certainty and deliver consistency across LDA homes. This is broadly welcomed among industry stakeholders.

3.5 MMC and Timber

MMC entails low-carbon building technologies and the wider use of timber has the potential to dramatically improve construction-sector productivity, innovation, speed of delivery, sustainability and cost-effectiveness.

In its 2023 report on MMC, the Joint Committee on Housing, Local Government and Heritage (2023) noted the significant opportunity to expand production of timber-frame MMC in Ireland. It focused on barriers to building with timber and how current technical guidance on fire safety makes provision for non-combustible construction materials in buildings taller than 10 metres as the prima facie means on compliance with building regulations. It should be noted that the Building Regulations (including Part B) are expressed in broad performance terms and do not set limitations on the use of materials. For example, the requirements of the Building Regulations do not prohibit the use of timber

products in construction at any height. [4] The Committee's report also highlighted the position of the National Standards Authority of Ireland (NSAI), which is to ensure highest fire safety standards, and its finding that 'there is nothing to stop a standard being developed to allow timber buildings at greater heights, as there are structural design codes which offer ways of designing buildings to meet safety and fire standards' (ibid: 12). The need to remove barriers to adopting timber-based building technologies on a larger scale, while continuing to ensure the highest fire safety standards, was highlighted.

In common with the approach of the MMC roadmap, the Joint Committee's key recommendations seek to deploy State procurement mechanisms that grow capacity in order to deploy low-carbon MMC in housing construction. Proposals include using multi-annual framework agreements replete with seed capital to create a pipeline for housing supply from companies expanding their capacity to deliver low-carbon building technologies in housing construction. The report positions the adoption of MMC low-carbon building technologies as helping drive the 40 per cent reduction in carbon emissions within the residential construction sector by 2030, as required under the Government's Climate Action Plan 2023.

A significant milestone set out in the MMC roadmap was subsequently reached in November 2023 with the establishment of the Interdepartmental and Industry Timber in Construction Working Group. This group was established to create the conditions to:

- increase the use of timber in construction whilst ensuring the highest degree of building safety and property protection;
- examine regulatory and standardisation standards challenges; and
- maximise the use of home-grown timber in construction.

Established within the context of the Government's EUR1.3bn Forestry Programme 2023–2027, which places a strong emphasis on the use of timber in construction and its important role in reducing the amount of concrete and steel used in construction, the Steering Group provides an opportunity for Government and industry to work collaboratively. The overarching aims are to create the conditions for increasing the use of timber in construction while ensuring the highest degree of building safety and property protection, to examine regulatory and standardisation challenges, and to maximise the use of home-grown timber in construction.

3.6 National Demonstration Park for MMC

Another major support under the MMC roadmap is the development of the National Demonstration Park for Modern Methods of Construction led by Laois and Offaly Education and Training Board at the National Construction Training Centre in Co. Offaly.

Modelled on the United Kingdom (UK) Building Research Establishment demonstration buildings at the Watford Innovation Park and managed by SOLAS, the Demonstration Park will be an important resource for developers, construction professionals and stakeholders who are interested in exploring innovative ways of building homes that are both sustainable and affordable. It is hoped that the Demonstration Park will inspire the construction industry and the general public to embrace new ways of building by showcasing the latest technologies and methods in construction.[5]

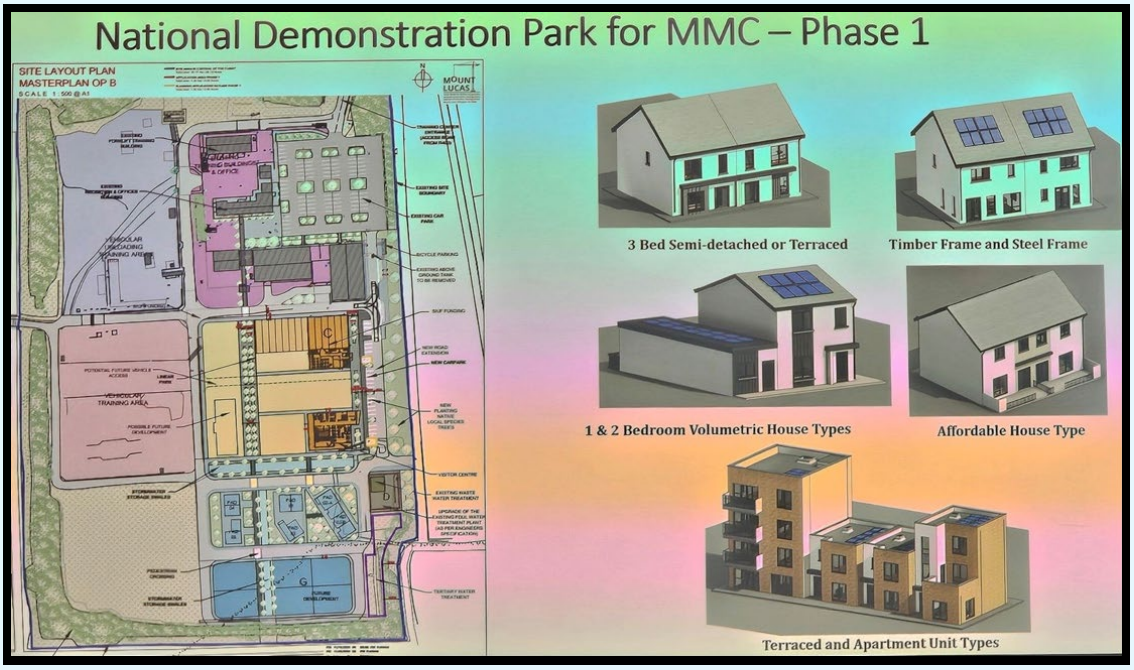
Phase 1 units to be installed include an apartment building, terraced houses and semi-detached houses. A pilot public housing project using an advanced 3D volumetric system that requires pre-manufacturing offsite will also be initiated. The Demonstration Park will enable exploration, demonstration, and better understanding and awareness of the latest

[4] Guidance on compliance with the various parts of the Building Regulations for non-complex, common buildings is given in a suite of Technical Guidance Documents. To accompany the Regulations, Technical Guidance Document B 2024 – Fire Safety – Volume 1: Buildings other than dwelling houses has been published on the Department's website.

[5] See online at https://mountlucas.ie/mmc/ [accessed 09/07/24].

MMC technologies and offsite building systems. Planning permission for the project is granted and procurement for the groundworks contractor is due in summer 2024.

Figure 3.1 Schematic Site Layout and Building Types for the National Demonstration Park for MMC



Source: Laois Offaly Education & Training Board (LOETB).

Chapter 4

Three Developmental Opportunities and Five Challenges

4.1 Introduction

This chapter examines the opportunities and challenges associated with modern methods of construction (MMC), drawing on literature and research as well as extensive engagement with stakeholders and experts in the construction sector.

4.2 Three Developmental Opportunities

This section outlines three key developmental opportunities for MCC in Ireland's housing sector.

4.2.1 Opportunity 1: Further Adoption of MMC within the Traditional Construction Sector

Ireland's residential construction sector, comprising an estimated 62,000 firms (CSO, 2020), is dominated by small and medium enterprises (SMEs) that use traditional construction methods.

Substantial variation is found for current estimates of the percentage of offsite construction that accounts for new residential units in Ireland, making comparisons with other countries problematic. While timber frame accounts for over 50 per cent of all new scheme-housing in Ireland, no definite baseline figures are agreed for the total residential sector. This should be remedied through new research and more effective market surveillance. Findings from Department of Enterprise, Trade and Employment research, underway in 2024, to establish a baseline figure across MMC categories can address this lacuna.

Under Housing for All, Enterprise Ireland has extended its Lean, Digital and Innovation supports to the residential construction sector. The Agency is also undertaking a review in 2024 of the Irish residential construction sector with the objective of identifying growth opportunities for SMEs focused on higher levels of productivity and innovation, as well as what interventions and incentives could be deployed to further support growth.

Enterprise Ireland commissioned research (EY, 2021) confirmed that 62 per cent of firms believe that volumetric construction will be of 'great importance' or of 'very great importance' in the next 10 years. However, utilisation of MMC in Ireland remains low, with just 7.4 per cent of firms regarding offsite manufacturing (OSM)/MMC as their main activities. This indicates the existence of significant scope and willingness to expand the use of MMC in order to realise its benefits.

