July 2024

Skills for Modern Methods of Construction

An Assessment of the Current and Future Skills Requirements for the Transition to Modern Methods of Construction

Report prepared by Ernst & Young Business Advisory Services

National Skills Council

Expert Group on Future Skills Needs

Contents

Acknowledgments

The Expert Group on Future Skills Needs would like to thank the members of the Steering Group established for this study, for contributing their time, valuable knowledge and expertise, including: Sarah-Jane Pisciotti, MMC Ireland and Chair of the Steering Group; Marcella Murphy, Construction Sector Group; Caroline O'Laochdha, Vision Built; Liam Berney, Irish Congress of Trade Unions; Liz Thomas, Skillnet; Shauna Dunlop, SOLAS; Denise Tuffy, Construction Industry Federation; Aisling Soden, IDA Ireland; Ross O'Colmain, Enterprise Ireland; Martin Murray, Procon Modular; Dan Lidan, Smart Offsite Association; Hugh O'Connor, DTE Manufacturing Ltd; Pranash Ramanundh, Royal Institute of the Architects of Ireland; Peter de Lacy Staunton, Irish Timber Frame Manufacturers Association; Jim Patterson, Alexanders Timber Design Ltd; Gary Smith, Keenan Timber Frame; Linda Kane, Céline McHugh, Manus O'Donnell and Sandra O'Reilly, Department of Enterprise, Trade and Employment; Sarah Miley and Damien Henehan, Department of Further and Higher Education, Research, Innovation and Science; Éadaoin Ní Fhearghail, Department of Housing, Local Government and Heritage; and Catherine Higgins, Department of Environment, Climate and Communications. The EGFSN would like to express its gratitude to all the industry experts who participated in one-to-one interviews, completed the detailed survey and participated in the workshops which formed such an important part of this study.

Finally, the Expert Group on Future Skills Needs would also like to express its appreciation of the high-quality work and expertise of EY Business Advisory Services, who were commissioned to undertake this study on behalf of the EGFSN.

Introduction to the Expert Group on Future Skills Needs

The Expert Group on Future Skills Needs (EGFSN) advises the Irish Government on the current and future skills needs of the economy and on other labour market issues that impact on Ireland's enterprise and employment growth. It has a central role in ensuring that labour market needs for skilled workers are anticipated and met.

Specifically, the EGFSN:

- Carries out research, analysis and horizon scanning in relation to emerging skills requirements at thematic and sectoral levels. Steering Groups comprising of experts from relevant enterprise sectors and the education and training sector may oversee sectoral research studies to be undertaken or commissioned by the EGFSN. Drawing on statistical input and analysis from the Skills and Labour Market Research Unit, SOLAS and consultation with the enterprise/ education experts as part of the study, draft reports setting out the projected needs are prepared by the EGFSN.
- Engages with the Higher Education Authority, SOLAS, Quality and Qualifications Ireland, the Regional Skills Fora, and education and training providers in the course of its research.
- Engage with Department of Further and Higher Education, Research, Innovation and Science, the Higher Education Authority, SOLAS and other relevant bodies to produce agreed action plans to address the skills needs identified.
- Submits the findings of its research and agreed Action Plans to the National Skills Council prior to publication.
- Disseminates its findings to the Regional Skills Fora and other relevant groups.

The Enterprise Strategy, Competitiveness and Evaluations Division within the Department of Enterprise, Trade and Employment provides the EGFSN with research and analysis support.

Foreword

Housing is an essential infrastructure in any society. Ireland's housing market has experienced significant volatility over the past two decades, with current housing demand outstripping supply. *Housing for All* is the Government's housing plan to 2030. It is a multi-annual, multi-billion euro plan which aims to improve Ireland's housing system and deliver more homes of all types for people with different housing needs. *Housing for All* contains more than 200 actions, including a request to the Expert Group on Future Skills Needs to determine the skills required to transform Ireland's construction sector through widespread adoption of Modern Methods of Construction.

A culture of good quality, sustainable innovation in residential construction through the development of Modern Methods of Construction is an important element of increasing housing supply and improving productivity in the sector. This research seeks to identify the nature of the skills needs of enterprises supporting the transition to MMC in the coming decade. By identifying the skills gaps that exist within the industry and offering recommendations to address them, this report aims to support the sector as it evolves, ensuring that a robust and resilient workforce is available with the appropriate skills to facilitate the transformation.

Across eight themes, 28 recommendations have been identified, bringing together insights from the domestic literature, international best practices, stakeholder engagements, and the current provision of training in Ireland. Many of the themes are inter-related and cross over with one another in terms of the actions they are proposing and will require collaboration across Government, industry and the education and training system in order to be successful. The eight themes cover a range of areas including senior management training, information sharing, new roles and labour retention, use of digital and AI tools, certification, early learning engagement, policy levers, and training provision.

I would like to thank the project Steering Group for its time and expertise throughout the process, as well as their help in ensuring a robust response to the survey carried out as part of the project. In particular, my thanks go to Sarah-Jane Pisciotti who chaired the Group and provided leadership for the process, and to Linda Kane from the secretariat who managed this study for the EGFSN. The EGFSN looks forward to working with the Department of Further and Higher Education, Research, Innovation and Science as they lead on developing an Action Plan which will take the report's recommendations and detail how they can be delivered. The EGFSN Secretariat will oversee the implementation of these actions over the next two years.

Tony Donohoe

Chair, Expert Group on Future Skills Needs

Research and Forecast for Skills Required for Modern Methods of Construction

Reliance Restricted

July 2024

Building a better working world

This report has been prepared by Ernst & Young, in accordance with an engagement agreement for professional services with the Department of Enterprise, Trade and Employment ("DETE"), who commissioned this research on behalf of the Expert Group on Future Skills Needs. Ernst & Young's obligations to DETE are governed by that engagement agreement.

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1 Executive Summary and Recommendations

Building a better working world

Adopting MMC is crucial for the construction industry to accelerate the delivery of housing, alleviate labour shortages, and improve productivity

Why is adopting MMC important?

Accelerating adoption of Modern Methods of Construction (MMC) has long been identified as a critical need for the construction sector for the following reasons:

1. Accelerate housing supply: The use of prefabricated components and modular building techniques has the ability to significantly reduce the time and resources required to develop new residential units.
2. Quality and efficiency: MMC offers improved quality control as many components are manufactured in a controlled factory environment. This can lead to reduced risks and better energy efficiency.
3. Labour shortage: The construction industry in Ireland, like many other countries, is facing a shortage of skilled labour. MMC requires less on-site labour and can help mitigate this issue by relying more on off-site manufacturing processes.
4. Cost savings: Over time, MMC can lead to cost savings through economies of scale, reduced waste, and shorter timeframes. This can make construction projects more financially viable and help to lower the cost of housing.
5. Sustainability: MMC often incorporates sustainable materials and practices, which is important for Ireland's environmental goals. The reduction in construction waste and the ability to design for energy efficiency contribute to a more sustainable construction industry.
6. Innovation and technology: Embracing MMC encourages innovation and the use of new technologies. This can position Ireland as a leader in construction technology and improve productivity and competitiveness.
7. Safety: MMC can improve safety on construction sites, as much of the work is done off-site in a controlled environment, reducing the risk of accidents and injuries associated with traditional construction methods.
8. Adaptablility: MMC allows for more adaptable and flexible design, which can be particularly useful in urban areas where space is limited or in retrofitting existing buildings.
9. Economic growth**:** The construction sector is a significant contributor to Ireland's economy. By adopting MMC, the country can stimulate economic growth through increased construction activity and the development of new industries related to prefabrication and modular construction.

What is MMC?

MMC consists of differing types of construction techniques that improve productivity and aims to reduce time, cost, waste and errors of building projects. These modern construction techniques include offsite construction (OSC), modular construction, pre-fabrication and 3D printing, as well as assembly onsite.

There are seven general categories of MMC:

1. 3D Volumetric Pre-manufacturing
2. 2D Panelised Pre-manufacturing
3. Non-Systemised Primary Structure Pre-manufacturing
4. Sub-Assembly (Pods) Pre-manufacturing
5. Additive Manufacturing
6. Traditional Building Product Led Site Labour Reduction
7. Labour Reduction/Productivity Assurance Improvements

Each MMC category contains different techniques, however training can be provided which covers transferable skills across manufacturing facilities. Skills and training required to accelerate MMC, however, must be considered more broadly across the supply chain.

The above stages have been identified within the supply chain as requiring particular training and upskilling needs. Given the nature of manufacturing components of a build offsite, the early stages of the MMC ecosystem become highly important. Thorough planning, the enablement of a ‘design freeze’ and overall recognition of the level of coordination required across the supply chain is necessary before offsite manufacturing can commence.

This report interrogates relevant literature and an international review of best practices on skills adoption to accelerate MMC adoption, while consulting with stakeholders and assessing skills supply

Purpose of the study

The Government's Housing for All (HfA) Plan, first published in 2021 and subsequently updated in 2022, is the Government's housing plan to 2030. It is a multi-annual, multi-billion-euro plan which will improve Ireland's housing system and deliver more homes of all types for people with different housing needs. The Government's overall objective is that every citizen in the State should have access to good quality homes:

- to purchase or rent at an affordable price
- built to a high standard and in the right place
- offering a high quality of life

It is estimated that Ireland will need an average of 33,000 new homes to be provided each year from 2021 to 2030, however this is likely to increase with the publication of the updated National Planning Framework in the coming months.

DETE proposed several MMC-related actions that were included in the updated HfA plan that was published in 2022. Action 13.10 (HfA 2022) calls for DETE to work with the relevant bodies on how to best examine the current and future skills needed for the transition to MMC. As such, DETE have procured this research, which has sought to:

- Identify the nature and scale of the skills needs of enterprises supporting the transition to MMC in the coming decade
- Develop a suite of recommendations that can be drawn up to ensure that the forecasted MMC skills needs are fully addressed by stakeholders through the education and training system and any other relevant source of skills supply

The research includes:

- Desk-based research on available literature to provide a thorough review and international benchmarking exercise
- Extensive stakeholder engagement, performed by conducting an industry survey, individual interviews and two workshops
- Development of two case studies and skills supply assessment

Contents of the report

Section 1: Contains the Executive Summary and Recommendations

Section 2: Sets out the background and context for the report, along with the definition of MMC

Section 3: Details the literature review of MMC skills needs across the supply chain

Section 4: Provides the international benchmarking exercise which identifies a review of MMC practices in England and Wales, Hong Kong, Japan, Scotland and Sweden

Section 5: Provides an analysis of the insights garnered from the stakeholder engagement, including the industry survey, interviews and two workshops

Section 6: Details two case studies which depict the disciplines and skills required to deliver scheme housing and apartments using MMC inputs

Section 7: Reviews and elaborates on the assessment of skills supply in Ireland at present, including any gaps that exist in training provision at present

Section 8: Contains the Appendices.

Both the literature and international reviews illustrate the value in training, upskilling and industry collaboration to utilise new technological advances in construction

The Literature Review discusses literature on skills needs required across the MMC supply chain, from both international and domestic sources

Literature Review

- MMC requires the evolution of traditional design and planning skills and approaches, including continuous training to remain up-to-date with the latest technologies
- Digitising procurement, and acquiring relevant skills in this areas, is a key hurdle to achieving the required process realignment needed to ensure the success of MMC
- The specific skills required to upskill the construction labour force have been identified and are well understood
- Installation skills build on existing on-site capabilities, but additional skillsets are required

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The International Review section covers the following countries to provide learnings on best practices:

- England and Wales
- Scotland
- Hong Kong
- Japan
- Sweden

International Review

- Countries such as Japan and Sweden have well established MMC processes historically which has allowed for a more embedded manufacturing system with less reliance on labour intensities
- There is a significant presence of demonstration parks and innovation hubs across the five countries reviewed, illustrating the importance of collaboration and knowledge sharing between industry, government and academia
- Government policies and programmes, including the employment of roadmaps and funding is common across all jurisdictions, demonstrating how effective policy levers can be used to promote MMC adoption
- A summary of findings from the International Review is provided for overleaf (pg. 8)

See pg. 33

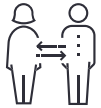
A number of lessons from the international review can be applied to MMC in Ireland

Country	England & Wales	Scotland	Hong Kong	Japan	Sweden
What they are doing	► Construction Industry Training Board Strategic Plan 2021-2025: new training programmes, qualifications and standardisations ► Affordable Homes Programme with a large commitment to MMC used in home delivery ► Talent Retention Scheme aimed to recruit, redeploy and train construction workers ► Onsite experience hubs across the country, particularly in underrepresented regions to future proof construction skills and bring together industry players and academia	► Built Environment – Smarter Transformation (BE-ST) launched as a collaborative hub to allow knowledge sharing between industry, government and academia on best practices in MMC ► Clear guidance from government on MMC to increase confidence and trust in the industry and increase the competency of those signing off MMC projects	► Construction Innovation and Technology Fund (CITF) to build up technologies and skills for MMC adoption ► Subsidised c.14,000 training places for construction practitioners to attend technology-related training ► Construction Industry Council (CIC) established to: provide trainings for industry, assess standards of skills of all participating in the industry, establish and maintain MMC centres ► Construction 2.0 publication, setting out clear targets for training	► Early government adoption allowed for cultural shift towards manufacturing processes ► Society 5.0 – increased use of technology (e.g. BIM & DfMA) and automation in the industry through pilot projects and guidelines ► Large amount of imported construction labour receiving specific trainings to acclimatise to the offsite and MMC driven Japanese construction industry ► Japan Build Digital Expo and J-Innovation HUB established to showcase innovation	► Embedded standardised processes has led to less labour shortages ► Development Fund of the Swedish Construction Industry (SBUF) to support the development of methods, equipment and research with affiliated companies ► Byggbranschens Utbildningscenter (BUC) established as a construction training centre to inform industry on sustainable training and deliver them through a choice of digital or in person classes, including the use of VR
Learnings for Ireland	► Develop a one-stop-shop for recruitment, redeployment and training for MMC roles ► Avoid similar pitfalls surrounding pipeline and training focus	► Develop an industry collaboration hub, showcasing new technologies and promote knowledge sharing ► Further promote certification guidance documents for industry, particularly for Agrément Certification	► Establish and monitor a central repository for training metrics linked to MMC ► Clear government roadmap on digitalisation and increased use of MMC in the industry	► Cultural shift in public attitudes towards using modern methods for residential development driven by Government ► Increased efforts to import skilled labour to accelerate adoption of MMC	► Enhanced collaboration between industry, academia and government funding to deliver training ► Increased use of alternative training delivery methodologies to engage trainees and promote enrolment

Three stakeholder consultation exercises were carried out to ensure a diverse range of views were captured on training and skills needs in Ireland

Survey 29 organisations

An industry survey was distributed to organisations across the MMC supply chain. Dashboard outputs of this survey can be found at Appendix 1.



Interviews 17 organisations

17 interviews were held with industry representative bodies and public bodies who gave a wide-ranging view of the use of MMC across the supply chain and the skills and knowledge gaps within the sector at present.

Workshops 22 organisations

Two workshops were held to further interrogate:

a. The skills and knowledge gaps at the planning, design, procurement and certification/sign-off stages of residential development using MMC; and

b. How to encourage more training and upskilling of the traditional workforce and break the barriers for the industry to access publicly funded training for MMC specific training courses

Consultation findings

Accelerating the adoption of MMC is multi-faceted, and it is acknowledged that the Government is taking a wide-lens view on issues to be tackled. Many topics discussed throughout the stakeholder consultation were broader than the specific scope of this research, however the key findings as detailed in this chapter are specific to addressing labour and skills needs.

The stakeholder consultation process provided key results for this report. These have been summarised under six key themes which capture the essence of the discussions. The consultations were conducted to investigate the skills needs across the MMC supply chain from industry, representative bodies, public bodies and training providers. A summary of the three methods of stakeholder engagement carried out are detailed overleaf, with the full section available on pg. 52.

We have grouped insights into 6 key themes

1

Knowledge gaps and the role of senior management

- Often cited was the existence of 'Knowledge' gaps rather than 'skills' gaps at senior levels of procurers and their professional advisers
- Greater knowledge is needed of the timing of procedures across the MMC supply chain to understand design and offsite/onsite connectivity and the need to integrate processes.
- Senior management in the construction industry should improve their understanding of the strategic value of MMC to drive implementation.

2

The skills required to get planning and design right are crucial

- Early integration of MMC in planning and design of builds is integral to implementing MMC efficiently.
- Enhanced coordination and collaboration across the supply chain is required.
- The '80:20 rule' should not apply to MMC, for which late-stage onsite adjustments are challenging.

3

Certification

- A greater understanding of the requirements for Agrément Certification is required in the industry to improve application processes and achieve timely certification.
- Training may be needed for design teams to confirm that Agrément Certified MMC systems work at site-level.
- Training for onsite installation of MMC products is required to ensure full compliance with Agrément Certification and building regulations.

4

Skill and labour retention

- Increased use of MMC may provide a solution to the 'brain drain' of the industry, as workers age.
- Computer literacy and the willingness of the labour force to engage in upskilling should be considered by training providers.

5

Cultural shift and gender diversity

- A shift in culture towards careers in the construction sector is needed, and MMC can aid to promote greater uptake.
- Increased use of offsite manufacturing processes can be conducive to enabling more women to pursue careers in construction.
- Rebranding as 'digitally-enabled construction' or' 'built environment' careers may attract younger workers

6

Accessibility of skills training

- Time and resource constraints create barriers for industry to access training, particularly for SMEs and microbusinesses.
- The lack of computer-skills and/or access to laptops, computers. for online learning is an impediment for SMEs which phone- or app-based training may overcome.
- A combination of further incentives and mandates could be required by Government to enable improved access.