There are significant opportunities for Ireland in increased timber use in construction and timber-based MMC; in particular, because of the substantial fibre available due to the maturation of forestry planting dating back over 30 years. Sawmill capacity has expanded, and new technologies are resulting in higher-quality products. Consumer demand, combined with investor profiling under ESG (environmental, social, and governance),[6] is encouraging greater use of timber-based construction in warehousing by large multinational companies and major retailers such as Lidl and Tesco. Examples given include recent developments in Ashbourne, Co. Meath; Blanchardstown, Dublin; and parts of Wicklow (see Figure 4.1).

[6] ESG is a set of aspects, including environmental issues, social issues and corporate governance, that can be considered when investing. ESG investing refers to the use of responsibility metrics and standards when making investment decisions. Environment criteria gauge how a company safeguards the environment. Social criteria examine how it manages relationships with employees, suppliers, customers and communities. Governance measures a company's leadership, executive pay, audits, internal controls and shareholder rights.

Figure 4.1: Warehouse under Construction in Blanchardstown Using Timber MMC

Following the cost of construction study published in May 2023, which analysed each component of the cost of construction of houses and apartments (DHLGH, 2023b), the Department of Housing, Local Government and Heritage (DHLGH) is now committed to publishing standardised approaches to designing housing, with the aim of reducing construction costs and supporting MMC adoption. A project steering group of government and industry representatives has been established with work scheduled to commence in H2 2024. In parallel, the latest Expert Group on Future Skills Needs report (2024) on the skills required for the transition to MMC and to support innovation makes 28 recommendations that will inform a forthcoming Department of Further and Higher Education, Research, Innovation and Science (DFHERIS) action plan.

4.2.2 Opportunity 2: Inward Investment by International MMC Companies

The second developmental opportunity is to encourage companies outside Ireland to supply MMC homes in the Irish market.

Under the Housing for All plan, since 2022, there has been ongoing engagement with international construction firms through IDA Ireland to encourage greater participation in the Irish housing market. A value proposition highlighting Irish housing market opportunities has been developed by the IDA for international construction companies, in conjunction with the DHLGH, DPENDER, the Land Development Agency (LDA), NSAI, local authorities and others.

A range of factors may influence decisions for international construction companies to expand and invest overseas, including: scale of available housing projects, availability of potential partners, complexity of housing projects, compliance of housing systems and products with local building regulations. Investment, if it does materialise, is likely to remain limited to the particular housing typologies used in Build to Rent and Purpose Build student accommodation where MMC categories 2, 3 and 5 are established.

It appears to be generally accepted by industry stakeholders that innovation in MMC products and component design and development can continue to focus on reducing price points in overall construction costs, but that propositions for scaled OSM will remain unfunded as there are not enough credible projects to bring industrialised MMC housing to market. Others note that the market for MMC in housing remains fragmented and undercapitalised. MMC industry stakeholders observe that this could quickly change under investment decision-making in response to State commitments to further scale the provision of social and affordable housing using MMC. Declan Wallace, Chief Executive Officer of Evolusion Innovation Ltd and Chair of MMC Ireland, quantified this potential, suggesting that MMC and OSM companies have the capacity to speedily increase annual housing output by 25,000 dwelling units. The key issue he argued was the need for a 'MMC pipeline' to provide certainty[7].

The example of the 2023 opening in Monaghan of an international centre of excellence for MMC to service European and global markets by Volumetric Building Companies (VBC), one of the world's largest volumetric specialists, is highly significant. The centre's product designers and technicians will offer advanced steel-framed volumetric and timber panelised MMC solutions. This represents a major boost to innovation in MMC for housing in Ireland. However, VBC reports that current Irish demand is primarily from the healthcare sector for steel-framed volumetric solutions. VBC has not developed an OSM centre in Ireland and will continue to rely on its manufacturing capacity based in Poland.

4.2.3 Opportunity 3: Entrepreneurial Growth for Domestic and Export Markets

The third developmental area is that of supporting the entrepreneurial growth of domestic and export markets for MMC in housing.

There is a substantial opportunity for Ireland to tap into a global volumetric construction market that was valued at USD97bn in 2022. Projected growth driven by rapid urbanisation and industrialisation, particularly in the commercial and industrial building sectors, is expected to reach a global value of USD188bn by 2031 (Skyquest, 2024).

There is strong market growth in residential volumetric construction for temporary housing for emergency and relief operations where buildings are designed to be repurposed and transported from offsite locations. Demand for high-quality, greener homes in the European Union (EU) is another major driver of growth. The value of the European volumetric construction market is estimated to reach over EUR10bn in 2024. Germany, with the largest construction sector in Europe, is experiencing a boom in prefabricated housing solutions – an estimated minimum 20 per cent of new residential development is being delivered via MMC (Mordor Intelligence, 2023).

Standardisation of the housing typology used in MMC is key and this is recognised under Enterprise Ireland's Build to Innovate programme.[8] Increased standardisation in MMC for housing in turn prioritises greater industrialisation in the construction and OSM sectors for housing using repeatable technical systems, designed and produced using efficient and reliable processes across the supply chain.

Stakeholders acknowledge the potential opportunities for standardisation to achieve significant and rapid transformation, growth and adoption of MMC in housing, as the following quote illustrates:

> *Our goal is very much to mirror what Tesla did. They've gone from, you know, 100,000 parts in the car down to 10,000 parts in the car. We're trying to do the same thing, reduce the number of components in our building typology, reduce the number of joints and fixings and ultimately reduce the number of mistakes or opportunities for mistakes and waste to happen. And increase the standardisation of our offering.*[9]

Procurement for MMC in housing will therefore require incorporation of criteria supporting the adoption of complementary processes such as 'lean manufacturing', which eliminates non-essential activities. This improves quality and production times and reduces waste.

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7 Welcoming Address by Mr Decland Wallace, Chair of MMC Ireland at opening of MMC Ireland National Conference, 22-23 May 2024, The Lyrath Estate, Kilkenny.

8 See online at https://www.enterprise-ireland.com/en/sectors/high-tech-construction-and-housing/built-to-innovate [accessed 15/07/24].

9 MMC industry anonymised interviewee.

Additionally, through industrialisation, the deployment of Design for Manufacturing and Assembly (DfMA), often referred to as a 'design kit of parts' (D-KOP), helps to simplify the production process, enhance the quality and sustainability of components and products, and is accompanied by the increased use of product platforms.

OSM and the deployment of MMC categories 6 and 7 (onsite building material and process improvements) components is also integral. These areas must become required criteria of the procurement strategy to adopt MMC in housing. Overall, this means that the housing procurement strategy for MMC aligns with and contributes to industrial policy and investment; for example, under the National SME and Entrepreneurship Growth Plan (DETE, 2021).

Significantly, under Ireland's policy-led transition towards the greater adoption of MMC, stakeholders highlight the importance of better State and market collaboration that engages successfully with the emergence of 'winners and losers' among volume house builders and SMEs in Ireland's traditional construction sector.

Similar to Just Transition requirements for progressing towards a climate-neutral economy, collaboration to advance the adoption of MMC will need to be carefully considered so that interventions and incentives can secure the livelihoods of construction industry workers and not accentuate negative, socio-spatial outcomes arising from uneven regional economic development.

In contrast, stakeholders clearly regard the future expansion of MMC capacity for housing as a significant growth opportunity. MMC presents the potential for balanced regional economic development under long-term planning for the provision of critical transport, logistics and utility infrastructure. As one interviewee noted:

> *We need to have an industrial policy capable of delivering development of MMC manufacturing in Ireland in such a way that distributes employment and takes advantage of manufacturing outside of the congestion of Dublin. Key to the regions is transport, sustainable transport is really important. We've been transporting goods, but our assembly technicians don't move around the country, our product does. So we have to really work on the sustainable part of our transport, looking at joining up how our materials flow around the country and out for export. We are going to get to a place where we have to get a lot of materials off roads and onto rail. So look at the link between Europe and the rail into Rosslare. That is going to be really important for us.*[10]

4.3 Five Challenges for MMC in Ireland

This section identifies five key challenges to the continued development of MMC for housing in Ireland:

- insurance;
- timber-based MMC;
- standard housing typology and procurement;
- investment; and
- perceptions and understanding of MMC.

[10] MMC industry anonymised interviewee

4.3.1 Insurance

The importance of insurance companies having well founded knowledge and understanding of what the categories of MMC are and the actual risks associated with their adoption and use in housing is critical.