While there are a substantial number of training courses provided in Ireland, barriers to access training persists for industry

The case studies provide a detailed view of skills required for housing and apartment developments using MMC inputs

Case studies

- The case study analysis provides tangible, Irish examples of the skills and knowledge required to build residential houses and apartments using MMC inputs of timber frame and pre-cast concrete, respectively.
- As structural labour issues persist in the construction sector, industry will be required to evolve their business and delivery models. Transferring site-based construction activities to a factory is a tangible way of overcoming the industry's shortage of skills.
- Traditional wet trades will continue to be necessary for any build, particularly for the external leaf, however, the intensity of these trades onsite reduces as the proportion of premanufactured components increases.
- It is expected that traditional onsite roles will evolve into positions that require expertise in logistics, supply chain management, and quality control within a factory setting. As a result, there is a growing need for cross-disciplinary skills that span both traditional construction practices and modern manufacturing techniques.

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The supply side assessment included the current provision of training courses to industry and the barriers for industry to engage

Supply side assessment

- There are currently a large number of training courses provided across various training providers, but most specifically by SOLAS, through Educational Training Boards (ETBs) across the country and Skillnet Ireland
- The establishment of the DFHERIS led Mount Lucas Demonstration Park for MMC under Laois and Offaly ETB, in particular, has provided a centralised hub for training for MMC specific skills
- Barriers to access training by industry persist, including the ability to relieve resources. As such, many offsite manufacturers have produced in-house training
- Increased use of alternative training practices, including the use of virtual reality, AI, and onsite training roadshows should be considered by training providers to increase enrolments and uptake by industry

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Recommendations have been developed from all aspects of the research, and collaboration between industry and Government is key to address the identified issues

Ireland has already begun to adopt best practices to transition to MMC in the Irish construction sector. Housing for All has developed actions to promote the adoption of MMC, some of which have already been delivered, including the Roadmap for increased adoption of MMC in Public Housing delivery.

The establishment of Construct Innovate and the Mount Lucas Demonstration Park for MMC have been delivered and are currently key enablers to promote innovation, research industry collaboration and skills training.

28 recommendations have been identified across eight themes, bringing together insights from relevant literature, international best practices, stakeholder engagements and the current provision of training in Ireland.

These recommendations provide an opportunity to further develop and foster a collaborative and innovative learning environment. This includes encouraging new entrants into the sector, and upskilling/retraining the current labour force. Transitioning to offsite construction should enable visibility of broadened construction careers, offering increased access for the regional labour force and new pathways for female entrants.

Collaboration between the construction industry and Government should be at the heart of delivering on these recommendations. Actions by both will be integral to set the pace at which MMC is accelerated in the Irish residential market.

It is noted that, following the publication of this research, the Department of Further and Higher Education, Research, Innovation and Science (DFHERIS) will develop an Action Plan to target actions Government can take to address skill and training needs to adopt MMC practices.

1. **Senior management training**
2. **Information sharing**
3. **New roles and labour retention**
4. **Use of digital and AI tools**
5. **Certification**
6. **Early learning engagement**
7. **Policy levers**
8. **Training provisions**

To fully embed MMC practices in the Irish residential construction sector, knowledge and awareness among senior management across the industry needs to be at the forefront

1 Senior management training

1.1 Upskilling/retraining must be done across the wider supply chain, including connected industries i.e. transportation, finance and insurance

1.2 Detailed planning and communication is required when components of a build are developed offsite. Enhanced communication skills should be developed by construction management across the supply chain to mitigate risks and ensure quality assurance

1.3 A continuation of knowledge sharing and best practices among local authorities to implement the use of MMC when procuring public housing

1.4 Targeted training, including micro credential programmes in MMC, should be provided for senior management of developers and contractors to improve awareness of enhanced capabilities of offsite manufacturing, as well as offer an improved understanding of the interconnectedness across the supply chain when producing built components offsite

To ensure widespread adoption of MMC practices for residential developments, senior management across the construction sector supply chain must be knowledgeable of the process to adopt offsite manufacturing processes.

Evidence from this research points to a knowledge gap between new entrants into the sector and senior decision makers, as recent graduates bring with them a higher exposure to the use of MMC and digital practices.

It is understood that there are restrictions on time and resources to enable senior managers access relevant training. The use of targeted micro credential courses could be considered to bridge this knowledge gap. There may also be a lack of awareness of the opportunities offsite manufacturing can provide, hence a limited awareness of a need for upskilling/training.

Heightened awareness from industry and Government alike will be crucial, along with increased use of training roadshows (Recommendation 8.1) and the establishment of a knowledge sharing hub (Recommendation 2.1).

The use of mandates, for example a requirement for a minimum level of training in DfMA may be beneficial if Government incentives do not receive the desired uptake (see Recommendation 7.1).

It will also be important to collect and review feedback from industry on the provision of courses to consistently improve delivery and ensure continued suitability.

Information sharing and collaboration across industry, academia and Government is required, however there needs to be improved data provision for new measures to be targeted

2 Information sharing

2.1 Establish offsite regional knowledge sharing hubs for industry to showcase new technologies and collaborate to accelerate the adoption of offsite processes in Ireland

2.2 Establish and monitor a central repository for training metrics linked to MMC

2.3 Investigate how the CSO can better capture statistics on the current labour force in manufacturing within the construction industry

Knowledge and information sharing across industry is integral to promote the embedded use of MMC practices. The benefits of establishing a hub reach far beyond labour and upskilling needs, including showcasing of new technologies and collaboration between industry, government and academia. The Demonstration Park at Mount Lucas could be best placed to play this role.

It is suggested that a regional hub is established in a strategic location to enable accessibility by offsite manufacturers. Feedback from the stakeholder consultations and evidence from the literature and international reviews indicated that manufacturing facilities located regionally can be enablers for improved regional employment for a more diverse workforce, which should continue to be promoted. If a knowledge sharing hub was established, it could be used to promote training available to industry and allow for live industry feedback on the need for new or improved courses.

As courses, and interaction with those courses, must be continuously reviewed, it is important to monitor training metrics centrally. It is understood that Skillnet Ireland are in the process of establishing a MMC platform to signpost relevant upskilling programmes and be a core source of information on MMC. This platform could be used to collate information for more informed training discussions and decisions.

Throughout our research, it was a challenge to identify the baseline labour force in offsite manufacturing facilities. As such, it was not possible to forecast future demand for skills. It will be important to obtain disaggregated data to ensure measures are effective and remain targeted. It is suggested that the CSO, investigate the identification of labour specific to offsite manufacturing facilities in the construction sector.

Development of new roles to promote a coordinated approach across the MMC supply chain should be supported, along with the retention of the current labour force both off and onsite

3 New roles and labour retention

3.1 Promotion of an 'MMC Integrator' role by industry to ensure coordination across the supply chain, including site configuration, to optimise knowledge sharing and efficiently and effectively utilise MMC inputs

3.2 Ensure sufficiency of several ancillary skills which are required to support an efficient scaling of MMC e.g. crane operators at specific heights for modular, lorry drivers for vehicles that can bear the required loads

3.3 Career pathways from traditional construction to offsite manufacturing need to be promoted to retain and attract labour within the construction sector and boost site knowledge within manufacturing facilities

Development of new roles, where necessary, and retention of the current labour force in the construction sector should be progressed in tandem. Attracting new entrants into the industry is explored further under the 'Early engagement' and 'Policy levers' set of recommendations, however the promotion of an 'MMC Integrator' role by industry will be pivotal to ensure the correct procedures are followed across the supply chain.

This role is also vital to manage the correct installation of offsite manufactured inputs to the onsite build. Additionally, ancillary skills such as crane and drone operators and lorry drivers (particularly for modular builds) will be crucial for correct onsite installation. As these skills will be further required as the demand for MMC inputs grows, sufficient availability of these skills is critical. Collaboration between industry and training providers will be necessary to manage the balance between the demand and supply of this labour.

Retention of the current labour force should continue to be a focus for the industry. Clear pathways need to be developed by industry bodies to ensure skills developed by the onsite labour force can be transferred into offsite facilities. This should minimise the 'brain drain' from the industry as the labour force ages, as well as bring onsite knowledge to the manufacturing process.

Digital advances in the construction sector should be supported to boost productivity and attractiveness in the industry

4 Use of digital and AI tools

4.1 Courses offering BIM/DfMA need to be continuously updated to keep up with technological progress

4.2 Further consideration of the implementation of AI to boost efficiency through streamlining project management, scheduling and risk management should be explored as digitalisation of construction and use of complex machinery and programming increases

4.3 Increased familiarisation of human-machine integration (cobotics) is required by both onsite and offsite labour, with courses tailored towards construction processes

4.4 Enhance the function of The National Construction Training Campus at Mount Lucas to include greater collaboration with industry, further innovative process and offer flexible learning including the use of AI and virtual reality tools

From January 2024 consultants engaged to design and oversee the construction of public works contracts with a value in excess of €100m will have BIM requirements included in their scope of service, under the Capital Works Management Framework (CWMF). Over a period of 4 years these requirements will be extended to include the engagement of consultants and contractors down to projects with a value less than €1m. This will result in the increased need for digital skills, which will require continuous development as technology advances.

AI will play an increasingly important role in transforming the construction industry. AI-driven technologies have the potential to significantly boost efficiency, enhance safety, streamline operations, foster innovation and sustainability, and minimise human error across the supply chain.

Cobots, another name for robots that work collaboratively alongside humans, are a key part of the transition to industry 4.0. Adopting this new technology will become increasingly important in construction as they can aid in labour intensive and time-consuming tasks, as well as aiding in the manufacturing and processes.

The Advanced Manufacturing Training Centre of Excellence offers courses on cobotics and robotic welding. Courses such as these may encourage horizontal mobility of labour as graduates of this course may choose to pursue careers in many different sectors, including the construction industry.

AI tools can also be used to broaden the learner base and improve training engagement with the industry. Innovative methods, such as smartphone apps, virtual reality experiences and other interactive learning should be investigated to create greater accessibility.

As Agrément Certification continues to be vitally important for MMC systems and products, ensuring industry capability to submit applications and compliance is crucial

5 Certification

5.1 Investigate the provision of a consultation service that is available to support offsite manufacturers going through the Agrément Certification application process and to ensure a more efficient process

5.2 Training provision for design teams to confirm that Agrément Certified MMC systems work at site-level

5.3 Existing labour should be upskilled to enable installation of MMC products onsite to ensure full compliance with Agrément Certification and building regulations

The NSAI develops and publishes standards to meet international demands for the quality, design, performance, safety and environmental impact of products and services. To date, only timber frame construction has a dedicated Irish Standard (I.S. 440), with all other MMC processes requiring Agrément Certification.

It is important to note that while the NSAI does provide a guide to Agrément Certification for MMC, there continues to be misalignment between the industry and the NSAI on the level of detail required to complete the application for Agrément Certification. As such, it is suggested that a consultation service is provided (by Government or an industry body) to facilitate a smoother application process.

Knowledge and skills outside the manufacturing setting is required to ensure the successful transition to MMC practices. It is important for both design and installation teams to be fully aware of the parameters in which the process and product has received Agrément Certification. Incorrect design and/or installation of prefabricated elements of a build could result in the certification being void, and therefore the build incompliant with building regulations.

Early engagement with new industry entrants should boost future workforce participation in MMC practices. A rebrand of the industry should be considered to boost attractiveness

6 Early learning engagement

6.1 Investigate the incorporation of MMC and offsite processes into all construction related curricula at third level education. This should include learnings from across the supply chain, including the need for early planning and design freezes

6.2 Continue to increase awareness, particularly in schools, on how offsite manufacturing processes can be conducive to enabling a more diverse workforce to pursue careers in construction

6.3 Rebrand construction careers as ‘digitally-enabled construction’ or' ‘built environment’ careers to attract a more diverse workforce including younger workers, new entrants and women.

For the industry to transition fully to MMC, education pathways must be aligned. New entrants studying construction at third level should have an understanding of MMC practices across the supply chain as standard.

As the construction industry continues to adopt more digital solutions to construction, these advances should be promoted to entice greater numbers of new entrants into the industry. Showcasing these technologies and the manufacturing facilities in schools can encourage students to choose a career in construction. As the industry targets pre-leaving certificate students, will create a pathway for a more diverse construction workforce, including greater female and neurodivergent participation.

Enhanced messaging and communication, however, will also be required to improve biases amongst parents (and in some instances guidance counsellors) to support students who may wish to choose a career in construction. Rebranding the industry may help to facilitate this further by showcasing an innovative industry working towards a public good.

The LMETB, AMTCE FET Advanced Manufacturing Pathways Schools Project is an example of how young people are given opportunities to engage with advanced manufacturing first hand. The project is rolled out in partnership with FET Colleges and with industry and could be further supported to expand the current reach.

The mix of government initiatives, along with mandates, should be considered to enhance industry participation in State-provided training

7 Policy levers

7.1 Further exploration of the use of mandates, as well as incentives, as levers to improve industry engagement with training provided to accelerate the adoption of MMC

7.2 Explore additions to the Critical Skills Employment Permits list to include digital construction skills

7.3 Investigate the provision of measures to address the priority skills gaps identified in Appendix A, where training courses are not currently provided

The Government, through Housing for All, has developed a number of initiatives to promote the accelerated adoption of MMC in Ireland. This includes the development of the National Demonstration Park for MMC at Mount Lucas, the Roadmap for increased adoption of MMC in Public Housing delivery, the Skillnet Ireland training portal and the ongoing development of an MMC Data Dashboard, as well as numerous freely accessible training courses (see Appendix B).

These initiatives are fundamental to continue to promote the use of MMC in the Irish residential construction sector, however barriers to access some of these measures persist. Further exploration of the use as mandates, such as the BIM mandate, as well as initiatives should be considered, notwithstanding the current challenges the industry faces. Any further mandates, however, should be considered in conjunction with other recommendations within this study.

Consideration should also be given to adding digital construction skills to the Critical Skills Employment Permits list, given the demand in the industry at present. Given Ireland already has an export market for premanufactured inputs to the wider global market, in time, skilled labour may also be exported from indigenous firms which may create a further incentive for upskilling, retraining, and encourage new entrants into the sector.

It has already been noted that collaboration between industry, Government and academia is crucial for a holistic approach to further MMC in Ireland. While there are training courses provided for half of the skills required, investigation should be carried out to determine the most efficient and effective measures to address the priority skills gaps which have been identified (Appendix A).

Training providers should consider the use of roadshow trainings and the use of current training facilities to reduce the barriers industry face in accessing courses

8 Training provision

8.1 Increase the use of 'roadshow training' by delivering relevant trainings onsite to enhance uptake

8.2 A new (and shorter) apprenticeship for offsite manufacturing should be developed to allow for a greater focus on new and existing technologies by integrating computer and data science

8.3 Training providers should acknowledge computer literacy barriers when providing online training courses to encourage greater participation

8.4 Explore use of any ETB-established 'Colleges of the Future' facilities to host specific local industry trainings

8.5 Encourage the inclusion of MMC specialist modules in construction course content in further and higher education settings as well as the necessary transversal skills to support the embedding of MMC practices.

There is currently an abundance of dedicated and peripheral courses to train and upskill the construction labour force in skills related to MMC. As cited, however, the industry faces many barriers to allow access to many of these courses, given resource and time constraints.

Roadshow training, including those already delivered by the LOETB should be promoted to deliver training on site, thus alleviating barriers and improving uptake. This can improve engagement by industry with State provided courses, creating greater centralised knowledge of skills attainment and continuous improvement on course delivery.

A dedicated apprenticeship for MMC could boost the profile of this area of the industry. A shorter apprenticeship option should be considered to encourage new entrants to maintain domestic careers. The duration of the apprenticeship would need consideration by training providers and industry to strike the right balance between adequate learnings and labour retention.

It is noted that the LOETB and TU Dublin are building a consortium of industry leaders, educational institutions, and government agencies to develop a suite of MMC programmes, including a proposed national MMC Project Management Apprenticeship Programme. The LOETB and TU Dublin will create a suite of programmes that equip future MMC professionals with the necessary knowledge, skills, and practical experience. The partnership is currently working with industry stakeholders to develop a proposal to meet the specific needs of the Irish construction sector. The industry-led consortium will aim to ensure the development of a suite of programmes that equip graduates with the skills and knowledge to effectively manage MMC projects and contribute to the future of the construction industry.

It will be important to incorporate specialist MMC skills into construction courses in further and higher education settings, and these skills will also need to be supported by other transversal skills such as complex problem solving, design thinking, creative thinking, managing teams, negotiation, conflict resolution, etc., so that graduates are equipped with a range of skills to facilitate the successful adoption of MMC methods.

2

Introduction

Building a better working world

Introduction

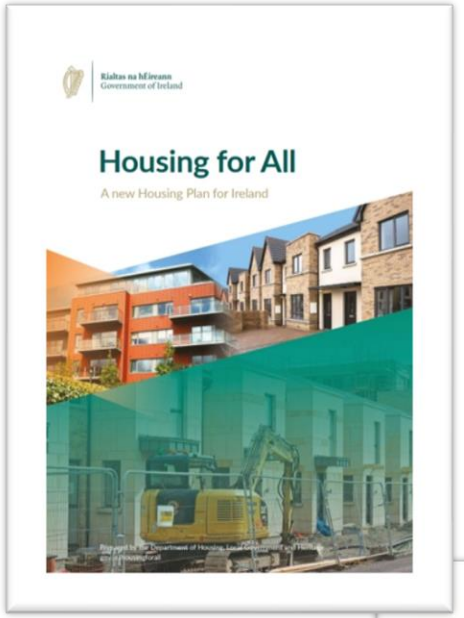
Digital technologies and their adoption are seen as crucial for the Irish construction and built environment sector to deliver improved productivity. One such trend is modern methods of construction (MMC) which has been established for more than ten years in Ireland and is attracting increased interest amongst developers who are beginning to adopt some of the different systems of construction available.

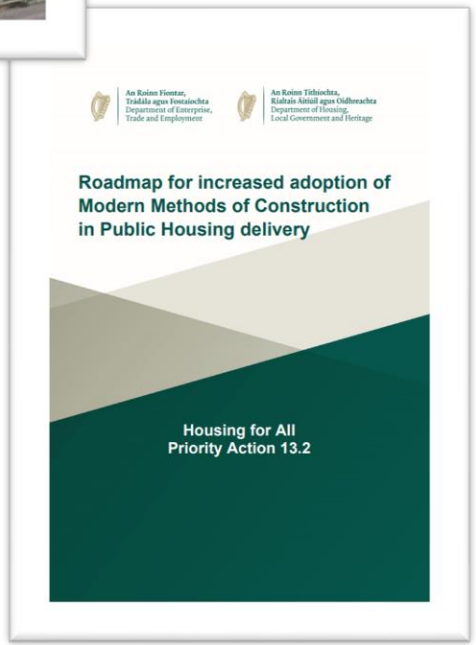
Policy is supporting this adoption by progressing numerous actions. Housing for All introduced a number of measures to be delivered when the plan was officially launched in September 2021 and updated in 2022. One of the actions is for the Department of Enterprise, Trade and Employment (DETE) to "Work with the relevant bodies on how best to examine the current and future skills needed for the transition to MMC." (Action 13.10).

DETE has already progressed in leading the adoption of MMC, including the establishment of an MMC Leadership and Integration Group with the Department of Housing, Local Government and Heritage (DHLGH), and the upcoming delivery of the National Demonstration Park for MMC to showcase MMC technologies. As several such initiatives are being progressed, it is important to ensure that Ireland will have a skilled labour force to align with the adoption of MMC.

DETE and DHLGH have also developed a roadmap for increased adoption of Modern Methods of Construction in Public Housing delivery. The roadmap sets out the role that public procurement can play in leading system transformation for increased adoption of MMC. It recognises that, as a major procurer of construction services, the State has a significant presence in the market.

In order to be fully informed of the scale of skills required in the short, medium and long-term to facilitate widespread adoption of MMC in Ireland, an evidence base is required to develop insights on sector requirements, and any current education, training, apprenticeship and labour supply gaps. As MMC encompasses construction, manufacturing and data technology skillsets in order to evaluate the policy input needed, an analysis needs to be developed.





What is Modern Methods of Construction?

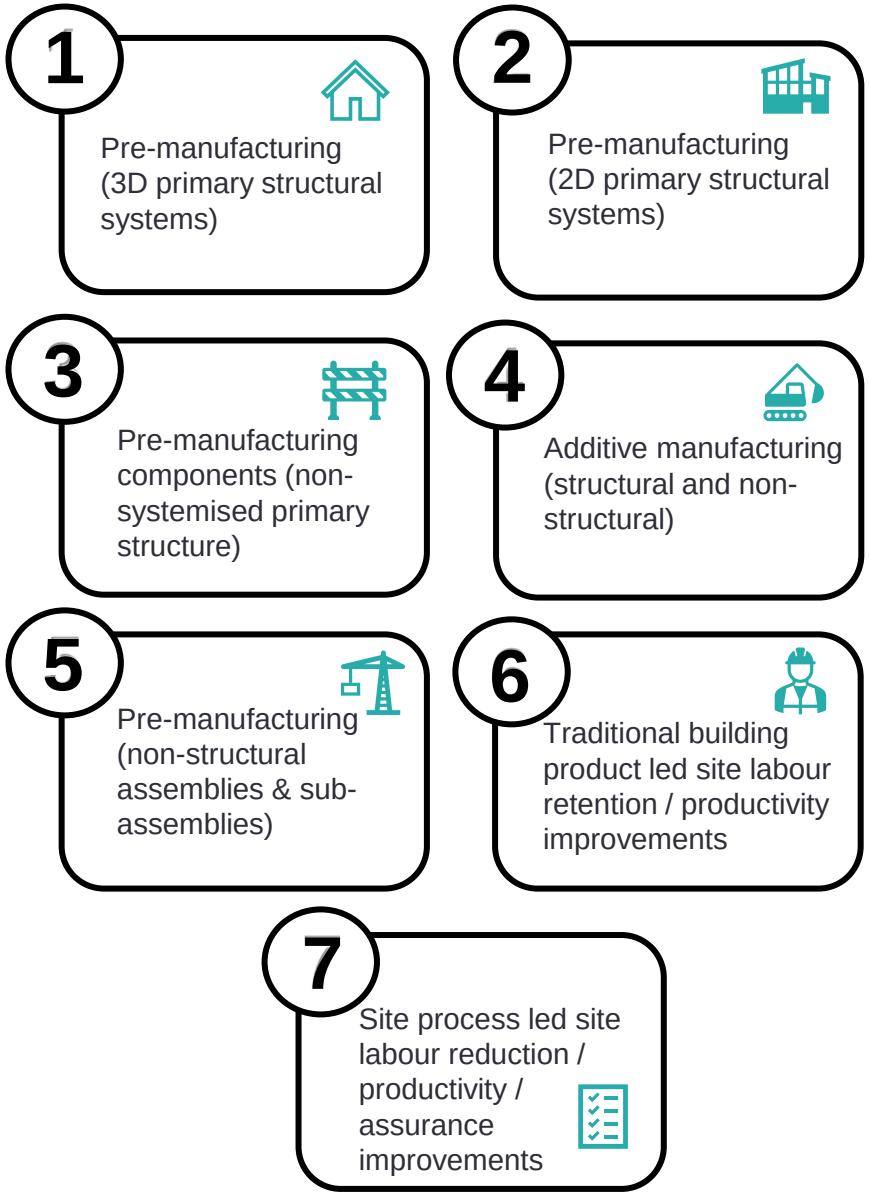
Modern methods of construction (MMC) describes the manufacturing or prefabrication of building components in an offsite facility to allow for onsite installation. MMC can offer innovative alternatives to a traditional build, allowing for enhanced efficiencies and productivity in the construction sector.

There are many types of MMC, including the use of timber frame, precast concrete and light gauge steel. A report conducted by Cast Consultancy, on behalf of the Ministry of Housing, Communities & Local Government in the UK, provides a seven category definition for MMC (across)(1). This definition and categorisation will be used throughout this report.

The degree to which these types of MMC are use in Ireland is mixed. Timber frame (category 2) has been integrated into Irish residential construction for decades and is widely used. The use of timber frame to develop low-rise scheme houses, in particular, has grown in recent years. The Irish Timber Frame Manufacturers Association (ITFMA) claims that 48% of scheme houses built in Ireland in 2021 used timber frame, compared to 37% in 2019(2).

NSAI data, outlined in a roadmap delivered by DETE and DHLGH(3), outlined companies who have secured Agrément or the IS440 standard for timber-frame for their MMC products and systems. The data shows that there are 44 companies with certification, as of May 2023. 27 of these companies have gained certification for timber frame products, while 8 were certified for the production of light gauge steel frames and one company was certified for volumetric builds. There are, however, a greater number of facilities in Ireland producing for an external market, particularly within the UK.

Although this report is focused on the residential construction market, the use of MMC in Ireland is wider. The use of volumetric building in the education sector, for example, is well established, along with MMC inputs for the development of data centres.



- (1) Modern Methods of Construction: Introducing the MMC Framework
- (2) Irish Construction News
- (3) Roadmap for increased adoption of Modern Methods of Construction in Public Housing delivery(2) (3)

The report

Context for this study

The Government's Housing for All (HfA) Plan, first published in 2021 and subsequently updated in 2022, is the Government's housing plan to 2030. It is a multi-annual, multi-billion-euro plan which will improve Ireland's housing system and deliver more homes of all types for people with different housing needs. The Government's overall objective is that every citizen in the State should have access to good quality homes:

- to purchase or rent at an affordable price
- built to a high standard and in the right place
- offering a high quality of life

It is estimated that Ireland will need an average of 33,000 new homes to be provided each year from 2021 to 2030, however this is likely to increase with the publication of the updated National Planning Framework in the coming months.

DETE proposed several MMC-related actions that were included in the updated HfA plan that was published in 2022. Action 13.10 (HfA 2022) calls for DETE to work with the relevant bodies on how to best examine the current and future skills needed for the transition to MMC. As such, DETE have procured this research, which has sought to:

- Identify the nature and scale of the skills needs of enterprises supporting the transition to MMC in the coming decade
- Develop a suite of recommendations that can be drawn up to ensure that the forecasted MMC skills needs are fully addressed by stakeholders through the education and training system and any other relevant source of skills supply

The research includes:

- Desk-based research on available literature to provide a thorough review and international benchmarking exercise
- Extensive stakeholder engagement, performed by conducting an industry survey, individual interviews and two workshops
- Development of two case studies and skills supply assessment

The details of this research are contained within this report, with the contents detailed across.

Contents of the report:

Section 1: Contains the Executive Summary and Recommendations

Section 2: Sets out the background and context for the report, along with the definition of MMC

Section 3: Details the literature review of MMC skills needs across the supply chain

Section 4: Provides the international benchmarking exercise which identifies a review of MMC practices in England and Wales, Hong Kong, Japan, Scotland and Sweden

Section 5: Provides an analysis of the insights garnered from the stakeholder engagement, including the industry survey, interviews and two workshops

Section 6: Details two case studies which depict the disciplines and skills required to deliver scheme housing and apartments using MMC inputs

Section 7: Reviews and elaborates on the assessment of skills supply in Ireland at present, including any gaps that exist in training provision at present

Section 8: Contains the Appendices.

3

Literature Review

Building a better working world

MMC has an impact across the full supply chain, which has implications for skills

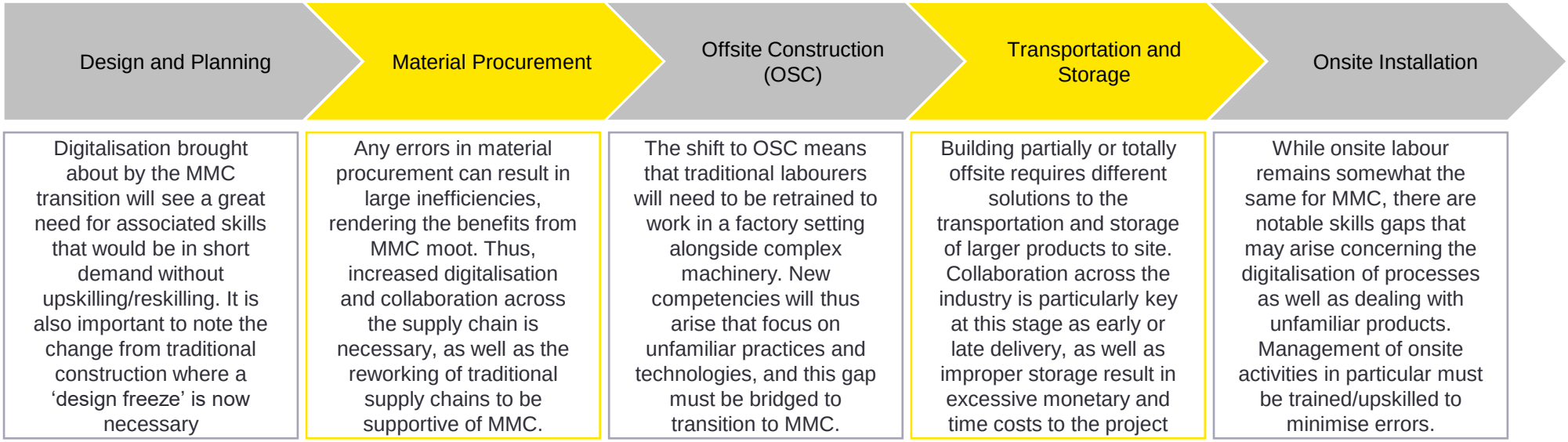
Modern Methods of Construction (MMC) have increasingly gained popularity over traditional construction methods due to its potential benefits in terms of quality control, time efficiency, and sustainability[1]. It consists of differing types of construction techniques that improve productivity and aims to reduce time, cost, waste and errors of building projects[2]. These modern construction techniques include Offsite Construction (OSC), Modular Construction, and pre-fabrication and 3d printing, as well as assembly onsite.

There are seven general categories of MMC[3]:

1. 3D Volumetric Pre-manufacturing
2. 2D Panelised Pre-manufacturing
3. Non-Systemised Primary Structure Pre-manufacturing
4. Additive Manufacturing
5. Sub-Assembly (Pods) Pre-manufacturing
6. Traditional Building Product Led Site Labour Reduction
7. Labour Reduction/Productivity Assurance Improvements

The term ‘pre-manufacturing’ describes processes away from the final site destination. This includes remote factories, near site or onsite ‘pop up’ factories. The pass test is the application of a manufactured led fabrication or consolidation process in controlled conditions prior to final assembly/installation. The most common categories of MMC used for housing in Ireland are 1, 2, 5, and 7[4].

The transition from traditional methods of construction to MMC requires a shift in the skillset of workers along each step of the supply chain. There is an increased emphasis on digital skills and techniques to allow for this transition. Firstly, the MMC supply chain is split into several steps, which differs from traditional construction, as below:



[1] Goodier, C., & Gibb, A., (2007) Future Opportunities for Offsite in the UK. https://doi.org/10.1080/01446190601071821

[2] Modern Methods of Construction – Defining MMC Business: Construction Professionals Skillnet Ireland (2022). Modern Methods of Construction Defining MMC Business (skillnetireland.ie)

[3] Modern Methods of Construction: Introducing the MMC Framework

[4] Modern Methods of Construction: An Introductory Guide

MMC requires the evolution of traditional design and planning skills and approaches

Skills Shortage

There is a delay in the uptake of MMC despite the benefits associated with it. It was found in 2021 that there was a lack of training and skills available to MMC production as current training for the skillsets required are focused on traditional construction[5]. Since this publication, numerous training programmes have been introduced into the Irish curriculum that incorporate aspects of MMC (see Appendix B). The majority of MMC companies in Ireland believe the current workforce does not have the required skillset for the industry[6]. A skill deficit in any or all sections of the supply chain will result in the benefits of MMC and OSC being curtailed. Thus, altering the skills of existing and new workers in OSC is a major consideration for the transition for increased use of MMC in the construction sector[7].

This changing skillset is causing problems with the uptake of MMC in some markets. In China, the cost-saving advantage of MMC was reversed as the deployment of OSC was considerably more expensive than traditional construction, which is being attributed to the lack of experience and skills in the sector[8]. The lack of upskilling or reskilling of the Chinese labour force has bottlenecked the adoption of MMC and denies the Chinese construction industry access to the benefits of the practice[9]. This skill deficit was combated with the hiring of foreign consultants that had the necessary skills, but resulted in high fees, causing major expense.

The introduction of MMC practices does not eliminate foundational skills acquired from traditional construction but adds layers of new competencies to the mix. We review the evolution of current skills in the different elements of the supply chain.

The successful adoption of MMC will require specialist upskilling and training but will also be supported by transversal competencies and skills such as leadership, management, digital and data literacy, and cross-disciplinary skills including supply chain management, sustainability, and robotics. These types of skills have also been identified in other industry skills analysis reports. Increasing training delivery across these shared areas of competency would not only improve outcomes in the MMC sector, but would also enable people to successfully transition between industries

[5] Mourão, L.B., (2021) Construction 4.0: An investigation of offsite construction in Ireland. http://dx.doi.org/10.13140/RG.2.2.35899.34087
[6] Modern Methods of Construction – Defining MMC Business: Construction Professionals Skillnet Ireland (2022). Modern Methods of Construction Defining MMC Business (skillnetireland.ie)
[7] Construction Industry Federation: Modern Methods of Construction (2021) Modern Methods of Construction Program | Department of Energy and Public Works (epw.qld.gov.au)
[8] Mao, C., et al., (2016) Cost analysis for sustainable offsite construction based on a multiple case study in China. https://doi.org/10.1016/j.habitatint.2016.08.002

Design and Planning

Design and planning in MMC involves the creation of blueprints for components to be manufactured offsite, generally through computer aided design. The use of skilled labour across the supply chain is vital to ensure processes run efficiently and productively in order to minimise delays and errors.

Traditional design and planning techniques need to evolve to reflect the changing nature of the industry in order to avoid delays and overruns. This is important specifically in pre-project planning where increased interconnection of each process in the supply chain could result in errors in the design process being amplified throughout construction[10].

Engineering and Design

Design for manufacturing and assembly (DfMA) requires careful consideration at an early stage, as each component will ultimately be assembled onsite. Computer Aided Design (CAD) tools are used by design teams to precisely align each element of the build, both offsite and onsite. Skills in DfMA, Building Information Modelling (BIM), and three-dimensional visualisation are crucial to facilitate the design and simulation of structures before production[11], which will further enhance precision and reduce errors.

Moving from a traditional build to OSC must allow for a ‘design freeze’ to allow for specifications to be fully considered along the supply chain and minimise any disruptive adjustments. Due to the interdependent nature of the components in a build using MMC, any changes made after design and planning are costly and make any potential efficiency and cost reduction of MMC practices limited[12]. Enhanced understanding of the need for a design freeze when utilising MMC in a build should be incorporated into training and development across the supply chain. Scotland’s skills hubs intend to achieve this through collaborative efforts across industry and academia[13].