A 2022 UK insurance industry study on MMC found that real estate underwriters have minimal experience of MMC and are more wary of perceived MMC risks, particularly in relation to fire safety. The study confirmed that real estate insurance cover for residential building projects incorporating MMC, in particular volumetric MMC, is often harder to obtain during the post-construction operational phase (Marsh McLennan, 2022). For Ireland, insufficient insurance industry knowledge of MMC can increase the possibility of insurance premium increases or underwriting refusals (RIAI, 2022).

Building insurance and perceived risk related to fire safety and insulation can represent a substantial challenge to increasing the use of MMC in residential development. For example, interviews with Irish MMC firms that supply non-structural assemblies using Insulating Concrete Formwork (ICF) revealed that insurance brokers have advised ICF suppliers that there is no appetite in the insurance industry to provide cover for new residential apartment buildings with insulation that does not have a Class A fire rating or to reinsure existing buildings without same. Significantly, only insulation manufactured using mineral wool, not the insulation used in ICF which is an expanded polystyrene (EPS), meets the Class A fire rating. Interviewees estimated that only between 30 and 40 per cent of apartment building insulation is made using mineral wool, with the majority using EPS or other oil-based polymer insulation products.

Furthermore, a category of insurance product called CAR (Contractors All Risks) insurance was noted by interviewees as possibly being systematically withdrawn on a scheme-by-scheme basis, again for apartment buildings with insulation that does not have a Class A fire rating.[11] Examples cited by interviewees included two large residential apartment schemes (300 units and 800 units, respectively) that were under construction and using ICF where requested CAR insurance renewal was refused. This led to significant interruption in the financial drawdowns and funding needed to continue. Enquiries made via brokers as to whether the insurance industry was undertaking risk assessment and seeking to 're-price' CAR were met with a categorical reply that offered no further explanation other than a confirmed decline to quote.

Interviewees expressed significant frustration with the insurance industry's apparent refusal to explain the basis of decision-making or to identify points of concern with the continued use of ICF products certified under National Standards Authority of Ireland (NSAI) Agrément and that meet or exceed building regulatory standards.[12] They also noted a general lack of awareness of this change in insurance industry decision-making among contractors, developers and statutory regulators.[13]

The MMC Leadership and Integration Group was referenced by interviewees as an appropriate vehicle for interventions to avoid costly disruption and to help resolve insurance and related finance matters impacting MMC competitiveness and growth. As one interviewee asserted:

> *It's not an overstatement to say that this has potential to bring the MMC construction industry, in Ireland at least, to a standstill. I'm not exaggerating either. This is actually much more fundamental. This is a withdrawal of a legal and financial service required for the maintenance of construction and the economy. And this is where our regulatory function must sit down and resolve the problem.*

More positively, other interviewees with specialist expertise and experience in MMC high-rise building construction noted their experience of successful remedies to the issue of emerging risks by introducing experts to engage with

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11 CAR insurance is taken out by contractors during the construction phase and provides liability cover for damage to property and materials, among other agreed specificities. When the construction phase is completed and the building is handed over to the client, CAR insurance ends and, typically, a new building insurance is agreed with real estate underwriters.

12 An NSAI Agrément certificate is a technical certification issued by the National Standards Authority of Ireland (NSAI). It is designed for new and innovative building materials, products and processes that do not yet have a long history of use or established national standards.

13 Further investigation is required to confirm whether this is a predominant action being taken by the insurance industry in Ireland or if it is limited to these two cases, and if these cases were successfully resolved.

insurers and demonstrate how risks of MMC products or solutions are being managed in other EU jurisdictions.[14] Greater clarification is needed between insurers and the construction sector in the use of MMC for housing.

4.3.2 Timber-Based MMC

Timber frame used in the construction of new homes is estimated to represent 46 per cent of the new scheme housing market in Ireland (CIF, 2021). Challenges to further expansion in the use of timber relate primarily to the fire safety and material strength performance for the use of timber in residential construction. These challenges are considered in more detail in the rest of section 4.3.2.

Fire Safety and Timber-Based MMC

While traditional construction systems such as reinforced concrete structures or steel have undergone large-scale material and fire safety design testing, which inspires confidence, new and innovative MMC designs are often not equivalently established in Ireland. The national standard for timber-frame construction notwithstanding, this is particularly true for the use of structural, mass engineered timber (e.g. Cross Laminated Timber and Glulam) in taller residential MMC buildings.[15]

The fire certification process varies between regulatory authorities, and stakeholders argued that this must become a focus for improved co-ordination in order to reduce risk and costs associated with delays and variable decision-making. One interviewee described the situation as follows:

> *We've done two of the exact same modular building in two different counties and while both are now certified in their own right, they've been very different experiences for us. You have to ask yourself why. It's because different Councils [local authorities] have their own views. It impacts modular housing more so because it holds up your factory if you're having to wait on a fire cert. You're at risk for a period of time while you're fabricating and typically the client has to carry that risk.*

Fire safety regulations are subject to review, most recently with a public consultation concluding in April 2023 (DHLGH, 2023a). The DHLGH subsequently published an Information Note on Alternative Approaches to Demonstrate Compliance with the Building Regulations (2024) that provides guidance on alternative approaches to the Technical Guidance Documents (TGD)[16] to demonstrating compliance with the Building Regulations. It contains a specific appendix in regard to alternative approaches to demonstrating compliance with Part B (Fire Safety) (DHLGH, 2024b).

For new innovative products or systems, compliance with the Building Regulations can be demonstrated by third party certification by an independent approval body, such as National Standards Authority of Ireland (NSAI) Agrément. Agrément certification is a means of demonstrating compliance with each of the 12 parts of the Building Regulations, and is generally accepted by Building Control Authorities.

Nonetheless, MMC industry interviewees expressed significant levels of frustration over how their evidence in submission appears not to be fully taken into consideration. Consequently, they argue that there remains no specific MMC guidance or recommendations in the TGD-B publication for 2024. Their view is this diminishes the use of timber MMC in building design and component materials, meaning that their performance in a fire event cannot be considered by fire safety regulators in determining compliance. In turn, this limits test and research evidence, resulting in limited expertise, consistency and competency in dealing with fire safety aspects of MMC for housing generally.

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14 MMC industry anonymised interviewees.

15 I.S.440: 2009+A1:2014 Timber Frame Construction, Dwellings and other Buildings is the Irish standard on timber frame construction (as referenced in Technical Guidance Document A 2012 and Technical Guidance Document B Vol 2 2017). I.S. 440 refers to responsibilities, materials, design, manufacture, construction details, site work and services. Manufacturers of timber frame buildings are assessed under an approval scheme operated by the NSAI for compliance with I.S. 440 requirements including Factory Production Control (FPC). A register of compliant manufacturers is available on the NSAI website at https://www.nsai.ie/certification/ [accessed 31.07.24].

16 Technical Guidance Documents are performance based and do not typically prescribe solutions relating to specific products. The TGD's rely on the proper and appropriate application of Standards, and Agrement Certificates.

A core issue is how, under MMC designs, key elements are not fire-protected individually. With MMC there is a reliance on internal plaster board linings for structural fire protection, which is not typically the case for traditional construction. This means that the consequences of internal plaster board linings failing to limit the spread of fire are potentially much greater (Quinn, 2024). Other fire risk issues relate to onsite MMC detailing and installation around building interfaces (e.g. windows and door openings).

Limited fire safety test evidence exists for the onsite installation of MMC in housing. Housing typology standardisation for timber use in MMC therefore requires a substantial focus on large-scale testing and structural resilience assessments to demonstrate that fire safety requirements are being met.

Material Strength Performance

The lower rate of using domestic or home-grown timber for MMC in housing is also related to its strength class (C16) being less than that of imported timber (C24). Home-grown timber requires different industrial specification for use in construction. For instance, a home-grown C16 timber beam may need to be 110mm deep to be of equivalent strength, in comparison with a 100mm beam of imported C24 timber.

The Timber in Construction Steering Group (noted in 3.5 above) has established a thematic group on regulations, standards and compliance to which DHLGH provides the secretariat. It is reviewing technical guidance and standards, codes and the wider research literature in Ireland and abroad on the design and use of mass-engineered timber and related timber products in construction. This work aims to support the development of recommendations for a national technical specification for the use of mass-engineered timber in construction in Ireland.