[9] Jiang, R., et al., (2017) A SWOT Analysis for Promoting offsite Construction under the Backdrop of China’s New Urbanisation. https://doi.org/10.1016/j.jclepro.2017.06.147
[10] Arashpour, M, et al, (2016) Analysis of interacting uncertainties in onsite and offsite activities: Implications for hybrid construction. http://dx.doi.org/10.1016/j.ijproman.2016.02.004
[11] Ginigaddara, B., et al. (2022) Offsite Construction Skills Evolution: an Australian Case Study. http://dx.doi.org/10.1108/CI-10-2019-0109
[12] Modern Methods of Construction – Defining MMC Business: Construction Professionals Skillnet Ireland (2022). Modern Methods of Construction Defining MMC Business (skillnetireland.ie)
[13] Haristains, R., Smith, R.E., (2018) Offsite HUB (Scotland): establishing a collaborative regional framework for knowledge exchange in the UK. https://doi.org/10.1080/17452007.2017.1314858

Training provided to digitalise the industry must be continuous and up to date

Design & Planning (cont'd)

Engineering and Design

BIM in particular is a crucial agent of change in the MMC ecosystem and is intertwined with its adoption into the construction landscape[14]. BIM consists of using a shared digital representation of a build project, usually 3D, to facilitate design, construction, and construction processes using CAD[15]. It has been shown that integrating BIM and other digitalised features into OSC increases efficiency, productivity, and lowers costs[16].

The use of CAD software is necessary for the creation of detailed and accurate designs. Upskilling and/or reskilling existing engineers and architects to become proficient with these tools resulting in fewer failures at the installation stage onsite. However, the development of these skills has been stymied by a lack of investment in the area by private organisations. Training in these areas should be made available not only for new entrants but also for existing professionals to ensure they stay up to date with industry changes.

BIM training must be continuous to remain up-to-date with the latest technology and software in the learning process. This will ensure BIM related skills to continue to evolve, which is crucial for a smooth transition to MMC.

The continuous upskilling and expansion of the construction sector has been a focal point in Ireland. The Digital Academy for the Sustainable Environment (DASBE) was launched in 2020 to provide a range of courses and micro credentials to those in the construction industry wishing to futureproof their skills. (see DASBE | Ireland – Digital Academy for Sustainable Built Environment)

In Australia for example, it was found there was difficulty finding sufficient OSC design skills within the current labour skillset. As a result, several professional institutions began to offer training and skill development for OSC-based design[17]. However, it was also noted that these skill development initiatives would need to be government led/provided as it would better align with standards and code development. Support would be provided from educational institutions for skills development.

To combat this Australia has training in 3D visualisation as well as DfMA and BIM, with various initiatives to enhance BIM use throughout the industry[18]. It is noted that the current use of these digital tools and design need further improvement to avoid failures and delays in the installation stage[19].

Continuous upskilling on the latest developments and technologies in the industry is recognised as a necessity by the UK and Hong Kong. The UK has introduced qualifications and training for digital construction design and BIM. However, interviews with industry experts suggest that further focus is needed to tailor courses on design for offsite manufacturing given courses are teaching how to use the software and not how to apply it within OSC[20]. In Hong Kong, the Construction Industry Council has introduced a number of BIM courses, certificates and accreditation schemes that pertain directly to MMC and how to apply digital techniques to OSC, as well as a state-of-the-art BIM training centre equipped with the latest technologies[21]. However, there remains a reluctance at the implementation stage across the industry due to a lack of standardisation, as well as resistance to change in the industry as a whole[22], showing the need to institute a manufacturing mindset when attempting to upskill.

[14] Farmer, M., (2016) The Farmer Review of the UK Construction Labour Model: Modernise or Die, Time to decide the Industry's Future. Layout 1 (constructionleadershipcouncil.co.uk)
[15] Honghong, S., et al., (2023) Digital twin enhanced BIM to shape full life cycle digital transformation for bridge engineering. https://doi.org/10.1016/j.autcon.2022.104736
[16] Yin, X., et al., (2019) Building information modelling for offsite construction: Review and future directions. https://doi.org/10.1016/j.autcon.2019.01.010
[17] Ginigaddara, B., et al., (2022) Industry 4.0 driven emerging skills of offsite construction: a multi-case study-based analysis. http://dx.doi.org/10.1108/CI-04-2022-0081
[18] Expert Group on Future Needs Report (2020) Building Future Skills: The Demand for Skills in Ireland's Built Environment Sector to 2030. http://www.egfsn.ie/all-publications/2020/building-future-skills-report-with-wit-tud-edits-completed-4.pdf
[19] Ginigaddara, B., et al. (2022) Offsite Construction Skills Evolution: an Australian Case Study. http://dx.doi.org/10.1108/CI-10-2019-0109
[20] CITB (2017) Faster, Smarter, More Efficient: Building Skills for Offsite Construction. *offsite_construction_full_report_20170410.pdf (citb.co.uk)
[21] CIC HK (2021) BIM Training Centre. BIM Training Centre | About Us | BIM (cic.hk)
[22] Chan, D.W.M., et al. (2019) Perceived benefits of and barriers to Building Information Modelling (BIM) implementation in construction: The case of Hong Kong. https://doi.org/10.1016/j.jobe.2019.100764

Digitising procurement is a key hurdle to achieving the required process realignment needed to ensure the success of MMC

Design & Planning (cont'd)

Planning and Control Systems

The added benefits of MMC can only be realised and its risks mitigated through extensive and detailed planning and communication. This is highlighted through the continuous identification of collaboration, quality assurance and control, planning and scheduling, and communication skills as being fundamental to onsite and offsite management[23,24].

Quality assurance in the design and manufacturing of components must be to a high standard and are seen as a critical part of OSC to avoid any costly delays to correct misalignments. This was found to be among the main issues when building modular schools in Slovakia[25]. In depth understanding of the materials and components must be learned for the minimisation of risk.

Understanding how to use and implement new technologies, such as Artificial Intelligence (AI), can improve efficiency and decrease errors in construction and engineering management[26]. These applications of AI can vary across the supply chain, through increased collaboration between robots and workers both onsite and offsite (cobotics) and project scheduling and risk management to boost efficiency[27]. The enhanced use of AI, however, also presents a range of challenges including changes to the current legal framework and a rethink of current insurance policies to cover the liabilities arising from AI-driven operations. Increased digital literacy and continued adaptation to new technologies are needed to allow the construction industry to adapt to MMC.

Enhanced logistical challenges associated with the shift to OSC requires additional specialist digital skills such as computer and information technology (IT) become crucial to ensure efficient communication along all stages of the supply chain, as well as ensuring automation in OSC is streamlined[28]. Continued adoption of advances in technology in MMC is vital for enhanced productivity in the construction industry. Continuous upskilling with these new technologies allows for MMC to become more adaptive and efficient[29].

In the UK, an emphasis is placed on the digital literacy of workers focused on planning and communication throughout the MMC process. This is planned to be achieved through the prioritisation of digital skills via the Digital Skills Competence Framework. Training would focus on the incorporation of technology into all aspects of OSC, including assessment and assurance of offsite components[30].

Procurement

With long standing supply lines and procurement methods fully established in the approach to traditional construction, development of new supply lines or reworking of old ones is necessary to transition fully to MMC[31]. As each component is tailored to the specifications of each build (without the use of standardisation), procurement of materials and manufacturing cannot begin prior to exact specifications being received. Holding stock of manufactured materials is also considered impractical, given the scale of units produced[32]. As such, any errors at the procurement stage of have a ripple effect, which may incur inefficiencies and increased costs[33].

Increased digital modelling techniques should be included throughout the procurement process of OSC. The digitalisation of procurement methods and the development of skills that allow the use of DfMA and BIM procurement systems is important for the transition to MMC[34]. The UK have introduced courses designed to incorporate digitalisation in procurement, as well as teaching on MMC specific challenges to ensure the workforce is equipped appropriately to adopt OSC[35].

[23] Ginigaddara, B, et al., (2022) An evaluation of offsite construction skill profiles. https://doi.org/10.1108/JFMPC-08-2020-0057
[24] Modern Methods of Construction – Defining MMC Business: Construction Professionals Skillnet Ireland (2022). Modern Methods of Construction Defining MMC Business (skillnetireland.ie)
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[28] Assaad, R. H., et al. (2022) The Impact of Offsite Construction on the Workforce: Required Skillset and Prioritization of Training needs. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002314
[29] Ginigaddara, B., et al., (2022) Industry 4.0 driven emerging skills of offsite construction: a multi-case study-based analysis. http://dx.doi.org/10.1108/CI-04-2022-0081
[30] CITB Strategic Plan 2021-2025 (2020) Standards & Qualifications Strategy 2021-25. citb_strategic_plan_2021-25.pdf
[31] Peck, R. (2021) Is Procurement a Barrier to Modern Construction? Is procurement a barrier to modern construction? - Supply Management (cips.org)
[32] Hussein, M., et al. (2021) Modelling in offsite construction supply chain management: A review and future directions for sustainable modular integrated construction. https://doi.org/10.1016/j.jclepro.2021.127503
[33] Al-Sadat Salari, S., et al., (2022) offsite Construction Three Echelon Supply Chain Management with Stochastic Constraints: A Modelling Approach. https://doi.org/10.3390/buildings12020119
[34] Ginigaddara, B., et al. (2019) Skills Required for Offsite Construction. (PDF) Skills Required for Offsite Construction (researchgate.net)
[35] Supply Chain Sustainability School (2020) Offsite for Everyone: A guide to the leaning materials. Offsite-for-Everyone_Digital-Brochure.pdf (supplychainschool.co.uk)

The specific skills required to upskill the construction labour force have been identified and are well understood

Offsite Construction

OSC has emerged as a partial solution to various challenges faced by the construction industry, including labour shortages, safety concerns, and weather-induced delays[36]. The transition to a factory environment requires a shift of skillsets, including increased technical and technological capabilities. Switching to an offsite manufacturing facility with the operation of machines on an assembly line, requires modernisation skillsets to enable the right human-machine integration[37].

Computer-Aided Manufacturing

This shift of focus towards the industrialisation and digitalisation in OSC leads to emergence of a skills gap where traditional onsite general labourers are required to upskill to utilise digital tools for managing and coordinating the production of inputs. The traditional construction labour force will transition into fabrication through computer aid, which will require upskilling to match the digital needs in a new technology-based construction process[38]. The transition to a more digitally literate workforce is important in overcoming the resistance associated toward the use of data and digitalisation within the construction industry[39].

Table 1 lists twenty-four key skills identified for each education level for OSC, based on a survey of 100 construction experts:

Seven of these skills are identified as essential for OSC:

- Automation, robotics, and computer-automated technologies (CAT);
- Placement, assembly, and installation;
- Manufacturing and fabrication processes;
- Operation management and process planning;
- Good manufacturing practices (GMP);
- Integration of onsite and offsite activities; and
- Offsite construction philosophy.

These skills should be developed alongside existing construction skills (rather than instead of), upskilling through additional training programs and improving the quality of labour, thus reducing cost, waste and time, allowing the benefits of MMC to be fully realised.

Table 1: Offsite Construction-related skills needed for the construction and fabrication workforce

	Experience level		Education level		The skill is necessary for:		
Skill	<5 years	>5 years	High school diploma	Associate degree	B.Sc. or postgraduate	Onsite and offsite	Offsite only
Logistics and transportation	X	—	X	—	—	X	—
Automation, robotics, and computer-automated technologies (CAT)	—	X	—	—	X	—	X
Workflow and schedule management	X	—	X	—	—	X	—
QA/QC, quality management systems, and commissioning	—	X	—	X	—	X	—
Estimation and cost management	—	X	—	X	—	X	—
Supply chain and procurement functions	X	—	—	—	X	X	—
Hoisting and rigging techniques	X	—	X	—	—	X	—
Health, safety, and environment (HSE) planning and management	—	X	X	—	—	X	—
Constructability and Collaboration	—	X	—	X	—	X	—
Contracts	—	X	—	—	X	x	—
Placement, assembly, and installation	—	X	—	X	—	—	X
Manufacturing and fabrication processes	—	X	X	—	—	—	X
Operation management and process planning	—	X	—	X	—	—	X
Labor regulatory and jurisdictional considerations	—	X	—	—	X	X	—
Lean six sigma	X	—	X	—	—	X	—
Good manufacturing practices (GMP)	—	X	X	—	—	—	X
Welding technologies	—	X	—	X	—	X	—
Integration of onsite and offsite activities	—	X	—	X	—	—	X
Corrective and preventive actions (CAPA)	—	X	X	—	—	X	—
Digital technologies	X	—	X	—	—	X	—
Offsite construction philosophy	—	X	—	—	X	—	X
Workforce management and development	—	X	—	X	—	X	—
Total quality management	—	X	—	X	—	X	—
Practical experience	X	—	X	—	—	X	—

Source: American Society of Civil Engineers, 2022[40]

[36] Arashpour, M., et al., (2016) Analysis of interacting uncertainties in onsite and offsite activities: Implications for hybrid construction. https://doi.org/10.1016/j.ijproman.2016.02.004
[37] Ginigaddara, B, et al., (2022) An evaluation of offsite construction skill profiles. https://doi.org/10.1108/JFMPC-08-2020-0057
[38] World Economic Forum (2016) Shaping the Future of Construction: A breakthrough in Mindset and Technology. WEF_Shaping_the_Future_of_Construction_full_report__.pdf (weforum.org)
[39] Farmer, M., (2016) The Farmer Review of the UK Construction Labour Model: Modernise or Die, Time to decide the Industry's Future. Layout 1 (constructionleadershipcouncil.co.uk)
[40] Assaad, R. H., et al. (2022) The Impact of Offsite Construction on the Workforce: Required Skillset and Prioritization of Training needs. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002314

The specific skills required to upskill the construction labour force have been identified and are well understood

Offsite Construction continued

It is important to note that while upskilling rather than reskilling is seen as the best step in transitioning a construction sector fully to OSC, expecting OSC and the associated skillsets to be another form of traditional brick and mortar construction should be avoided[41].

Using machinery in a factory setting as part of an assembly process is a step-change from traditional construction tools used in onsite construction. Frequent engagement with OSC tools and technology during training and upskilling is paramount in the development of competency, followed by proficiency, with MMC.

The UK has introduced new apprenticeship standards and new training programmes to combat the skills gap that is limiting the transition to OSC. These apprenticeships have been regeared to have a more collaborative relationship with technology through training integrating computers and data science in all sectors, while modernising and digitising existing techniques[42]. Provision of these apprenticeships allows for the upskilling of existing workers to the skillset required in OSC through high quality, standardised training focusing on managing the integration of digital practices into construction[43]. This is conducted through the development of new resources for organisations and workers to increase capacity for upskilling, and thus increasing the capability to further transition to OSC.

Alternately, Scotland focuses on the development of digital literacy and OSC operations through the use of 'Skills Hubs'. Slow uptake and low productivity in the MMC sector has resulted in industry collaboration, along with inputs from academia. These hubs allow for enhanced collaboration across the sector, enabling knowledge sharing in an environment with access to all necessary tools, including the important skills necessary for OSC and examples of best practice. Academic collaboration then adds additional upskilling/reskilling requirements and the identification of any gaps in the current collective knowledge[44].

Free training, with recruitment centres focused on modernising the construction sector, has been set up in New Zealand[45], with certain territories in Australia also introducing them. Queensland has introduced Rapid Accommodation and Apprentice Centres (RAAC) to showcase and develop OSC machinery and skills[46]. Australia has also introduced continuous upskilling opportunities through new MMC centred training programmes and certificates to enable their full transition into OSC[47].

Singapore has partnered more closely with academia to bridge the skills gap pertaining to offsite construction. Tertiary education incorporates MMC and OSC practices into their curricula for those studying within engineering or construction disciplines, as well as offering elective modules on these practices. Additionally, more structured internships were introduced that provide for offsite presence to allow for enhanced understanding of processes in advance of interning at respective sectors within the supply chain[45].

[41] Ginigaddara, B., et al., (2022) Industry 4.0 driven emerging skills of offsite construction: a multi-case study-based analysis. http://dx.doi.org/10.1108/CI-04-2022-0081
[42] Expert Group on Future Needs Report (2020) Building Future Skills: The Demand for Skills in Ireland's Built Environment Sector to 2030. http://www.egfsn.ie/all-publications/2020/building-future-skills-report-with-wit-tud-edits-completed-4.pdf
[43] CITB Strategic Plan 2021-2025 (2020) Standards & Qualifications Strategy 2021-25. citb_strategic_plan_2021-25.pdf
[44] Haristains, R., Smith, R.E., (2018) Offsite HUB (Scotland): establishing a collaborative regional framework for knowledge exchange in the UK. https://doi.org/10.1080/17452007.2017.1314858
[45] Expert Group on Future Needs Report (2020) Building Future Skills: The Demand for Skills in Ireland's Built Environment Sector to 2030. http://www.egfsn.ie/all-publications/2020/building-future-skills-report-with-wit-tud-edits-completed-4.pdf
[46] Queensland Government, Department of Energy and Public Works (2023) Modern Methods of Construction Program | Department of Energy and Public Works (epw.qld.gov.au)
[47] Construction Training Australia, Training Package for the Building and Construction Industry BCF00_1.pdf (training.gov.au)

Installation skills build on existing on-site capabilities, but additional skillsets are required

Transportation & Storage

Given the scale of offsite construction and onsite installation with MMC output, compared to traditional construction assembly onsite, a greater reliance and risk is placed on transportation and logistics. The availability of suitable transport for larger scale units, along with the risk of administrative errors, requires consideration and the need for skills in this particular area, as inefficient management of logistics can lead to significant cost burdens and delays to delivery[48].

Traditional construction lacks sufficient dry or climate-controlled storage facilities onsite to store building materials and premanufactured components[49]. Additionally, any delay or early arrival in transportation of the prefabricated components to site can lead to decreased productivity and additional costs, which can lead to double-handling costs and further transportation costs to store components offsite[48].

The scale of the components, particularly with volumetric prefabrications, raises new complications in the transportation to onsite assembly. The size of components needs to be considered when choosing an applicable site for construction to allow for minimum complications during transit e.g. low bridges, tight turns[50]. Secondly, manufacturing offsite can increase the risk of damage in transit, which could render the component unusable onsite. These risks include water entering the module if not adequately secured and protected or other physical damage[51].

The increased importance on appropriate transportation and storage requires increased levels of communication and collaboration, backed up by increased use and proficiency in digital management skills. The necessary skills are often developed in conjunction with other on and offsite skills, given their importance across the supply chain, e.g. in the UK the *Supply Chain Sustainability School* develop their courses with the focus of using OSC and how to adapt to the changing transportation and logistics in construction[52].

[48] China Zeng, L., et al. (2022) Side-payment contracts for prefabricated construction supply chain coordination under just-in-time purchasing. https://doi.org/10.1016/j.jclepro.2022.134830
[49] Quale, J.D. (2017) Chapter 9: Onsite vs Offsite, Comparing Environmental Impacts. https://doi.org/10.4324/9781315743332
[50] Cardoner, M. (2022) Modular Home Transport from Offsite Construction to Plot. Modular Home Transport From Offsite Construction To Plot – prefabie.
[51] Scottish Government (2022) Modern Methods of Construction (MMC): Guidance for Building Standards Verification. Modern Methods of Construction (MMC): Guidance for Building Standards Verification (www.gov.scot)
[52] Supply Chain Sustainability School (2020) Offsite for Everyone: A Guide to the Learning Materials. Offsite-for-Everyone_Digital-Brochure.pdf (supplychainschool.co.uk)

Onsite Installation

The skillset required for onsite construction is evolving, shifting from traditional methods of construction to onsite installation of prefabricated components. While traditional trades remain necessary, reskilling and upskilling is needed to refocus labour speciality to connection and installation of individual modules constructed offsite[53]. Onsite assembly requires exact knowledge of the connection of components, but traditional activities of construction labour such as stacking, lifting (with lifting aids), and crane operation, in particular, continue to be required[54].

An increased demand for skills pertaining to management and control of onsite activities, e.g. project and site managers, safety officers, and foremen, is required to allow for seamless installation onsite. Increased knowledge of components, along with enhance collaboration and coordination capabilities across all elements of the supply chain is required to ensure appropriate specialisation in quality assurance, onsite governance, and risk management.

Specialised skills required for the onsite installation of premanufactured components often vary depending on the type of OSC used in production. For example, extensive use of machine operators and trade workers are needed for volumetric pre-manufacturing, whereas panelised pre-manufacturing continue to require traditional onsite workers such as carpenters[55]. Accordingly, Australia emphasises transferability of skills from between project types in training programmes provided given the changing needs of projects which require slightly adjusted skillsets[56]. Similarly, the UK focus on providing training for a multiskilled, technical workforce, with training tailored to the onsite installation of different premanufactured components. The UK also places an emphasis on working with technology onsite, including training programmes to increase the digital literacy of onsite workers[57].

[53] Mao, C., et al., (2016) Cost analysis for sustainable offsite construction based on a multiple case study in China. https://doi.org/10.1016/j.habitatint.2016.08.002
[54] Ginigaddara, B., et al. (2022) Offsite Construction Skills Evolution: an Australian Case Study. http://dx.doi.org/10.1108/CI-10-2019-0109
[55] Perera, S., et al. (2022) The New Generation of Construction Skills: Transition from Onsite to Offsite. http://dx.doi.org/10.1007/978-3-030-95798-8_17
[56] Construction Training Australia, Training Package for the Building and Construction Industry BCF00_1.pdf (training.gov.au)
[57] Expert Group on Future Needs Report (2020) Building Future Skills: The Demand for Skills in Ireland's Built Environment Sector to 2030. http://www.egfsn.ie/all-publications/2020/building-future-skills-report-with-wit-tud-edits-completed-4.pdf

International Review

Building a better working world

International Review Summary

Country	England & Wales	Scotland	Hong Kong	Japan	Sweden
What they are doing	► Construction Industry Training Board Strategic Plan 2021-2025: new training programmes, qualifications and standardisations ► Affordable Homes Programme with a large commitment to MMC used in home delivery ► Talent Retention Scheme aimed to recruit, redeploy and train construction workers ► Onsite experience hubs across the country, particularly in underrepresented regions to future proof construction skills and bring together industry players and academia	► Built Environment – Smarter Transformation (BE-ST) launched as a collaborative hub to allow knowledge sharing between industry, government and academia on best practices in MMC ► Clear guidance from government on MMC to increase confidence and trust in the industry and increase competency of those signing off on MMC projects	► Construction Innovation and Technology Fund (CITF) to build up technologies and skills for MMC adoption ► Subsidised c.14,000 training places for construction practitioners to attend technology-related training ► Construction Industry Council (CIC) established to: provide trainings for industry, assess standards of skills of all participating in the industry, establish and maintain MMC centres ► Construction 2.0 publication, setting out clear targets for training	► Early government adoption allowed for cultural shift towards manufacturing processes ► Society 5.0 – increased use of technology (e.g. BIM & DfMA) and automation in the industry through pilot projects and guidelines ► Large amount of imported construction labour receiving specific trainings to acclimatise to the offsite and MMC driven Japanese construction industry ► Japan Build Digital Expo and J-Innovation HUB established to showcase innovation	► Embedded standardised processes has led to less labour shortages ► Development Fund of the Swedish Construction Industry (SBUF) to support the development of methods, equipment and research with affiliated companies ► Byggbranschens Utbildningscenter (BUC) established as a construction training centre to inform industry on sustainable training and deliver them through a choice of digital or in person classes, including the use of VR
Learnings for Ireland	► Develop a one-stop-shop for recruitment, redeployment and training for MMC roles ► Avoid similar pitfalls surrounding pipeline and training focus	► Develop an industry collaboration hub, showcasing new technologies and promote knowledge sharing ► Further promote certification guidance documents for industry, particularly for Agrément Certification	► Establish and monitor a central repository for training metrics linked to MMC ► Clear government roadmap on digitalisation and increased use of MMC in the industry	► Cultural shift in public attitudes towards using modern methods for residential development driven by Government ► Increased efforts to import skilled labour to accelerate adoption of MMC	► Enhanced collaboration between industry, academia and government funding to deliver training ► Increased use of alternative training delivery methodologies to engage trainees and promote enrolment

In England and Wales, the 2016 Farmer report laid the foundation for the current Strategic Plan in place, which sets out the actions and policy required

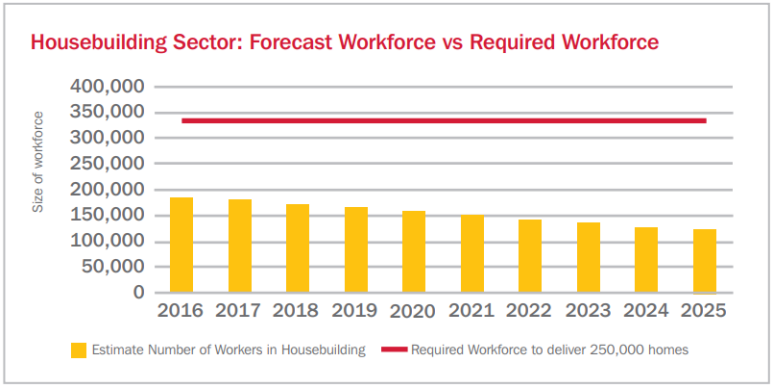
Background

The UK has long sought to realise the benefits of MMC and prefabricated housing with the commissioning of a report in 2005 that identified the MMC process as a process to produce more, better quality homes in less time[1]. This report laid out both the need for the construction industry to pivot to MMC as well as the potential development risks in the industry and how to manage them.

More recently, the Farmer report "Modernise or Die" was commissioned by the Construction Leadership Council and looked at the construction labour market in the UK. This report highlighted the need for a shift from traditional construction to MMC, the myriad benefits associated with the transition, and the skills needed to support this[2].

In particular, this report discusses the need for increased digitalisation and the need to overcome the stigma surrounding data, as these are seen as crucial components for MMC. Furthermore, it was noted that without a plan and commitment to transition the industry, the current skills shortage would likely worsen, with 620,000 people projected to retire from the construction industry before 2026. This coupled with the increase in commitment to deliver homes by the UK government (250,000 each year) requires an increase in new entrants to the industry and a changing skillset to target this "demographic time bomb". Below is the worker capacity discrepancy laid out by Farmer in 2016:

Figure 1. From Cast Presentation at ULI UK Capacity Conference, 26 April 2016[2]



Role of Government Policy

The path forward laid out by Farmer in 2016 highlighted the need for a transformation throughout the industry whose evolving labour supply, alongside its training, demand and adoption of new technologies, is clearly defined, mapped and developed. This must be underpinned by government action who have an active role in both the demand and supply side. This can be achieved through influencing the new housing that promote the use of MMC, as well as collaboration with industry to develop and deliver training to increase the supply of labour.

Following this report, the UK government has made a number of commitments to the MMC transition, highlighting it as a means of driving innovation in the industry, alleviating the current labour constraints and solving the supply and affordability crisis in the residential market[3]. However, as noted in the Built Environment Committee's letter to the Secretary of State for Levelling Up, Housing and Communities in January 2024, no tangible targets or measures have been given, with the overall commitment to MMC has been undirected and nonstrategic. Thus, a full MMC strategic plan is needed to set out clear objectives for a full transition[4].

A Strategic Plan from the Construction Industry Training Board (CITB) for 2021-2025 set out the key skills challenges in the industry across this period and how to tackle them[5]. This laid out the skills required for modernising the industry (as well as core skills to be maintained) and strategies for training and reskilling to keep up with demand from the industry. There is a clear five-step process in this strategic plan:

1. **Attract** new workers, highlighting the changing and digitised nature of the industry
2. **Inform** those on clear and obvious progression and training plans that can develop their careers
3. **Inspire** and motivate through increasing understanding and interest in the industry through tasters of new technologies and opportunities
4. Target career changers and others to **join** the industry through increased numbers of apprenticeships and other pathways
5. **Retain** qualified staff through the promotion of programmes such as Fairness, Inclusion and Respect (FIR)

[1] NAO (2005) Using modern methods of construction to build homes more quickly and efficiently
[2] Farmer, M (2016) Modernise or Die: Time to Decide the Industry's Future
[3] Broun, J (2022) Policy Briefing - The UK Government's Modern Methods of Construction (MMC) Policies and Strategies
[4] Letter from Lord Moylan to Rt Hon. Michael Gove MP, Secretary of State, Department for Levelling Up, Housing and Communities, 26 January 2024 (parliament.uk)
[5] CITB (2020) CITB Strategic Plan 2021-2025

In England and Wales, the 2016 Farmer report laid the foundation for the current Strategic Plan in place, which sets out the actions and policy required

Construction Industry Training Board

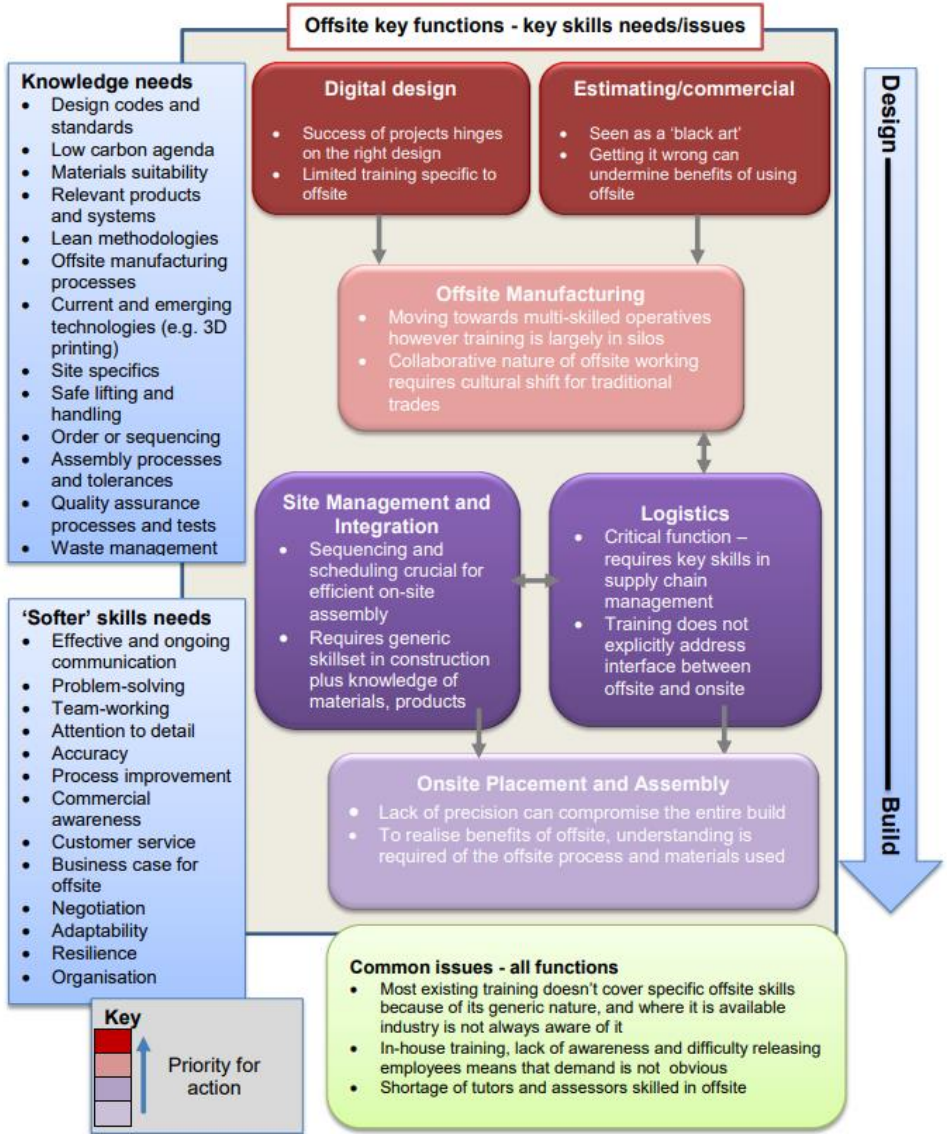
In the wake of the farmer report, in 2017 the CITB conducted research into the shifting skillsets in MMC, in particular offsite manufacturing. The research discovered that in order for the UK to capitalise on the benefits of this practice, the country's construction sector would need to have both sufficient *capability* and *capacity* across the entire delivery chain[6].

As shown in Figure 2, the CITB found that upskilling of the current workforce and qualifications of those entering the workforce was not delivering the skills necessary for a transition to offsite construction and MMC. It noted there were several contributing barriers, including:

- Limited training specific to offsite construction
- Training available did not typically include training on the 'softer' skills
- Shortage of teachers/tutors with knowledge of MMC
- Where training did exist, most employers were not aware of them or were unable to access them
- Tendency toward in-house training and upskilling, which builds on a limited knowledge of MMC

The CITB recommended a change to the construction training landscape to better facilitate the transition to offsite construction. This included, but was not limited to, development of new qualification units and standalone knowledge training, making training more accessible (blended learning) and the establishment of training hubs to improve accessibility, offer flexible learning models and to act as a place to share best practice in the industry.

Figure 2. Offsite functions: common skills and knowledge needs and issues[5]



[6] CITB (2017) Faster, Smarter, More Efficient: Building Skills for Offsite Construction

Despite the Strategic Plan, progress has been slow, and a Parliamentary committee is now reviewing whether Government's approach is overcoming the barriers to greater use of MMC

Pipeline

The Department for Communities and Local Government (DCLG) published their own report in 2017 highlighted the critical importance of MMC as a means of scaling up housing delivery and increasing innovation in the sector[7]. The DCLG did note, however, that the lack of a pipeline for delivery and difficulty accessing finance to the same ease as traditional builders limits the potential for contractors to efficiently utilise MMC. The skills shortage in the construction industry, coupled with the changing nature of the skills required for MMC, was also noted in the report and a new pathway into construction would be required to bridge these changing skills requirements.

The Affordable Homes Programme introduced in 2021 was a large commitment to MMC in home delivery, with £7.4bn worth of grants to be provided to the development of affordable homes with strategic partners[8]. To be eligible for these grants, these strategic partners were obliged to have 25% of homes delivered using MMC. This definition of delivering MMC was given as using categories 1 or 2 as defined by the MMC definitions framework, or with construction processes that achieve a pre-manufactured value (PMV) score of 55% or above.

Wales has also identified MMC as key to their social housing delivery programme and in 2020 a strategy was delivered to build upon the UK government's MMC commitments. This aimed to refocus resources towards delivering more social homes using MMC through the development of the supply chain in Wales[9].