Interviewees noted how additional investment in Ireland's sawmill and timber frame sector is required, particularly in terms of the technology needed to produce new products capable of substituting for certain timber imports. Progress in this area was welcomed:

> *We need to look at these other jurisdictions and how they have addressed it [timber in MMC] and in fairness there is a new timber in construction steering group that has been established. That's a positive step.*[17]

4.3.3 Housing Typologies and Procurement

Industry stakeholders highlight the need to reframe the overall public procurement process for MMC in housing to better include specified and designated standard housing typologies. Another notable procurement concern among interviewees is the nature of the relationship between the contractor and the offsite product manufacturer over critical issues of forward funding, risk and exposure.

The continued absence of customised, new standardised housing typologies for mid- to high-rise, higher-density MMC and hybrid residential buildings for new housing delivery reinforces the perception that adopting MMC is only possible for forms of low-rise housing (not greater than 3 storeys/11 metres in height).

To enable industry growth, developing standardised, residential design typologies certified by the NSAI remains a significant requirement, particularly for the future supply of Category 1 MMC 3D volumetric residential development. This point was also made in research by Ireland's Construction Industry Federation (CIF, 2021).

Newly standardised housing design is required for affordable housing that not only meets household user needs over their lifecycle, but that also addresses requirements for new forms of estate layout and design that will increase settlement densities while also delivering quality placemaking. This is also recognised by the Housing Commission recommendation no.22 that 'the state must support the collaborative development of standard house and apartment types to drive efficiency, reduce costs and support viability' (Housing Commission, 2024: 93).

[17] MMC Ireland anonymised interviewee.

As noted in 4.3.2, in order to facilitate alternative construction methods, this will require regularly updating the technical guidance documents that accompany the Building Regulations. Another impediment is the absence of standardisation for a component design kit-of-parts (D-KOP), which is deployed, for example, by local authorities for key elements in social and affordable housing projects (kitchens, stairs, landings, bathrooms).

Concerns also exist over the intellectual property of the volumetric housing design and assembly, and questions persist about how transparent and collaborative this process will be. This concern is amplified by an apparent absence of dedicated resources at local authority level to secure and assemble data and insights in order to facilitate knowledge production and exchange.

The role of the Construct Innovate technology centre in developing data management and infrastructure to evaluate the Social Housing Accelerated Delivery Programme (ADP) should be considered. This should also include the two Category 1 MMC volumetric pilots for 12 houses at a site in New Ross, Co. Wexford and for a 60 unit apartment scheme in Carlow town, Co Carlow and, more broadly, evaluation across its design and build procurement of MMC in housing.[18]

Procurement strategy for MMC in housing can rely on new research funded by Science Foundation Ireland and underway at University College Dublin. This research identifies a lack of knowledge of MMC categories and their influence on project constraints, as well as the lack of an appropriate quantification of the 'total value added' from MMC use, as barriers to the greater adoption of MMC in Ireland. The research aims to address this challenge by developing a decision support-making tool that enables an impartial assessment of the viability of MMC categories for a considered project and their total sustainability value (social, economic, and environmental). As per its website, the Platform4MMC project aims to 'foster faster and well-informed decision-making by both public and private bodies in the bid to alleviate the housing crisis, while meeting sustainability requirements'.[19]

Finally, industry stakeholders related their experience of current regulatory requirements, journey time and costs associated with NSAI certification. They considered it to be a long and expensive process but one that was also seen as an investment. Stakeholders also argued that that the costs associated with the introduction of new innovative systems can act as a barrier to SMEs entering the market.

4.3.4 Investment

The finance model for MMC in housing differs substantially from that of traditional methods of construction.

This is primarily due to the requirements of offsite manufacturers and suppliers in the MMC value chain for substantial upfront investment in their fixed assets, such as plant facilities and machinery. Similar requirements for front-loading payments also arise for more intangible assets such as skilled labour, certification and design standardisation.

Industry interviewees welcome the Government's Growth and Sustainability Loan Scheme, although a majority also confirmed that a dedicated policy to build a finance model supporting MMC real estate development activity was not yet forthcoming. While recognising the role of Ireland's banking and finance system in providing investment and sources of working capital, interviewees noted how a confluence of events (including higher energy costs, price inflation, increases in interest rates and the nature of contractual payment terms) had made accessing funding more challenging. As one interviewee observed:

> *The financial risks currently facing the sector are growing. Contractual payment terms have to be really well understood between parties. I don't think it's fully understood as there's not any real movement towards a front-end investment model for us. We have most of our projects in the factory and we don't get paid until they go to site. We have to fund a huge amount of this and await payment later. The funding model doesn't allow payment to happen easily.*[20]

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18 A Stage 1 application for the New Ross scheme is submitted to DHLGH with a view to tender by Q4 2024 and to award contract in early 2025. A Stage 1 application is proceeding for the Carlow town scheme with a view to tender by Q1 2025 and to award contract by mid-2025.

19 see https://www.sfi.ie/challenges/sustainable-communities-challenge/Platform4MMC/ [accessed 24/07/24

20 MMC industry anonymised interviewee

Another interviewee was clear in articulating how Ireland needs greater institutional reform in finance and investment, while arguing for the establishment of a strategic State development bank for housing:

> *If we're going to double the capacity of the MMC industry we need to double the financing. Something needs be done to have a dedicated state financial development bank for housing, or something along those lines, that pulls together the type of financial investment required to address some of these matters.*[21]

4.3.5 Perceptions and Understanding of MMC

Survey data covering consumers, developers, funders and insurers indicate that the benefits of MMC are not fully understood and that negative perceptions exist, particularly in relation to perceived risks (Sweeny, 2024). This survey evidence suggests that inadequate understanding of the MMC industry can be a barrier to MMC adoption, especially for government and local authority respondents (Wang & McCrum, 2024). The other key barriers identified include difficulty in transitioning away from traditional methods and the immaturity of the supply chain.

There is evidence that people are positively predisposed towards MMC, particularly concepts such as' modular' or 'offsite housing' (Wang & McCrum, 2024). Section 5.7 consider how the image of the MMC sector might be enhanced, This section notes some of the challenge. There are some negative perceptions, for example towards what has been termed the 'prefabrication hangover' by industry stakeholders. This is the stigma associated with failed past practices that has generally made prefabricated housing unattractive to construction industries around the world, as well as to end users (Hall & Viden, 2005)..

There are three particularly noteworthy examples of a persistent underlying bias against MMC for housing in Ireland:

- Dublin's relatively recent demolition of medium- and high-rise buildings for social housing in Ballymun and Inchicore i.e. St Michael's Estate;
- A negative perception among Dublin residents concerning new supply termed 'rapid-build' housing; and
- Negative narratives on recent residential public housing supply utilising MMC substitute the terms 'prefab-housing' and 'rapid-builds' for the official term of 'volumetric housing', and in doing so attempt to apply them as labels for illusory adverse attributes of MMC public housing, for example (and incorrectly) that it is of lesser quality to traditional builds. A pejorative muddying of MMC housing terminology, and its misuse, is commonplace in Irish public debate on housing and particularly so among actors articulating negative responses to proposed and actual provision required for key groups in need of temporary emergency accommodation, including Beneficiaries of Temporary Protection (BTP).

In addition, it is worth noting that survey data covering consumers, developers, funders and insurers indicate that the benefits of MMC are not fully understood, and that negative perceptions can exist, particularly in relation to perceived risks (Sweeny, 2024).

[21] MMC industry anonymised interviewee

Chapter 5

Conclusion and Recommendations: Six Lines of Action

5.1 Introduction

This report defines modern methods of construction (MMC) and their potential to deliver a significant increase in the supply of much-needed quality homes, to decarbonise new housing supply, and to create employment opportunities across Ireland.

The Council acknowledges the range of current policy, structures and processes that have been created to support the expansion of MMC in Ireland. Based on research and intensive dialogue within the construction and enterprise sectors, and with input from national and international experts, the report identifies six lines of action to further the expansion:

- institutional leadership;
- standards and innovation;
- targets;
- innovative finance;
- new employment opportunities; and
- positive promotion.

5.2 Institutional Leadership

A more resourced, formalised and innovative collaboration could drive expansion in the scale and scope of MMC for housing supply and renovation.