This Welsh commitment is backed by a £65m Transitional Accommodation Capital Programme that was designed to deliver 1,000 additional homes using MMC[10] as well as an Innovative Housing Programme which had £35m available to social landlords and Local Housing Authorities (LHAs) in the form of grants and loans to deliver social and affordable homes using MMC[11]. The goal of this capital sum was to use the public delivery of housing to support and offer growth opportunities for SMEs using MMC, as both of these programmes stipulated the factory-built homes were to be produced in Wales. This aimed to provide success stories for future MMC projects, paving the way for private market uptake as well as developing the skills and knowledge pool in the country's industry.

Despite the commitments by the Government to promote MMC through Homes England and other programmes development financing and providing the right training to support its adoption, it has been argued that not enough was done to support the transition. At present, there is an inquiry into the commitment by the UK government to support MMC and what went wrong[12]. Their commitment to the adoption was said to be "undirected and nonstrategic" as young MMC companies struggled with a lack of a pipeline for delivery. The lack of measurable objectives and overpromising left England's manufacturers with a "build it and they will come" mindset which led to many failures around the country[13], many of which were invested heavily in by the UK Government, such as Urban Splash in 2022[14].

Key to failure is the lack of economies of scale that modular manufacturers (category 1 companies) in particular need to function sustainably. It was found that other factors such as risk aversion on the part of warranty providers, insurance companies and insufficient clarity for building regulations have all contributed to the lack of uptake on MMC and/or delayed deliveries which did not allow these MMC companies to compete[15]. The tendency for the industry to stick with what is tried and tested, coupled with the Grenfell tower tragedy has resulted in MMC viability in delivering housing in England being greatly hindered, despite the myriad benefits.

This highlights the need to target the entire supply chain with MMC knowledge and skills development in order to have it fully penetrate the industry.

[7] DCLG (2017) Fixing our broken housing market
[8] DLUHC (2022) Scoping Report for the Affordable Homes Programme 2021-2026
[9] Welsh Government (2020) Re-imagining social house building in Wales - A Modern Methods of Construction Strategy for Social Housing
[10] James, J. (2022) Written Statement: A Place to Call Home - Transitional Accommodation Capital Programme
[11] Welsh Government (2020) Innovation Housing Programme (IHP) & Modern Methods of Construction (MMC)
[12] UK Parliament (2024) Modern methods of construction – what's gone wrong?
[13] Why has the adoption of MMC at scale in the housing sector failed? (2022)
[14] Banks, C (2024) MMC inquiry: government investment 'undirected and nonstrategic' - Construction News
[15] MMC sector may continue to struggle without a fresh approach from the Government - Committees - UK Parliament

Specific measures to target widening the labour pool are in place

Labour Shortage

It was noted in the CITB Strategic Plan for 2021-2025 to be important that re-joiners and experienced workers are the first target cohorts to alleviate labour shortages within the industry, as highlighting the demand for their current skillset and a pathway forward in a changing industry would both maintain the talent and knowledge pool while also ensuring they stay informed on the industry development and skills[16]. This is to be achieved through the Go Construct website that will signpost progression and training opportunities as well as working with the Talent Retention Scheme to highlight the changing nature of the industry and the differing roles available in the MMC transition.

As time progresses, there must be a pivot to attract school leavers and other new entrants to the industry in order to keep the pool of talent constantly replenished to keep up with construction demand. Highlighting the digitised and changing nature of the industry is key, alongside increasing the number of apprenticeships. These apprenticeships must evolve to increase the use of MMC and digital solutions targeting the younger generation with these interests.

The Welsh Government's commitment to MMC delivery is aligned with their commitment to diversify the industry and continuing to make full use of their available workforce. MMC enables this as it presents an opportunity to welcome new entrants and underrepresented groups, including those furthest from the job market, into the construction sector through the offering of a completely different culture and location[17].

There was a specific push to target sections of the labour force underrepresented in the UK within construction, namely women and the aging population who would be inclined to leave the industry as the physical and travel demands start to outweigh their commitments and capabilities.

Collaboration between Industry, Academia and Government

Following from the Farmer report, there was a large push from England and Wales to facilitate the adoption of MMC to deliver homes. Partnership between government and industry was seen as key to the successful transition and the Industrial Strategy Construction Sector Deal set out the aim to transform the industry and to produce a more highly skilled workforce[18]. The implementation of this plan to adapt the construction industry, which included changing the training of the workforce to address the skills deficit as well as the demographical challenges face, was led by the Construction Leadership Council (CLC), in collaboration with the CITB and other major training institutions.

The reforms aimed to create training that was more strategic, industry led and that allows participation from employers of all sizes. This included overhauls to apprenticeships, introducing new standards and increased numbers, routes into the construction sector, promoting a more diverse workforce and increased focus on digital literacy and soft skills.

A new route into the construction sector is outlined from the CLC's Industry Skills Plan in 2021[19]. This plan outlined how the industry can solve the core skills issue. This involved the development of a clear route of entry and progression through the construction and MMC sectors and how to attract and retain a diverse group of talent. The plan included:

1. Improving access to opportunities and attractiveness for all careers
2. Boosting access into industry
3. Development of sector specific competency frameworks, ensuring ongoing continuous professional development and revalidation of competences
4. Up-skilling and re-skilling in the skills needed to transform the industry now and, in the future

[16] CITB (2020) CITB Strategic Plan 2021-2025
[17] Welsh Government (2020) Re-imagining social house building in Wales - A Modern Methods of Construction Strategy for Social Housing
[18] Industrial Strategy (2018) Construction Sector Deal
[19] CLC (2021) Industry Skills Plan for the UK Construction Sector 2021 - 2022

Experience or demonstration hubs have been created across England and Wales to serve as showcase facilities, and to enable facilitation across the industry

Demonstration Parks

Foundational to the CITB Strategic Plan is the building and expanding of 'construction hubs' that will align training and competencies across the country, as well showcasing new MMC and technologies. The continuous development of adequate training and facilities helps to foster the growth of a labour base for MMC. These hubs were built in regional areas often underserved by the provision of adequate training and investment[20].

The change by the CLC from their industrial skills plan was also supported by the launch of Onsite Experience Hubs in 2021 to bridge the gap between training in construction and MMC and working. Nine were set up across England and four in Wales, enabling over 5,100 and 1,900 people to become employment and site ready respectively within the first three years[21,22]. These were designed as 'one-stop-shop' solutions for construction employers, streamlining the training and up-skilling process around the country, linking together employers, training providers, local authorities, community agencies and other partners, as hubs to enable the development of employment and site-ready people from local communities.

Wales has particular steps compared to the rest of the UK, under guidance and funding from the CITB. The £6.5m Construction Wales Innovation Centre in Swansea aims to "future proof construction skills" in Wales[23]. This centre includes resources available for onsite and offsite construction, with an overall emphasis on net-zero targets, carbon awareness and digital skills, with the latter being trained partially through the state-of-the-art Construction Virtual Environment Resource Training (CONVERT) in which virtual and augmented reality are used to deliver immersive learning experiences, through mimicking real situations in MMC.

These hubs serve as keystones to unlocking the potential of MMC throughout England and Wales as they bring together industry and aid in the development of training for the new world of construction, where the status quo used to be development of internal, company specific training (if any). Additionally, they help elevate the industry's collaboration and digital skills essential for an MMC transformation.

The Construction Innovation Hub was awarded funding in 2018 to aid in the propelling of MMC and to aid in the development of digital tools, competencies and skills in the sector[24]. The Hub focuses on collaborating with government and over 600 organisations to create a construction market that has both the capability and capacity for the future construction demands[25].

[20] Rogers, D. (2021) Mace tells government setting up six regional MMC hubs will speed up its rebuilding programme
[21] Onsite Experience hubs - England - CITB
[22] Onsite Experience hubs - Wales - CITB
[23] CWIC (2019) Wales' landmark new £6.5M Construction centre officially opens in Swansea
[24] University of Cambridge (2022)The Construction Innovation Hub - Centre for Digital Built Britain completed its five-year mission and closed its doors at the end of September 2022
[25] About us | Construction Innovation Hub

Scotland is part of the CITB but has also taken a number of specific local measures to drive MMC

Background

Scotland has a very similar background to that of England and Wales. The Scottish Government, as well as the rest of the UK, have recognised MMC as a solution for increasing capacity in the homebuilding industry, as well as increased sustainability of the industry through decreased waste and energy usage[26]. The Construction 2025 strategy (published in 2013) set out a plan for cooperation between the construction industry and government, including an action plan for the path towards MMC and increased digitalisation and innovation in construction[27]. Additionally, Scotland is privy to the CITB and overall UK objectives, as with England & Wales, when it comes to the implementation of MMC.

However, there are a number of strategies that were implemented early in Scotland that have better paved the way for MMC. In 2015 Homes for Scotland called for the increased use of offsite construction for meeting the Scottish housing demand, a universal definition framework for this practice (which became MMC), and an enhanced role for the Construction Scotland Innovation Centre into R&D as well as facilitating greater stakeholder engagement[28].

BE-ST Campus and exhibits[32]

Demonstration Parks

A key MMC innovation in the UK was the implementation of Offsite Hubs in Scotland[29]. These were designed to encourage an R&D approach to skills and development for offsite construction and to facilitate stakeholder collaboration throughout the fragmented industry. The Hubs offered a place for academia, industry and government to collaborate and facilitated the development of an aligned industry plan[30]. The industry collaboration within the Hub also produced training recommendations and materials for the latest technologies used across the industry. The collaborative nature allowed the sharing of best practice between different industry stakeholders, avoiding the repetition of mistakes and errors to drive productivity.

This offsite Hub project yielded a final report titled “Building Offsite: An Introduction” which outlined the benefits, challenges, skills requirements, and other findings from the project[31]. This success in Scotland lead to the Built Environment – Smarter Transformation (BE-ST), formally Construction Scotland Innovation Centre, continuing this practice of collaborative hubs for MMC and has further expanded to a Centre of Excellence for High-Performance Buildings[32]. These Hubs continue to act as communities that exchange local and international knowledge on MMC as well as continuing to recommend and supply high-quality upskilling opportunities and training.

The Edinburgh Home Demonstrator (EHD) project was also set up with the new MMC collaborative business model in mind. It aims to demonstrate to the industry and clients a suite of housing typologies that are all aligned with Scotland’s offsite vision and new approach to briefing, design, procurement and construction[33]. The vision of the EHD projects is to showcase what MMC can offer, aiming to dispel the perception of premanufactured housing being dull and standardised, by showing their customisable design.

[26] CIC (2013) Offsite Housing Review
[27] Industrial Strategy: government and industry in partnership (publishing.service.gov.uk)
[28] HFS-Offsite-MMC-Report_SCREEN_Version.pdf (homesforscotland.com)
[29] UKFP_briefing_paper_-_Edinburgh_Napier_Offsite_Hub_case_study.pdf (publishing.service.gov.uk)
[30] Hairstans, R., Smith, R. E. (2017) Offsite HUB (Scotland): establishing a collaborative regional framework for knowledge exchange in the UK
[31] Building_Offsite_An_Introduction.pdf (buildoffsite.com)
[32] An International Centre of Excellence - BE-ST
[33] EHD (edinburgh-home-demonstrator.org)

Scotland defined 3 key themes to guide and drive the delivery of MMC – Policy, Product and Alliance

Collaboration between Industry, Academia and Government

The creation and success of the offsite Hubs in Scotland played a pivotal role in the continuous collaboration between stakeholders in the residential construction industry, particularly concerning the provision of relevant training necessary for MMC adoption.

BE-ST released a report in 2020 to guide new policy on the use of MMC to deliver housing in Scotland[34], announcing offsite manufacturing as key to overcoming Scotland's affordable housing problems and result in a more productive construction industry. It noted that while Scotland does adopt a successful offsite approach to housing delivery, a clear national policy implementing it collaboratively across the supply chain is needed, particularly in procurement. Also, development of a clear pipeline for delivery is needed to allow manufacturers to maximise productivity, however this required a stronger pipeline of skilled professionals.

In August 2023 the EDH published an *Introduction to a New Delivery Model for Affordable Homes* using MMC through working closely with public sector partners, industry and academia[35]. The interventions required include a transparent MMC pipeline to enable economies of scale, de-risking and enhancing housing products, creating an environment for MMC, and collaborative delivery and a regional alliance. Key to this delivery is addressing skills and resource challenges, particularly at the regional level where capacity and skills now and in the future were a main barrier to successful delivery of affordable homes. In overcoming these challenges, it recommended the expansion of the regional offsite hubs across Scotland. In Figure 3 the three delivery model themes are outlined, with each aspect having three sub-themes. The capacity alignment sub-theme outlines the regional skills shortfall that must be addressed for successful delivery.

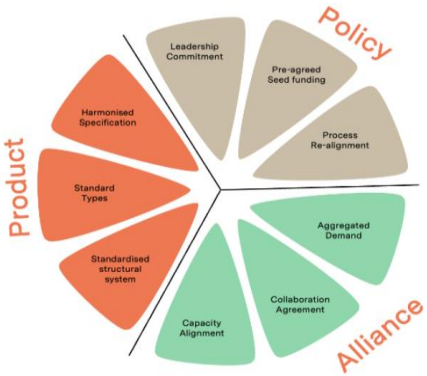
Pipeline

In 2021 the Scottish government made a commitment to have more homes built using MMC with the Affordable Housing Supply Programme[36]. However, there are no targets contained within the programme but rather guidance on greater use of offsite construction in the delivery of homes. The Housing to 2040 policy (in which the Affordable Housing Supply Programme falls under) does however stipulate that all housing delivered for social and affordable housing from 2026 must have zero-emissions[37]. It was noted in that report that to achieve this, greater investment into and use of MMC and offsite construction would be needed, as well as a new business model in the construction industry to support this. This new business model would require providers, designers, developers and builders to collaborate from the outset to avoid designers asking for products which require unnecessary customisation (collaborative procurement).

Role of Government Policy

Certification and verification of MMC buildings presented an issue in Scotland despite the use of the practices, as such the MMC Guidance for Building Standards Verification was released in 2022[38]. The guidance provides an overview for both certifiers/verifiers and those using MMC processes when developing residential units. It includes all potential risks with different materials and processes within the context of current UK/Scottish regulation. The aim of this guidance was to inspire confidence in the industry and to ensure those who are certifying have experience in the sign-off process for MMC onsite.

Figure 3. EHD Delivery Model themes for Affordable Homes[35]



[34] Deakin, M., et al (2020) Increasing offsite housing construction in Scotland: An evidence base to support new policy and systems
[35] Edinburgh Home Demonstrator (2023) Introduction to a New Delivery Model
[36] Affordable Housing Supply Programme - More homes - gov.scot (www.gov.scot)
[37] Housing to 2040 (www.gov.scot)
[38] Modern Methods of Construction (MMC): Guidance for Building Standards Verification (www.gov.scot)

In common with most jurisdictions, Scotland has specific initiatives to address labour shortages in the construction sector

Labour Shortage

The decreasing number of skilled workers in the construction industry is also limiting productivity and the potential of MMC adoption in Scotland. In a 2019 report, it was recommended that the necessary skills for MMC needed to be continually supplied to ensure the industry continues to develop[39]. This can be done through encouraging offsite through new public procurement platforms that specifically require MMC, a central offsite training academy and support for multi-skills development.

It was also noted that the high leaver rate in the construction industry, exacerbates the labour shortage problem. Thus, maintaining workers within the industry/targeting those who have recently left was targeted by the Scottish Government. This was done through clear career pathways and upskilling opportunities in MMC through a centralised information platform. Finally, it was noted that this should not stop once implemented and to ensure that the industry keeps developing that educators and career staff should be up-skilled as new technologies and developments emerge.

[39] New Housing and Future Construction Skills (www.gov.scot)

Land availability and housing demand led to specific initiatives in restrictions in Hong Kong to drive the adoption of MMC

Background

Limited space and a growing population on Hong Kong Island has resulted in the need for efficient use of space and resources, and Modular Integrated Construction (MiC) had been identified as a solution to combatting the huge housing demand challenge[40]. As such, the Hong Kong government decided to make a commitment to the use of the practice in the city and in 2018 published Construction 2.0, which outlined their vision for the future of the industry[41]. This vision was based on 3 pillars of change: Innovation, Professionalisation and Revitalisation.

Role of Government Policy

Construction 2.0 also set out clearly defined targets to measure performance and commitment to MiC and DfMA. This included a number of projects using innovative MMC practices and objectives based on the level of training hours completed by new and experienced workers, among other targets. Furthermore, the Development Bureau of the Government of the Hong Kong (DEVB), alongside the Construction Industry Council (CIC), set up the Construction Innovation and Technology Fund (CITF).

The CITF was founded to encourage wider adoption of innovative construction methods and new technologies in the construction industry[42]. This fund received HK$1 billion at its founding and a further HK$1.2 billion in 2022 to aid the Hong Kong construction sector build up the technologies needed for MiC, BIM and DfMA, as well as the necessary skills for their workforce to fully utilise these new technologies. As of August 2022, the CITF had approved over 2,690 applications from more than 930 enterprises for the adoption of innovative construction technologies, and about 13,900 training places, offering funding grants of more than $746 million.

Construction Industry Council (CIC)

The CIC was tasked with overcoming the potential obstacles in Hong Kong and set up a myriad of training and information resources for MiC and innovation and digitalisation in the industry. They were set up to[43]:

- provide training courses for the construction industry;
- establish and maintain industrial training centres for the construction industry;
- assist, including by the provision of financial assistance, in the placement of persons who have completed training courses provided for the construction industry;
- assess the standards of skills achieved by any person in any kind of work involving or in connection with the construction industry, to conduct examinations and tests, to issue or award certificates of attendance or competence, and to establish the standards to be achieved in respect of any such work.

Pipeline

To encourage the use and uptake of MiC and MMC, Hong Kong have made MiC a core requirement for new building works within the administrative area. In 2020 the DEVB set out a new policy for the adoption of MiC for new building works with total construction floor area larger than 300m[43]. The Government have recognised the need for the efficient implementation of MiC and the building of an environment conducive to this. Both industry and policy level incentives are included, rather than MiC acting as an alternative technology option[44]. Additionally, one of the major challenges identified in MiC adoption was a shortage of knowledge and experience, and the creation of an environment conducive to its adoption would require a workforce competent and experienced with this new technology[45].

[40] Abdelmageed, S.M., et al (2020) Benefits and Challenges of Modular Integrated Construction in Hong Kong: A Literature Review
[41] Development Bureau of Hong Kong (2018) Construction 2.0: Time to Change
[42] CITF (cic.hk)
[43] DEVB_TC(W)_2_2020_Modular_Integrated_Construction_(MiC) (psgo.gov.hk)
[44] Zhang, S., et al (2021) Assessment of Feasibility, Challenges, and Critical Success Factors of MiC Projects in Hong Kong
[45] Construction Industry Council Corporate Profile

Land availability and housing demand led to specific initiatives in restrictions in Hong Kong to drive the adoption of MMC

Collaboration between Industry, Academia and Government

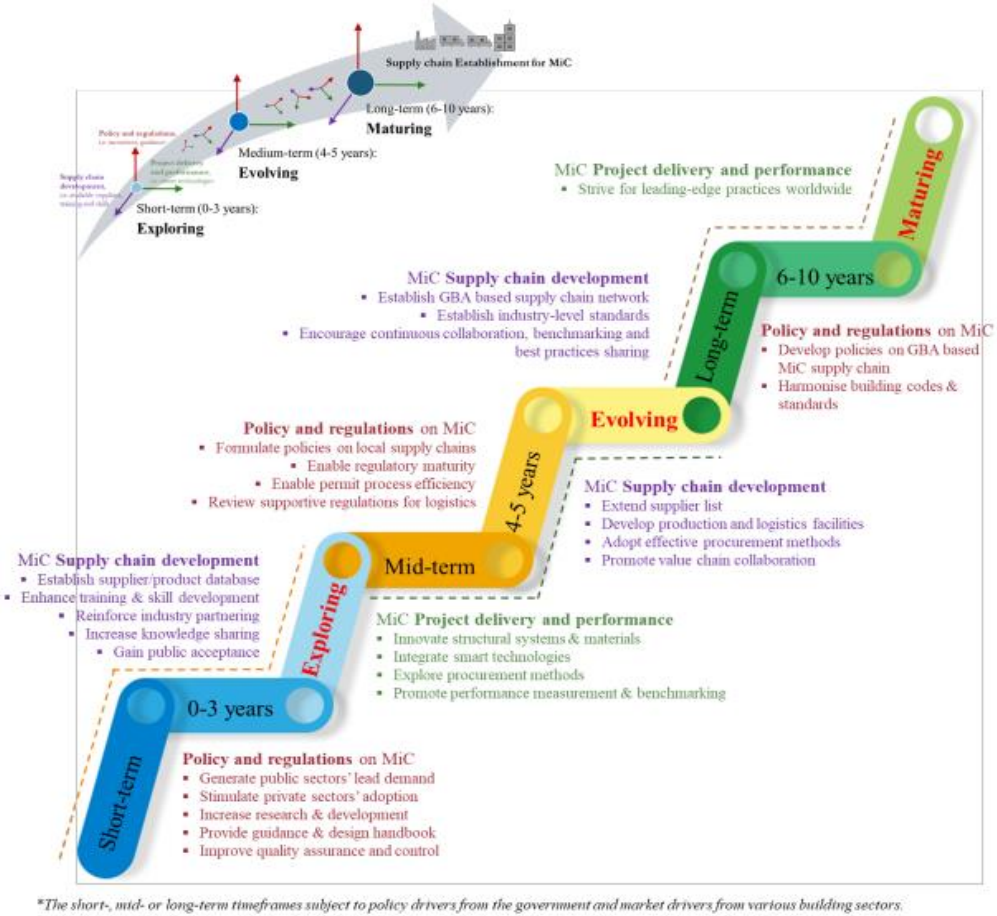
The CIC has also continued to commit to the use of MiC in the industry with the release of a roadmap in conjunction with the University of Hong Kong. This aimed "*to improve the Hong Kong construction industry's understanding of MiC and to help de-risk MiC adoption in Hong Kong by identifying and analysing the challenges in establishing MiC supply chains for buildings in Hong Kong in order to enhance construction productivity, quality, safety and sustainability*"[46].This roadmap outlined short-, medium- and long-term actions to facilitate MiC adoption in Hong Kong (Figure 4). Key actions highlighted to explore, evolve and mature MiC in Hong Kong were the need to develop a comprehensive knowledge base of MiC methods, the need for industry-wide knowledge sharing and training, well-developed policy and regulation to incentivise use, and the establishment of an efficient supply chain for MiC, including transportation, storage and the workforce to accompany this. Increasing confidence in the young industry was also mentioned as a need to ensure the uptake of MiC stretches across all industry and to avoid any supply chain disruption.

Labour Shortage

A key advantage at Hong Kong's disposal is its proximity to mainland China and the large labour force surrounding the Pearl River Delta Metropolitan Region, one of the world's largest urban areas (over 86 million people)[47]. The CIC and Hong Kong Government recognise this and foster a strong relationship with jurisdictions surrounding the river estuary through the CIC Mainland Liaison Services. With offices in Guangdong and Shenzhen the CIC visited over 40 organisations to identify the best talent and business opportunities for MiC.

DEVB implemented a Labour Importation Scheme in 2023 in order to overcome the labour shortage in Hong Kong's construction industry, allowing the temporary importation of labour from mainland China[48]. This scheme required any company applying to have a 2:1 manpower ratio in favour of local labour to ensure wages and cost for Hongkongers was not driven down. Furthermore, the imported labour was to ensure that local labour was also participating in all training ensuring local supply continues to be adequately trained in MiC. In the first year of the scheme, it received just under 4,000 applicants for the construction sector[49].

Figure 4. Roadmap and action plans for MiC implementation in Hong Kong



**The short-, mid- or long-term timeframes subject to policy drivers from the government and market drivers from various building sectors.*

Source: Modular Integrated Construction for High-rise Buildings in Hong Kong: Supply Chain Identification Analyses and Establishment[46]

[46] Pan, W., et al (2021) Modular Integrated Construction for High-rise Buildings in Hong Kong: Supply Chain Identification, Analyses and Establishment. - Reference Materials on Roadmap for MiC Implementation in Hong Kong

[47] Communiqué of the Seventh National Population Census (No. 3) (stats.gov.cn)

[48] DEVB - Labour Importation Scheme for the Construction Sector (1345)

[49] Lee, J. (2023) Hong Kong receives 4,000 applications to work in construction sector under labour import scheme. Hong Kong Free Press HKFP

Hong Kong created demonstration parks which each had a specific focus

Demonstration Parks

The CIC have introduced four main exhibition centres focussed on different aspects of industrialised and innovative construction. These are the CIC Digital Twin Hub, Construction Innovation and Technology Application Centre (CITAC), the MiC Resource Centre and the CIC Zero Carbon Park[50].

The Digital Twin Hub was established with BIM as the main focus, and to become a central hub for training and knowledge sharing around all digital twin tools and courses[51]. It hosts many training courses for the industry, as well as other resources that are extremely helpful in facilitating BIM uptake. These include BIM competitions based on best practice and implementation, checklists to ensure BIM readiness, BIM showcases of successful projects and access to academic publications on the technology from third level institutions in Hong Kong[52].

The Construction Innovation and Technology Application Centre (CITAC) was created to act as a knowledge hub collecting, showcasing and promulgating the latest local and overseas construction technologies with a view to promoting the implementation and application of construction innovation[53]. The centre has showcased over 400 different innovative technologies as of 31 December 2022, and had over 9,000 users in 2022.

The MiC Resource Centre was set up in mid-2021 to serve as a one-stop-shop focussed entirely on MiC, supporting industry stakeholders in their adoption of the practice into their processes[54]. The Centre not only demonstrates exhibit apartments built using MiC, but it also provides professional information and the latest news on MiC for industry professionals. Over 7,000 people visited the centre in 2022, with students from tertiary and secondary schools being particularly targeted to show the changing nature of the industry and to show a viable future within MiC[55]. These visits included seminars and exhibits, but importantly included hands on workshops with new technologies.

The Zero Carbon Park at Kowloon Bay serves as the campus for both the CIATC and MiC Resource Centre and has been open since 2012, far longer than the other ventures[56]. It opened with an exhibition centre, education centre and information centre for zero/low carbon building design and technologies, as well as promoting low carbon living in Hong Kong. The park has evolved since its conception and also acts as a knowledge sharing hub for all aspects of MMC and had over 150,000 visitors in 2022. It houses a variety of exhibitions for all ages and experience, from a prefabricated ‘MiC play unit’ for children to complex solutions to the building new infrastructure in Honk Kong that reduce energy consumption and increase the sustainability of the city.

CIC Digital Twin Hub[52]

CITAC[53]

MiC Resource Centre[54]

CIC Zero Carbon Park[57]

[50] CIC iHub - Stepping into the future
[51] CIC (2023) Digital Twin Hub - Facility Booking Brochure
[52] CIC Digital Twin Hub | About Us | BIM
[53] CITAC - What is CITAC (cic.hk)
[54] CIC MiC | MiC Resources Centre
[55] Construction Industry Council Annual Report 2022
[56] Mission, Vision & Value (cic.hk)
[57] CIC - Zero Carbon Park (Chinese version only) | HKGBC

Historical and cultural factors in Japan drove a deep adoption of MMC and offsite building in the post-World War II period

Background

The main catalyst of MMC and offsite construction adoption in Japan was the destruction of the country during World War II with 63,153ha of city land destroyed, resulting in a housing shortage of approximately 4.2 million houses[58]. Other aspects that made Japan's construction sector conducive to offsite production and prefabricated homes are:

- 90% of homes are detached, with only 25% of new completions from speculative development;
- a 'scrap and build' mentality of house building with landowners upgrading their homes after the presupposed lifespan of housing of 20-30 years, which results in the cultural separation of land from the buildings and recycling of older buildings' materials for the manufacturing of new prefabricated housing; and
- prevalence of seismic activity on the archipelago which contributed to the relatively low lifespan of Japanese housing and shift toward prefabrication as a viable means of rebuilding due to the quick building times associated with MMC[59].

This historic use of offsite production continues to modern day where approximately 20% of new homes in 2018 were constructed using offsite construction through mass-customisable kits[60].

This offsite construction of homes in Japan was inspired by the *Toyota Production System* based on a highly automated factory system[61]. The industry thus tends to be described as a manufacturing rather than construction process, and the skills needed at this stage are closely related to car manufacturing processes. Skills and knowledge were transferred from the car sector, and then built on by the offsite industry over a period of decades.

The seismic activity also gives rise to stringent anti-seismic regulation of residential properties constructed offsite, compared to the relative leniency of the same regulation of traditional construction. Consequently, premanufactured homes underwent rigorous testing, as well as increased investment into research and development, resulting in the shift in perception of these homes to be of higher quality compared with traditional construction in Japan[58].

Role of Government Policy

Government support through campaigns in the 1970s aided in the uptake of prefabricated homes. The Government introduced a 'House 55' project in 1976, a competition to incentivise innovation in the prefabricated construction industry. While the overall prize was not material, the competition served its purpose: to encourage innovation and demonstrate to manufacturers that the design and production of homes need not be uniform[62]. In this sense, the project was a success and allowed for mass customisation of the products. The perception of prefabricated, post-war homes being poor quality and design shifted to a high end, quality-orientated product that met the consumers' diverse housing demands[63]. These homes also provide a sound economic choice in a country impacted by natural disasters as they have been designed to withstand earthquakes and typhoons in line with strict regulation. This has also led to homes having notably less air-leakage than traditional builds and increasing the overall lifespan of the homes[58].

Pipeline

The Car manufacturing industry in Japan also differed from factories in countries like the USA and Germany. The model of mass production and varied production was not seen as viable in the Japanese market, thus the new market-based system was introduced by Toyota[60]. This was effectively a model of "Pull Production" delivering as products were demanded and avoiding excess stock and overproduction. This allowed the efficient use of Japan's limited resources after WWII and transferred well to housing production, replenishing an incredibly small supply post-war.

[58] Buntrock, D. (2017) Chapter 10 Prefabricated housing in Japan; Offsite Architecture: Constructing the future
[59] Johnson, W. (2007) Lessons from Japan: A comparative study of the market drivers for prefabrication in Japanese and UK private housing development
[60] Teh, N. (2019) Japan Transforming Construction 2019, Innovate UK Global Expert Mission
[61] Linner, T., Bock, T. (2012) Evolution of large-scale industrialisation and service innovation in Japanese prefabrication industry
[62] "House 55 Project" and Misawa Homes Group (Competitive period: 1975 - 1976) Misawa Homes Institute of Research & Development Technical Report vol. 21 - 2
[63] Noguchi, M (2003) The effect of the quality-oriented production approach on the delivery of prefabricated homes in Japan

Japanese demographics and the impact on the available labour force have added a further dynamic to their requirement to continue to drive MMC adoption

Labour shortage

An aging and declining population in Japan has also influenced the need in more recent times to veer away from traditional construction and towards offsite production of building materials. In particular, to combat this shortage there is greater emphasis on the digitalisation, automation and robotisation of the manufacturing process[64]. One of the main technologies implemented into the process was BIM. This was achieved during the 2010s through the policies set out by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). They published BIM guidelines in 2014 detailing the fundamental concepts of the software available and showcased a number of pilot projects that use BIM not only at the design stage, but throughout the construction management[65].

In addition, the MLIT worked with the construction industry to implement the "I-construction" standard and "Society 5.0" to achieve widespread use of BIM and other Information and Communication Technology (ICT) in the industry[66]. However, there continues to be resistance to further digitalise the industry, given only 34% of business leaders in Japan consider their companies are ready to adopt digitisation. A mindset change in governance and strategy was identified as key to a successful digital transformation[67].

Japan is also combatting its growing demographic problem in the construction industry, both onsite and offsite, through the importation of labour. This labour is not accustomed to the differences in the Japanese construction industry with a deep history of prefabrication. To maintain productivity at construction sites, companies need for increased investment in training and improve the way skills are passed on to foreign workers entering the Japanese labour force[68]. In order for the continuation of the Japanese approach, the Government needed to introduce policy outlining the key skills that foreign workers would need to acquire, ensuring all imported labour is fully trained and ready to work in Japan[69].

The replacement of the foreign technical internship system for construction professionals was seen as necessary to the development of the Japanese construction sector[70]. This would allow foreign nationals entering the industry the opportunity of job mobility, where the old system restricted entrants to a single company. Additionally, the new system will ensure the unskilled/differently skilled foreign labourers entering acquire the skills of the indigenous workforce.

The Japan Association for Construction Human Resources (JAC) was established in 2019 to hire and train foreign workers as technicians to support construction sites in the Japanese construction industry[71]. This Association provides specific resources and supports to ensure that all entering the construction market are thoroughly ready and assess this through skills evaluations. Various other supports are available for those hiring these workers, to ensure a smooth transition and to keep the industry as productive as possible. This does not cover just the skills for Japanese construction practices, but also getting acclimatised to the Japanese culture through securing housing and providing Japanese lessons. This is to ensure the only thing to be considered is providing work and production to the Japanese economy.

Demonstration Park

Japan have little need for a demonstration park for MMC as their long history with offsite construction means that their workforce and construction companies have great familiarity with the practice and have the necessary skills and competency for MMC.

However, one aspect of MMC that requires continuous upskilling is the digital transformation of the industry. Promotion of upskilling, retraining and technological advancements are available to the Japanese market and are showcased twice every year in Tokyo and Osaka at the Japan Build Digital Construction Expo[72]. Each Expo consists of eight shows and various stans and stalls showcasing the latest developments in the construction industry from around the world.

[64] Japan's ageing, labour-starved construction industry pouring investment into AI, robots | The Straits Times
[65] Kaneta, T., Furusaka, S. (2017) Overview and problems of BIM implementation in Japan
[66] Bringing Innovation to the Worksite with" Smart Construction" / The Government of Japan - JapanGov –
[67] Using digital transformation to thrive in Japan's new normal an urgent imperative_upd201223.pdf (mckinsey.com)
[68] Sugihara, J. (2018) Japan's construction sites seek to be foreigner-friendly workplaces - Nikkei Asia
[69] Japan eyes training foreign workers amid labor shortages - The Japan Times
[70] Osaki Exum, A. (2023) Japan panel compiles new system for foreign technical interns - The Japan Times
[71] Outline of JAC | JAC | The Japan Association for Construction Human Resources (JAC) (jac-skill.or.jp)
[72] JAPAN BUILD - International Building & Home Week (japan-build.jp)

Collaboration between key Japanese stakeholders is a long-established approach

Collaboration between Industry, Academia and Government

The offsite construction industry within Japan in well embedded in the manufacturing industry and they are seen as similar from a regulation and policy standpoint[73].

The Ministry of Economy, Trade and Industry (METI) recognised that for the Japanese industrial economy to thrive, the growing gap between urban and rural areas in terms of industrial competency and innovation must be bridged. The J-Innovation HUB initiative was created to allow regional bases to work together with universities and industry players to build an innovation system that lifts up the local economy[74]. While the project does not focus on construction, a number of the collaborative projects emerging include offsite manufacturing innovation.