International experience demonstrates that a strong commitment from the Government is critical to supporting the market delivery of prefabricated housing. This includes 'institutional arrangements in accordance with the systematic planning and execution of national strategies and policies that will affect the construction industry. Accordingly, the overriding factor to the developmental transformation of the sector is the commitment of the government at all levels (Amtered El-Abidi *et al.*, 2019; cited in Payne & Serin, 2023).

Government institutions have a particularly important role to play in bringing together policy-makers and industry practitioners to share knowledge and experience, and to ensure that policy development meets industrial strategy aims while maintaining high standards in the public interest. The MMC roadmap established under Housing for All is a notable achievement in this regard. In the context of formalised institutional dialogue, industry stakeholders have the opportunity to highlight systemic failures that may not otherwise be apparent to policymakers. Conversely, such collaborative fora present public sector actors with the opportunity to communicate institutional aims and objectives through dialogue, while benefitting from feedback and opinion in a constructive, two-way exchange.

Drawing on the Irish construction sector's learning and recent experience in the United Kingdom (UK) market, Ireland holds the distinct advantage of being a 'second mover' towards the increased adoption of MMC in housing. Its growth to become a net exporter to the European Union (EU) of MMC build-ups and sub-assemblies has been facilitated by knowledge exchange and policy transfer from EU countries where MMC in housing is mature and advanced.

Applying this learning to successfully overcome barriers to the greater adoption of MMC in Irish housing, particularly in critical areas of investment in MMC capacity and within the context of the State's overall role as a major procurer of construction services, could lead to the creation of sustainable supply chains for increased new housing delivery and retrofitting in Ireland. In turn, this would support opportunities for balanced regional economic development through clustering and co-locational decision-making for investment and employment under long-term planning for critical transport, energy, water and communications infrastructure.

It is vital to underscore the importance of resourced, effective, modern transport infrastructure that enables integrated, international logistics, crucial for growth and development within the MMC sector. Irish MMC products and materials must flow in a sustainable manner from where they are produced to where they are used. To achieve its full potential in the decarbonisation of the construction sector and built environment generally, while also expanding export-led growth, greater volumes of Ireland's MMC materials and products for housing (and other sectors) will need to travel via rail more than via roads. International rail, port and sea connections between Ireland, the UK and Europe will be critical.

The experience of other industrial sectors, particularly Ireland's life science, pharmaceutical and data sectors where MMC is already successfully established, suggests that the ambitions for MMC in housing need not be cautious or modest. In contrast, this report finds that the move towards the greater adoption and use of MMC in housing among producers and users must be ambitious in its invention and execution.

Enhanced institutional leadership that recognises the impacts of MMC on housing provision, climate action and economic and entrepreneurial opportunities is crucial. There is scope for the State, working through the existing structures, to build on the various initiatives currently being pursued and to go further to develop and promote additional MMC-specific initiatives to address impediments to its wider adoption by industry, to facilitate knowledge-sharing between public and private sector stakeholders, and to demonstrate the potential benefits of the sector to the construction industry and the wider public.

The Council believe that institutional leadership can facilitate and support the adoption of MMC by:

- facilitating dialogue and knowledge exchange between policy-makers and industry practitioners;
- encouraging collaboration in policy development and MMC advocacy;
- facilitating greater standardisation of housing typologies for MMC;
- developing supportive regulatory frameworks that realise the commercial potential of MMC while maintaining safety and quality standards;
- creating a stable and reliable source of demand through the procurement of MMC in public housing; and
- leveraging the institutional capacity and resources of public bodies such as the Land Development Agency (LDA), local authorities and larger AHBs to unlock the development potential of strategically important development sites using MMC at scale.

A number of these issues are discussed in more detail in the rest of this chapter.

In addition, public sector bodies can play a leadership role by adopting MMC in public sector projects such as social and affordable housing schemes. Successful implementation of MMC in major publicly funded housing projects can serve to demonstrate the benefits of the sector, while providing a stable and reliable source of demand to spur investment in industrial capacity-building.

The LDA is identified by industry and agency stakeholders as being capable of working with larger urban local authorities to advance their housing delivery programmes using key strategic urban sites in order to realise scaled, mid- and high-rise residential density for new social and affordable housing using standardised MMC housing typology.

Industry stakeholders also noted the critical importance of integrating main contractors with MMC providers of volumetric housing on public procurement frameworks, particularly for new design and build public procurement for MMC residential supply. In response to the idea that MMC is not well understood (see section 4.3.5), they highlighted the importance of promoting best practice and knowledge-sharing across the construction industry.

More specifically, they argued for earlier engagement between main contactors and MMC providers in order to better support design decision-making leading to greater cost-effectiveness. Under current procurement practices that can lead to more prescriptive designs for tendering, early engagement has not been forthcoming. Industry stakeholders

point to examples of the positive experience of contractual approaches in Ireland where MMC solutions have been successfully deployed in the development of new schools, in improving and expanding existing schools, and in the healthcare sector where new hospitals have been successfully delivered using MMC.

Therefore, while MMC in housing is restricted by wide-ranging challenges impacting a procurement strategy that relate to the co-ordination of projects, stakeholder collaboration and operational requirements, the potential adaption of successful procurement rules and regulations for MCC from other sectors is achievable in the near term.

To activate and enable early MMC adoption by public housing project sponsors, a commitment to multi-annual funding must also be made. Industry stakeholders note how forward-funding and early contractual payments are required to enable contacting authorities to plan ahead and commit to stable, commercial engagements that build supply chain relationships for MMC in housing. In turn, this will advance innovation and quality, bring forward delivery timelines and boost housing supply outcomes.

Finally, in relation to institutional leadership, increased adoption of MMC will also require more research and development (R&D). The establishment of Construct Innovate and its overall objective of realising a digital transformation of construction in Ireland is welcome. However, there is not enough R&D in the Irish construction sector generally and there is a need to kickstart an industry-wide approach to deliver greater innovation and development focused on residential MMC solutions to housing supply and placemaking needs. The State has a critical role to play in supporting R&D to advance MMC technologies and techniques. Investment in R&D will lead to innovations that improve efficiency and sustainability, while supporting the establishment of new firms specialising in MMC.

5.3 Standards and Innovation

Government policy requires that all new housing must be of a high quality and meet the requirements of the Building Regulations. These require that materials used in housing must be fit for their intended use and the conditions in which they are to be used.

Within this overarching frame the residential sector, like any commercial sector, is constantly seeking ways to innovate and improve the safety, longevity, quality, cost and environmental impact of its products and services.

As outlined, MMC is a means by which the sector can meet building regulations and innovate, learn and improve. This section looks at how procurement can be revised to support the development and adoption of MCC in housing, and the potential to build on the existing appetite for collaboration and learning that exists within Ireland's MMC industry and development sector generally.

Procurement

The Council recommends the creation of a dedicated MMC procurement strategy, under the Government's Capital Works Management Framework, that enables enhanced design and build contractual arrangements for high pre-manufactured value (PMV) MMC producer categories in 3D and 2D volumetric housing systems, including timber-based MMC. This procurement strategy should include Design for Manufacturing and Assembly (DfMA) and Design for Reuse (DfR) as required technical criteria for the evaluation of tenders and to support the shift toward increased value outcomes based on circular economy principles. Secondly, the procurement of MMC for housing must be capable of supporting investment in repeatable technical systems, designed and produced using efficient and reliable processes across the supply chain.

Broderick and Hickey (2024) detail how capturing the full cost and productivity benefits of MMC involves selecting from 2D panels, 3D modules, and hybrid designs; optimising the choice of materials; and overcoming challenges related to design, manufacturing, technology, logistics and assembly. DfMA addresses these challenges by adopting a 'highly integrated approach to offsite manufacturing (OSM) and onsite assembly that facilitates technological innovation and the use of digital construction tools' (ibid: 5).

A DfMA approach to building design anticipates the use of specific MMC components and takes into account how these will be manufactured offsite and assembled, together with other elements, during construction. Materials are selected

with manufacturing efficiencies in mind; interfaces with other MMC and traditional building elements are fully planned. This requires component manufacturers to have more input in the design at an early stage and closer integration of project phases and stakeholders, which can be facilitated through Building Information Modelling (BIM)[22] and other enabling technologies.

A value outcome across the supply chain of including DfMA and DfR as required technical criteria in the evaluation of tenders for new public housing supply under MMC procurement strategies is that it holds the potential to create a circular economy in the construction industry, with many of the design tasks required for successful DfMA adaptable for use in DfR.

The role of innovation tools to enable learning was referred to by industry interviewees advocating a 'design kit of parts' (D-KOP) development approach. Notwithstanding identified barriers of competitive commercial interest regarding intellectual property and a lack of consolidated demand, research is providing evidence of how the horizontal integration of standardisation approaches to the design dimensions of housing combine with performance and interface standards to produce a set of digital assets for the D-KOP. This enables DfMA and results in improved communications across the supply chain, fewer design changes, speedier approvals, and faster programme delivery with better quality and environmental outcomes. For example, early findings from research commissioned by the UK Department of Levelling Up, Housing and Communities in 2023 confirms how a strategy that utilises standard parts under DfMA can be established for low-rise housing (Akerlof & DLUHC, 2024).

Local authority senior managers report that the ADP design and build has a transformative effect on legacy sites and accelerates the use of MMC in public housing. As the ADP procurement is programme-focused, scope exists for contractors to innovate and adopt MMC. Procurement is also more efficiently delivered through the establishment of a series of regional contractor frameworks, with one local authority acting as a lead for each region. This has addressed concerns over a lack of competence in the procurement experience for MMC within some local authorities.

With budget expenditure per framework anticipated to range from EUR250m to EUR400m over a four-year period, the view of industry stakeholders is that this procurement needs to be optimised and must remain agile as the complexities and challenges of adopting MMC in housing are best understood between contractors and local authorities. This is especially relevant to the MMC roadmap milestone of initiating delivery of MMC Category 1 volumetric housing system pilot projects, now underway for two sites in Wexford and Carlow. The Wexford proposal is for approximately 12 houses on a site in Cluain Fada, New Ross. The Carlow proposal is for an apartment scheme of approximately 60 apartments on a site at Barrowville Court in Carlow town. While the scale of procurement for Category 1 MMC is minor in comparison, interviewees note the current industry focus in Ireland is primarily on MMC Categories 2 (2D primary structural systems) and 5 (non-structural assemblies and sub-assemblies). These categories of MMC favour competitive advantages over traditional construction approaches and allow DfMA that scales up overall capacity in panellised and pre-manufacturing assemblies and sub-assemblies.

Learning and Innovation

NSAI provide a database of Agrément certified MMC systems which comply with building regulations. At date of publication there are 20 MMC systems certified on this database (NSAI, undated). In addition, Wood Technology Ireland maintains a database of IS 440 certified timber frame systems (Wood Technology Ireland, undated). In addition, there are currently 35 certified timber frame systems on this website. In total there are 55 certified MMC systems available to the market in Ireland.

For new innovative products or systems, compliance with the Building Regulations can be demonstrated by third party certification by an independent approval body, such as National Standards Authority of Ireland (NSAI) Agrément. Agrément certification is a means of demonstrating compliance with each of the 12 parts of the Building Regulations, and is generally accepted by Building Control Authorities.

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[22] BIM is a process for creating and managing information on a construction project throughout its whole life cycle. It is a collaborative way of working, underpinned by the digital technologies that unlock more efficient methods of designing, creating and maintaining our assets. Properly implemented, BIM delivers projects to a higher quality and safety standard. One of the key outputs of this process is the Building Information Model itself, the digital description of every aspect of the built asset. This 3D model draws on information assembled collaboratively and updated at key stages of a project. See online at What is Building Information Modelling? | Capital Works Management Framework (constructionprocurement.gov.ie) [accessed 15/07/24].

However, there is no industry-wide, open-source, online portal for MMC residential suppliers to allow access to data and information on products and materials used in different designs and specifications that are National Standards Authority of Ireland (NSAI) certified.[23] In its absence, there is knowledge exchange between firms and companies with experience of having to change their product manufacturing process while also meeting performance requirements.

To help streamline the overall process of certification and associated costs, greater standardisation for specific 'build-ups' and assemblies used in the production and manufacturing of residential buildings is also required. Stakeholders argue that efforts to accelerate design standardisation for residential construction must also allow for flexibility in the substitution of component materials used.

Through greater collaboration, a single trusted source of vetted materials and suppliers, where technical guidance documents, safety sheets and performance calculations are available to use in specified build methodologies is nascent among industry actors.

This is helping to address construction price inflation by allowing price hikes for components and materials to be absorbed without having to undertake extensive and costly retesting due to materials or components being 'swapped out' of the production process.

Additional benefits of better industry-wide collaboration could include shorter supply chains with reduced transport costs and carbon consumption, while maintaining vertical integration in industry supply chains.

Research into testing and performance requirements have helped design and test new products, and alternative approaches for the specific technologies, in shorter time frame and in a more collaborative manner (Leimüller & Wasserbacher-Schwarzer, 2020). They help industry to gain improved understanding about innovations and therefore for regulation to be more effective. In addition, the participating innovators learn how to comply with the regulations. (Leimüller & Wasserbacher-Schwarzer, 2020).

The Council recommends that, under existing Housing for All structures, further research should consider how to support collaboration in Ireland between research bodies and industry to achieve a greater understanding of compliance and testing requirements.

Research work on MMC testing and certification could help shape the procurement strategy for MMC by helping to identify and secure standard component parts for use in MMC. The recent experience of the Office of Public Works in providing volumetric housing for Beneficiaries of Temporary Protection (BTP), and of local authorities with experience in the delivery of public housing using design and build procurement for MMC, offers an immediate starting point for more enhanced collaboration through experimentation, testing and learning.

In addition, the Council proposes that a resourced work programme for this new collaborative initiative should be developed and supported by the Department of Enterprise, Trade and Employment (DETE) MMC Leadership and Integration Group and the Department of Public Expenditure and Reform's Construction Sector Group.

5.4 Targets

This area of action features more concrete and binding targets that can provide further certainty, and in doing so help confirm an expanded supply pipeline of housing projects.

The ADP for new social housing delivery using MMC (see section 3.4) is making significant progress. The MMC roadmap's pivot towards a more market-shaping approach to public housing procurement is realising a substantial industry response. It is enabling a broader range of innovative solutions for new housing delivery that build confidence and boost Ireland's MMC capacity.

[23] While this remains outstanding, the Department of Enterprise, Trade and Employment (DETE) has commissioned research to develop a dashboard of metrics for MMC adoption, which should also track productivity related to same. This is to be made available in 2024 (DPENDR, 2024).

Nonetheless, a substantial opinion among stakeholders is that the initial ADP delivery targets are likely to be insufficient to trigger the required investment to expand overall manufacturing capacity and strengthen competencies. Under current public housing scheme procurement, bundles of orders in the magnitude of 50–80 units across multiple local authorities are anticipated. Expectations are that the established Tier 1 manufacturers will respond competitively under the current frameworks and will adjust their capacity to deliver.

In contrast to the current agnostic approach of the MMC roadmap, industry stakeholders observe how the MMC roadmap requires clearer specification of the MMC category considered best suited to public housing; i.e. Government should set more ambitious delivery targets for public housing using MMC. MMC industry stakeholders' proposition for a timely expansion of an equivalent to the ADP across all local authorities, together with a substantial increase in the target for new social and affordable housing supply using MMC, should be given serious consideration.

This view is reinforced by the Housing Commission (2024) finding that Ireland requires a targeted increase in the proportion of social and cost-rental housing to 20 per cent of the national stock, ensuring an appropriate tenure mix. It also notes that numerous bodies have responsibility for the delivery of social and affordable housing and believes that 'all public bodies and state agencies with a role in social and affordable housing delivery should be aligned and mandated to adhere to a Housing Procurement Strategy with consistent structures, criteria and assessment' (Housing Commission, 2024: 103). Significantly, competencies developed by local authorities in the current ADP can benefit all local authorities and help ensure a large proportion of the Housing for All target of 50,100 new social homes to be built between 2025 and 2030 are delivered under the design and build procurement frameworks established under the ADP that enable MMC in public housing.

The Housing Commission goes on to recommend the introduction of 'a National Housing Procurement Strategy that promotes collaboration between contracting parties and the supply chain to support the delivery of housing, and reform the Public Works Contracts with a new focus on collaboration and dispute resolution' (Recommendation no.27). Another relevant recommendation is to 'enhance contracting authority and supplier procurement teams with appropriate resources and competencies to accelerate the delivery of housing programmes' (Recommendation no.28).

In addition, Ireland's progress towards the adoption of regulations on the 'carbon footprint' of a residential development was seen by stakeholders as being too slow. This is due to obstacles such as the absence of substantial requirements to declare embodied carbon for proposed development under current local authority planning development management.[24]

Several interviewees contrasted this with Denmark's introduction of regulations from 1 January 2023 requiring an incremental annual reduction of the mandatory carbon limit allowable for buildings, to the required target set for 2030. This strategy is regarded as a major contributor to the expansion of timber-based MMC solutions across the construction sectors of the Nordic economies and is considered an example for Ireland to follow.[25]

Notably, the Housing Commission recommendation no.81 is for the State to 'support and deploy more widespread use of timber in housing construction and reform the building control system accordingly'. This will require incentivising and financially supporting the use of timber in housing construction, including in higher-rise buildings. An additional mandate for Enterprise Ireland is also proposed, in order 'to provide development supports aimed at encouraging the adoption of timber in housing construction'.

The Council recommends an incremental increase in the targets and funding for new public housing using MMC.

Assessment of the investment and development of human resources required to meet revised targets among public housing delivery partners is also needed, specifically the LDA; local authorities; AHBs; the NSAI; the Office of Government Procurement; SOLAS; Education and Training Boards, relevant commercial semi-state companies (e.g. Coillte); and non-governmental organisations (e.g. the Irish Green Building Council).

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[24] Embodied carbon is the carbon footprint of a building (or infrastructure) project before it becomes operational. It consists of all the Greenhouse Gas (GHG) emissions associated with extracting, manufacturing, transporting and installing building materials on site. It also includes the emissions from the construction practices and equipment used to install the materials.

[25] See online at https://www.nordicsustainableconstruction.com/ [accessed 15/07/24].

5.5 Innovative Finance

Creating a dedicated forward-funding arrangement for domestic investment in Ireland's MMC for housing should be considered. This would help avoid the risk that capital flows primarily to other EU jurisdictions or globally where the production and manufacture of MMC Categories is more advanced and investment opportunities are readily available.

A new source of debt finance for the capital costs of providing new social and affordable housing is available from Ireland's credit union sector.[26]

Innovative proposals under development include the initiation of a dedicated aggregator structure to pool financing from AHBs to a scale sufficient to access global debt capital via a bond issuance. The envisaged benefits include cheaper secured and unsecured funding, enabling AHBs to bid early and competitively against private equity funds and to forward-fund developments, including upfront investment in securing a pipeline of housing supply using MMC.

In effect, this form of financial innovation may be capable of operating as an attractive, alternative, debt procurement model for AHBs, in addition to their current reliance on State grants combined with loans from the Housing Finance Agency and Ireland's banking sector. Investment sector interviewees advocate for a substantial engagement with regulatory authorities in order to further elaborate and develop this financial model for MMC in housing.

The Department of Finance report on Ireland's residential development financing provides an estimate of the total development finance required across the public and private sectors in order to meet the Housing for All target of 33,000 homes per year. The report finds there is an 'active funding market for social and affordable delivery with strong competition to provide funding in this segment, with domestic banks, secondary and alternative lenders, the LDA and AHBs all active market participants' (DoF, 2024: 5). The report confirms the increasing role that AHBs play in providing funding to developers through the construction phase of delivery and how this is growing in scale. Importantly, it recognises how 'AHBs and developers have highlighted that this approach can reduce total overall acquisition costs for the AHBs by eliminating any private financing costs (debt and equity), can make high density developments viable and can allow AHBs more control over the design process' (DoF, 2024: 5).

Enhanced engagement across Government could help ensure that future scaled investment in MMC for public housing (e.g. under the ADP) or other targeted initiatives is included in the categorisation of 'infrastructure' available for funding under the Future Ireland Fund and Infrastructure, Climate and Nature Fund Act 2024.

The Infrastructure, Climate and Nature Fund (ICNF) offers a possible opportunity for newly targeted investment in MMC for housing delivery. Envisaged as acting in a countercyclical manner, the infrastructure element of the ICNF will act as an adjunct to the National Development Plan and provide resources for the Government to support capital projects in an economic downturn and where government revenues have fallen. The countercyclical element in the ICNF has substantial value in cushioning future economic shocks and maintaining growth-enhancing investment through periods of lower or negative growth. It should also help prevent the loss of the relevant expertise required for capital projects (builders, engineers, architects, etc.) to the construction sector with negative outcomes for the State and society.

A total of EUR3.15bn is available for climate and nature spending in Ireland between 2026 and 2030. Government targets on achieving reductions in greenhouse gas emissions and on nature restoration and water quality targets are identified as the 'trigger mechanism' for activating access to this funding. Up to 25 per cent of the ICNF (less any commitments to climate and nature expenditure) can be used in one year in relation to infrastructure.

[26] See the Credit Unions Approved Housing Body Fund online at www.cuahbfund.ie [accessed 15/07/24].

5.6 New Employment Opportunities

Greater MMC adoption in housing will involve a mixture of new and higher skills and competencies found in construction, manufacturing and supply chain management.

This reflects the impact of digitalisation, and, as non-traditional MMC becomes increasingly embedded, a range of employment opportunities are emerging for new entrants with a greater range of diverse competencies, experience and backgrounds.

For example, the advantages of BIM, now commonly used across MMC companies, are considered as being of enormous benefit to industry-wide efforts to digitalise construction processes through sharing information and increasing collaboration. Benefits include project monitoring for costs and, critically, for carbon.

Interviewees note, however, that the 'BIM mandate' needs to be fully established in public procurement of all scales of housing as a matter of urgency, with some suggestions that early adopters in the MMC sector should achieve preferential ratings under the Capital Works Management Framework for large-scale housing procurement.

Policy-makers need to provide additional supports and incentives to facilitate further upskilling for MMC roles (CPS, 2022). This should ensure an adequate pipeline of skilled professionals in critical skills areas such as production line management and process control, specialised design, BIM, architecture and logistics.

Through collaboration with educational institutions, industry bodies and other training providers, the State has a key role to play in developing specialised training programmes to support MMC-specific skills. Such efforts should draw upon the experience and expertise of industry practitioners to ensure that training options align with industry needs. This will require increased co-ordination and additional resourcing of training programmes from organisations such as SOLAS; education and training boards; Construction Professionals Skillnet; the Construction Industry Federation; trade unions; the Health and Safety Authority; National Construction Training and Safety; and the tertiary education sector and other training providers, including community-based training providers funded under the Social Inclusion and Community Activation Programme and wider labour market activation initiatives.[27]

In the area of apprenticeships and internships, there is a need for dedicated training options specific to the MMC sector, in order to provide hands-on experience and practical skills development options for students and trainees. Such initiatives should be accompanied by promotional campaigns to raise awareness of career prospects for trainees in the MMC sector.

The overall upskilling of existing workers will need to cover the site management, integration, onsite placement and assembly that will be increasingly required for MMC. This can represent a cost burden for firms and companies seeking to adopt new MMC solutions under digitalisation, as well as requiring a shift in culture and attitudes to new ways of working.

The requirement to cultivate a growing, diversified construction labour force with multiple skills and competencies is the basis of the Department of Further and Higher Education, Research, Innovation and Science Action Plan for Apprenticeship, 2021–2025 (DFHERIS, 2023). The Action Plan highlights data for 2019 to 2023 categorised by gender breakdown across construction-related work and skills, illustrating the scale of the disparity between male and female employment. It stresses the importance of addressing this, by means of gender-inclusive recruitment policies across the sector, mentoring programmes for female employees, and staff training on gender bias.

The potential of greater MMC adoption to substantially alter the mix of skills and competencies required of new entrants to the construction sector underscores the critical role of education and apprenticeships.

Interviewees consider that expediting upskilling for construction (particularly for MMC) via changes in Senior Cycle 'learning pathways' to new higher and further education traineeships and apprenticeships is critical. Mentoring, coaching and placements for Transition Year students need to be readily available alongside dedicated career guidance

[27] See online at Social Inclusion and Community Activation Programme (SICAP) 2024 – 2028 - Pobal [accessed 15/07/24].

and events targeting secondary school students. Interviewees confirmed their experiences in this regard as challenging, while noting that success requires initiative and a developmental approach at the firm or company level.

Industry interviewees are also keen to stress the need to better understand migration impacts and dynamics among skilled workers employed in MMC construction and noted how tight, regional labour markets experience periodic, and at times rapid, change. Interviewees reflected how push and pull factors driving migration patterns and regional employment must inform the Government response to delivering interventions to support the future skills and needs required for the greater adoption of MMC in housing. Some noted a reluctance to invest in upskilling as construction labour market instability continues due to changes in net migration patterns. Overall, however, interviewees recognise how migration dynamics in construction are well known and that the challenge of 'holding talent in the country' can be anticipated and planned for.

5.7 Positive Promotion

This section considers how the image of the MMC sector could be enhanced, both to improve how it is understood and to improve its attractiveness to potential employees.

The COVID-19 era search for space brought forth a reappraisal of previously demonised higher-density forms of residential space, especially deck-access apartment, maisonette or flat living of a type still very much in use as housing in Dublin.

This insight is partly confirmed by Wang and McCrum (2024), who included members of the general public in their survey on attitudes to MMC and report a positive perception towards the 'modular house' and 'offsite house', and a more negative perception towards the 'prefabricated house' and 'rapid-build house'. The reception to the consecutive programmes of 'volumetric modular' housing schemes recently delivered by Dublin City Council (DCC), for example in Dublin 8 (Bonham Street) and Dublin 20 (Chapelizod), has also been very positive. Both housing developments deployed MMC for housing, with procurement frameworks based on shared learning and experiences between DCC, DHLGH and contractors (DCC, 2024). Documented learning from this experience would contribute to the evidence base and Dublin City Council should consider producing a study and report.

A promotion campaign to demonstrate the quality of these housing solutions and communicate the role of MMC in housing and placemaking for communities requires greater collaboration and leadership among the key actors involved.

Examples of quality MMC housing typologies need to be showcased as attractive residences and spaces for sustainable communities. The successful delivery of the MMC Demonstration Park in Co. Offaly is an imperative in this regard. A substantially resourced programme of exhibition and knowledge exchange, utilising in-person and remote engagement, transmedia resources, and micro-credential learning and training, is required to address gaps in knowledge and understanding of MMC in housing. These gaps remain significant among public agencies, the construction industry and professional practitioner networks; for example, in design; architecture; engineering; planning and development; finance and insurance; and regulation and standards.

A significant opportunity exists for public agency, industry representative and practitioner network participation in the EU High Level Construction Forum. Following the update of the Green Deal Industrial Plan (European Commission, 2023), the purpose of the High Level Construction Forum is to co-create (and monitor) the green, digital and resilient transition pathways for the EU construction industry ecosystem. This will be done in partnership with industry, public authorities, social partners and other relevant stakeholders.[28]

In addition, in relation to the State's housing provision for Beneficiaries of Temporary Protection (BTP) and, given that the temporal use of this volumetric housing is short-term, sequential and limited, the misplaced attribution that the dwelling is also temporary and, by inference, in some way disposable, cheaper and less desirable, needs to be challenged (Murphy & Stapleton, 2024).

[28] See online at High Level Construction Forum | BUILD UP (europa.eu) [accessed 15/07/24].

This can be done by demonstrating how volumetric housing is required to meet all certification and building control standards in Ireland, with a 60-year durability guarantee for all key elements. As such, volumetric housing is a net contribution to the stock of new, quality housing.

The temporal use of demountable and offsite manufactured volumetric housing systems as 'meanwhile' developments on brownfield and other available sites can be envisaged as a precursor to the residential densities required to deliver compact residential growth and sustainable development objectives (Akerlof, 2024).

In conclusion, the National Economic and Social Council (NESC) recommends an expanded programme of promoting MMC in housing in order to increase understanding and acceptance across Irish society and in key sectors, such as insurance, finance, regulation, design, engineering and planning.

5.8 Conclusion

This report examines MMC, the challenges to its greater adoption in residential development and placemaking, and the substantial benefits of successfully deploying and advancing MMC in housing.

The Council finds that using MMC provides an opportunity to deliver housing in a new, adaptive and sustainable way. It has very significant potential to decarbonise new housing supply and renovate existing stock.

It can also be an important source of job creation and export-led growth and a means of enabling more balanced regional economic development in Ireland. Greater adoption of MMC in housing will also contribute to helping transform Ireland into a more circular economy.

This report helps clarify what issues are stifling progress and has identified concrete actions for implementation. Key among these is continually increased collaboration between State and market actors to realise the potential of MMC to increase overall housing delivery. Collaboration is key to enabling the long-term vision and potential of the MMC sector in Ireland in areas such as regulation, design, manufacturing, standards, procurement, and skills development.

There is a clear need for the State to develop and promote additional MMC-specific initiatives to address impediments to its wider adoption by industry, to facilitate the knowledge-sharing among public and private sector stakeholders that can resolve regulatory obstacles and other issues, and to demonstrate the potential benefits of the sector to the construction industry and the wider public.

Significant potential for institutional leadership exists in the larger local authorities and AHBs, whose greater financial and human resource capacities and competencies are currently deployed for delivering new social and affordable housing projects that utilise MMC. The ADP demonstrates the benefits of MMC and can facilitate housing system-wide knowledge exchange, while also fostering greater adoption and demonstrating the commercial viability of MMC for industry stakeholders.

The report confirms that innovative tools to facilitate experimentation and enable greater regulatory and entrepreneurial learning should be deployed. It also outlines the value of regulatory experimentation tools ('sandboxes') to support a housing-system wide transformation and the greater use of MMC across the residential home building sector in Ireland.

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161	Social Enterprise on the Island of Ireland	2023			

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1	Ireland's Economic Recovery: An Analysis and Exploration	2011	15	Cost-Benefit Analysis, Environment and Climate Change	2018
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3	Towards a New Climate Change Policy	2012	17	The Framing of Climate Action in Ireland: Strategic Considerations	2019
4	Ireland and the Climate Change Challenge: Connecting 'How Much' with 'How To'. Final Report of the NESC Secretariat	2012	18	Urban Structure, Spatial Planning and Climate Emissions	2019
5	Review of Developments in Banking and Finance	2013	19	The Transition to a Low-Carbon and More Digital Future: Supporting the Needs of Vulnerable Workers and Enterprises	2020
6	Employment and Enterprise Policy	2013	20	Approaches to Transition	2020
7	Greening the Economy: Challenges and Possibilities for Integrating Sustainability into Core Government Policy	2013	21	Shared Island Consultation: Climate and Biodiversity Challenges and Opportunities	2021
8	Activation Policy	2012	22	Community Call: Learning for the Future	2021
9	Consumer Prices	2012	23	Shared Island: Projects, Progress & Policy The Good Jobs Agenda	2021
10	Review of Irish Social and Affordable Housing	2014	24	Housing and Urban Development Policy Priorities	2021
11	Financing of Social Housing in Selected European Countries	2014	25	Shared Island: Projects, Progress & Policy The Island Economy	2021
12	Reflections on Infrastructure Policy and Institutional Developments in the UK	2017	26	Building a New Relationship between Voluntary Organisations and the State in the Health and Social Care Sectors	2021
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14	International Approaches to Land Use, Housing and Urban Development	2018	28	Shared Island: Projects, Progress & Policy Sharing Knowledge and Lessons in Combatting Poverty	2021

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31	An Opportunity to Review and Reframe Collective Bargaining and the Industrial Relations Regime	2023			

Research Reports					
No.	**Title**	**Year**	**No.**	**Title**	**Year**
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2	Cluster in Ireland; The Irish Popular Music Industry: An Application of Porter's Cluster Analysis	1997	13	Advancing the Low-Carbon Transition in Irish Transport	2019
3	Cluster in Ireland: The Irish Indigenous Software Industry: An Application of Porter's Cluster Analysis	1997	14	Transport-Orientated Development: Assessing Opportunity for Ireland Background Case Studies	2019
4	Profit Sharing Employee Share, Ownership and Gainsharing: What can they Achieve?	2000	15	Four Case Studies on Just Transition: Issues for Ireland	2020
5	Sustaining Competitiveness Advantage: Proceedings of NESC Seminar	1998	16	Modelling the Zero-Carbon Transition: International Approaches and Lessons for Ireland	2020
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8	Socially Integrated Housing and Sustainable Urban Communities: Case Studies from Dublin	2016	19	Economic Resilience in Sustainable Communities: Innovative Approaches in Public Spending to Maximise Local Benefits	2021
9	The Burren Life Programme; An Overview	2016	20	Challenges and Opportunities for Rural Ireland and the Agricultural Sector	2021
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