One such project is developed by Tokai National University where the large manufacturing history and competencies in the Tokai region would be harnessed in the creation of an Institute for Future Materials and Systems[75]. The aim is to "*develop a facility environment for cross-sectional industry-academia collaboration projects centered on advanced materials",* encouraging local companies (including encouraging start-ups) to develop their industries and labour force through collaboration with other companies and academia.

In 1963 the Japan Prefabricated Construction Suppliers and Manufacturers Association (JPCSMA) was founded to develop skills and promote research into modernisation of the residential construction industry and support the development of a competent workforce and ecosystem for offsite construction[76].

The activities carried out by the JPCSMA include:

1. Independent certification activities related to prefab housing and building (Certifying precast concrete (PC) component quality, Inspecting PC structures, Certifying qualifications of PC building construction management engineers, certifying qualifications of PC components manufacturing management engineers, and Certifying qualifications of prefab housing coordinators)
2. Disaster countermeasures (support for construction of temporary emergency housing, and investigation and research into related technology)
3. Public relations (publication of journals, and surveys on numbers of completed prefab housing construction projects)
4. Warranties and insurance against defects
5. Planning and work supervision for PC construction
6. Investigation and research into prefab housing and buildings
7. Presentation of opinions and suggestions on measures involving housing and residential land

[73] Bock, T. and Linner, T. (2015) 'Large-Scale Building System Manufacturing in Japan', in Robotic Industrialization: Automation and Robotic Technologies for Customized Component, Module, and Building Prefabrication. Cambridge: Cambridge University Press, pp. 93–224.
[74] J-Innovation HUB (meti.go.jp)
[75] Adoption Information | J-Innovation HUB (meti.go.jp)
[76] An Introduction to Japan Prefabricated Construction Suppliers and Manufacturers Association | 一般社団法人プレハブ建築協会 (purekyo.or.jp)

Sweden is a good example of how offsite construction was historically mobilised on a significant scale, which has laid a strong foundation for MMC today

Background

Sweden has a long history of offsite manufacturing with first outputs of the practice dating back to the 1840s. Offsite construction was originally used for rapid military construction in the harsh weather conditions of Scandinavia. It wasn't until after WWI where large scale urbanisation and industrialisation forced the Swedish government to enact radical change in the housing construction sector, opting for offsite manufacturing to balance the rapid need for housing against the harsh winter[77]. Sweden is also the most heavily forested country in the EU with over 28million hectares of land covered by trees [78]. Swedish forestry was suitable for use in prefabricated housing and Cross Laminated Timber (CLT)[79].

Major advancements towards MMC were made during the 1970s and 1980s where rapid industrialised construction was adopted to build over a million homes, borrowing processes from car and shipbuilding production, ending a fifty-year housing crisis. This initiative to industrialised production was so successful that it became the main focus of the housing construction industry and after government subsidies ceased in 1994 the practice continued to make up the majority of the industry[77]. The continued use of offsite construction processes has resulted in over 60% of multi-family homes and 90% of single-family homes built using offsite manufacturing[80] .This historical relationship gives rise to higher competence in the industry when adapting to MMC due to the workforce's generally high level of education and knowledge of offsite construction, customer needs and the green benefits of the practice.

As with the Japanese example, the car manufacturing industry heavily influenced the industrialised construction seen historically in Sweden[77]. Thus, the Swedish construction industry has evolved to produce housing efficiently, with most companies being vertically integrated[81]. This gave rise to the platform approach to industrialised construction used in Sweden which is based on mass production with aspects of LEAN construction, while aiming to address market requirements through highly differentiated products[82].

The process can be defined as a method for the sharing of production processes and components, allowing companies to develop differentiated products efficiently through the use of a flexible construction and manufacturing process. Using this process in offsite production allows the creation of an increased variety of products with a decrease in cost and time to deliver. For such a manufacturing process to work efficiently, however, constant development of products and personnel are needed as there is a need to think across multiple generations of products and processes. This allows the benefits of MMC to be realised without impacting consumer sentiment through repetitive design, instead seeing the products and processes change with market demands.

Labour Shortage

Sweden, as with many developed countries, is experiencing a shortage in recruiting trained professionals in many industries, among them construction. It was found that construction workers, civil engineers for construction, and many others were facing a shortage in recruitment[83]. However, shortages are not as stark as elsewhere, as Sweden has the tenth lowest number of occupation shortages in Europe for the construction industry[84]. The widespread use of offsite construction in Sweden may have alleviated a potential skilled labour shortage. This is due to the tasks needed for MMC becoming more standardised and repetitive in nature, as well as a decrease in demand for onsite skilled labour with construction offsite[85]. This can highlight the offsite approach as an avenue for combatting labour shortages.

[77] Lidelow, H (2017) Ch. 13 Offsite Construction in Sweden: From technology driven to integrated process
[78] Forests, forestry and logging - Statistics Explained (europa.eu)
[79] Leandersson, B. (2021) Major shift needed to increase UK uptake of MMC
[80] Lidelow, H (2020) Swedish Experiences on Modern Methods of Construction
[81] How Sweden became the home of prefab - Built Offsite
[82] Maxwell, D. (2016) Platforms for industrialised construction – lessons from Sweden
[83] New shortage occupation list in Sweden 2023 | Swedish Immigration
[84] EURES answers your top questions on labour shortages and surpluses in Europe (europa.eu)
[85] The Offsite Revolution in Construction (bcg.com)

Sweden is a good example of how offsite construction was historically mobilised on a significant scale, which has laid a strong foundation for MMC today

Collaboration between Industry, Academia and Government

Innovation has always been at the centre of the Swedish construction industry. The Development Fund of the Swedish Construction Industry (SBUF) was established in 1983, which works in cooperation with academia, government, and industry to promote development in the building process and to support the development of methods, equipment and research to make the construction industry more effective and efficient[86]. There are c.3,000 current affiliated companies with the SBUF and about 100 projects are granted funding every year. One of the founding members of SBUF is the Swedish Construction Federation, which is dedicated to ensuring a steady supply of skilled workers for the domestic construction industry[87].

As the majority of Swedish manufacturers (72%) only focus on this part of the supply chain and are not working onsite for installation[88], knowledge sharing and collaboration becomes key to housing delivery. The success of industrialised construction and groundworks firms in Sweden required an understanding of the necessity for knowledge transfer across the supply chain. A company must have knowledge of all stages in the construction, from design to facility management, which enables them to successfully launch a quality concept and execute manufacturing efficiently[89]. Sweden has the skills and knowledge readily available for offsite construction through a century of experience with these manufacturing processes' use in the country, as well as extensive collaboration throughout the industry.

Role of Government Policy

Despite Sweden's well trained and informed workforce on MMC, there still exists the same problem as in traditional construction around the world – resistance to change. The need for the digitalisation of the industry also applies in Sweden as it was found that a quarter of companies state there is a shortage of digital skills to fill required roles[90].

The Smart Built Environment is one of the major programmes to deal with the digitalisation of the industry, receiving funding from Sweden's innovation agency, energy agency and council for sustainable development[91]. Their Strategic Agenda for 2020 sets out what the industry will look like in 2030 and the steps needed to get there[92]. They identify a key driver to uptake of any technology as the "power of example", that broad implementation of new technologies and digitalisation need both successful projects to be seen and "system demonstrators" to allow workers and companies to become familiar with them. Their report on Digitally Constructive Ecosystems found that digitalisation cannot be implemented piecemeal at different stages of the supply chain, and industry must start forming the digitalised construction ecosystem immediately through the binding together of the supply chains into digitally connected networks[93].

Demonstration Parks

The Byggbranschens Utbildningscenter (BUC), a construction training centre, is utilised to inform companies on sustainable training and deliver them through a choice of digital or in person classes. They have a new VR based training tool to give firsthand experience on working in the construction sector[94,95]. The topics covered at this centre span the entire MMC supply chain, all age groups from school children to experienced professionals, with a focus on sustainability and the future of the construction industry. The centre focuses on training instructors and organisers to ensure that the construction industry's training being carried out is reliable, safe and of a high quality, and to ensure the development of training is harmonised across companies[96].

The BUC tailors training to suit the industry demands. If there is a discrepancy in training supply and company requirements, there is an offering of company-specific training in which a choice of training can be tailored specifically to the needs and wishes of the company[97]. These are offered inhouse at the company, at the BUC, or remotely. This is at the discretion of each company's training manager.

[86] SBUF in English | SBUF
[87] Skills supply | Construction companies (byggforetagen.se)
[88] Steinhardt, D., et al (2017) The structure of emergent prefabricated housing industries: a comparative case study of Australia and Sweden
[89] Hjort, B., et al (2014) Success Factors Related to Industrialised Building in Sweden
[90] Nordics Construction 2023: Addressing Talent Challenges for the Future Workforce (authodesk.com)
[91] About us - Smart Built
[92] strategic-agenda-2020.pdf (smartbuilt.se)
[93] 20211109_ub_wp_roadmap_report.pdf (uppkoppladbygg.se)
[94] Virtual reality (VR) training at the Construction Industry's Training Center • The Construction Industry's Training Center (buc.se)
[95] About us • Construction Industry Training Center (buc.se)
[96] Construction Industry's Organizer Training • Construction Industry's Training Center (buc.se)
[97] Company-specific training • Construction Industry Training Center (buc.se)

5

Stakeholder Engagement Insights

Building a better working world

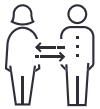
We utilised a stakeholder consultation, through a variety of formats, to gather views and insights from across the sector

Following a detailed stakeholder consultation process, we have analysed the responses to ascertain the key themes that emerged. These have been summarised under six key themes which capture the essence of the discussions. The consultations were conducted to investigate the skills needs across the MMC supply chain from industry, representative bodies, public bodies and training providers. Details of the three methods of stakeholder engagement carried out are detailed below.

Survey

29 organisations

An industry survey was distributed to organisations across the MMC supply chain. Summary outputs of this survey can be found at Appendix 1.



Interviews

17 organisations

17 interviews were held with industry representative bodies and public bodies who gave a wide-ranging view of the use of MMC across the supply chain and the skills and knowledge gaps within the sector at present.

Workshops

22 organisations

Two workshops were held to further interrogate:

a. The skills and knowledge gaps at the planning, design, procurement and certification/sign-off stages of residential development using MMC; and

b. How to encourage more training and upskilling of the traditional workforce and break the barriers for the industry to access publicly funded training for MMC specific training courses

Consultation findings

Accelerating the adoption of MMC is multi-faceted, and it is acknowledged that the Government is taking a wide view on issues to be tackled. Many topics discussed throughout the stakeholder consultation were broader than the specific scope of this research, however the key findings as detailed in this chapter are specific to addressing labour and skills needs.

We have grouped insights into 6 key themes

1

Knowledge gaps and the role of senior management

- Often cited was the existence of 'Knowledge' gaps rather than 'skills' gaps at senior levels of procurers and their professional advisers
- Greater knowledge is needed of the timing of procedures across the MMC supply chain to understand design and offsite/onsite connectivity and the need to integrate processes.
- Senior management in the construction industry should improve their understanding of the strategic value of MMC to drive implementation.

2

The skills required to get planning and design right are crucial

- Early integration of MMC in planning and design of builds is integral to implementing MMC efficiently.
- Enhanced coordination and collaboration across the supply chain is required.
- The '80:20 rule' should not apply to MMC, for which late-stage onsite adjustments are challenging.

3

Certification

- A greater understanding of the requirements for Agrément Certification is required in the industry to improve application processes and achieve timely certification.
- Training may be needed for design teams to confirm that Agrément Certified MMC systems work at site-level.
- Training for onsite installation of MMC products is required to ensure full compliance with Agrément Certification and building regulations.

4

Skill and labour retention

- Increased use of MMC may provide a solution to the 'brain drain' of the industry, as workers age.
- Computer literacy and the willingness of the labour force to engage in upskilling should be considered by training providers.

5

Cultural shift and gender diversity

- A shift in culture towards careers in the construction sector is needed, and MMC can aid to promote greater uptake.
- Increased use of offsite manufacturing processes can be conducive to enabling more women to pursue careers in construction.
- Rebranding as 'digitally-enabled construction' or' 'built environment' careers may attract younger workers

6

Accessibility of skills training

- Time and resource constraints create barriers for industry to access training, particularly for SMEs and microbusinesses.
- The lack of computer-skills and/or access to laptops, computers. for online learning is an impediment for SMEs which phone- or app-based training may overcome.
- A combination of further incentives and mandates could be required by Government to enable improved access.

A differentiation between knowledge gaps and skills gaps was drawn by stakeholders

Knowledge gaps and the role of senior management

Throughout the three forms of stakeholder engagement, the common trend of a *knowledge* gap rather than specific *skills* gaps emerged, particularly at senior management level across the MMC supply chain. 55% of survey respondents suggest that an improved understanding of the MMC housing supply chain and the delivery process is an immediate need in the sector.

When utilising MMC in a build, an understanding of the procedure required at *every* point of the supply chain for different types of MMC was considered crucial to ensure the most efficient use of time and resources. For example, a procurement body must understand that early design freeze is vital to allow for the most effective use of offsite manufacturing.

This includes knowledge of location of access roads, utilities routes, connection points and requiring collaboration between design teams and all enabling stakeholders in a site prior to tender. A skilled design team or an MMC integrator - a role that may be required until this knowledge is embedded among architects and engineers - should be able to work with contractors and MMC manufacturers to agree design adjustments prior to manufacture. Training courses in comprehensive MMC integration and the required collaborative approach may be beneficial for professional advisers, public and private procurers including Local Authorities, AHBs, SME contractors and utilities providers.

The impact of knowledge gaps can be widely felt and may have wider consequences, including increasing the risk aversion to utilise MMC due to anecdotal examples of misused MMC products. Further collaboration across the supply chain is needed to improve delivery of projects that include MMC to embed a track record of efficient delivery of homes which will be needed to encourage accelerated use.

While having a wider understanding of MMC products across the supply chain is important to ensure an efficient use of MMC in the built environment, improved broad knowledge within each stage of the supply chain is also required. While the provision of modules within higher level education and upskilling is being provided to new entrants within the industry, an issue persists where longer serving labour force participants – who are often senior advisers or decision-makers - are not engaging with training or adopting new techniques.

Half of the survey respondents suggested that additional skills were required for MMC supervisory, leadership and management roles immediately to support the growth of MMC, while a further 38% suggested these skills were needed in the medium-term.

Carrying on with ‘business-as-usual’ to develop the built environment, particularly for residential construction, hampers improvements to productivity in the sector. In order for the industry to adopt new construction techniques and MMC, senior management must become more familiar and build their knowledge base.

> *Workers are coming out of apprenticeships with knowledge employers don’t have. Employers and management are starting to realise new entrants are starting to speak a language they don’t understand.*
>
> **A representative from a training provider**

> *“Improving people’s knowledge and awareness across the board is fulfilled by engaging in training.”*
>
> **A representative from a training provider**

Investing in skills required early in the MMC workflow was agreed to be crucial to ensuring MMC benefits can be derived across the entire supply chain

The skills required to get planning and design right is crucial

Fully understanding how to effectively plan and design for the use of MMC products within a build is crucially important to allow MMC add the most value to a project. Early knowledge of how MMC should be incorporated into a build will not only feed into the procurement process and specification of a project but will also allow for efficiencies in production.

As such, architects need to be proficient with design for manufacture and assembly (DfMA) to allow for the effective incorporation of MMC into a project. 55% of survey respondents believe that this should be an immediate priority for skills growth in the sector. An increase in DfMA proficiency will involve both a cultural and, in time, a generational shift (a common theme across all professions) as the use of MMC becomes more widespread. Improved use of DfMA will drive an increased demand for MMC, given that early incorporation of MMC into design is key for planning and procurement.

A greater need for standardisation of design and consistency is key to enable more trusted use of MMC products. The introduction of the EU Digital Product Passport (DPP) may aid the consistency of the use of products over time, and increase the use of BIM in projects, however this is unlikely to take effect until 2026. Given that MMC products are fixed in nature from advanced manufacturing, and that certification standards must be maintained, developing a limited number of standard designs to utilise MMC processes effectively will be instrumental in driving the adoption of MMC.

Given the level of specification required for offsite manufacturing, collaboration at every stage is crucial to allow for effective delivery. Enhanced coordination must be enabled at every stage of the supply chain, however if design and planning are not carefully considered at an early stage in the process, there will be knock-on consequences at later stages of the build. 62% of survey respondents believe that early engagement and early contractor involvement is required immediately in the sector to support the growth of MMC.

Improving the planning and design of builds using MMC products will also improve the procurement of projects using MMC. Of course, how MMC operates within a build must also be understood by the procurement team. If MMC is integrated effectively by design and planning teams, along with enhanced collaboration, client expectations can be managed, and better procurement is enabled. Educating the market, including lenders, insurance brokers and client-side decision makers, with risk and lean methodologies will be important where players are more familiar with traditional formats of construction.

> *Understanding of MMC at the planning stage is vital, for MMC to be efficient planning, design and coordination decisions have to be frontloaded.*
>
> **A representative of the offsite manufacturing industry**

> *Better planning alleviates inefficiencies in design and procurement.*
>
> **A representative of the offsite manufacturing industry**

> *Being afforded the time and knowing it's needed to plan effectively is key to delivering offsite manufactured products efficiently onsite.*
>
> **A representative of the offsite manufacturing industry**

> *We can teach all of the traditional construction companies to use MMC, but if we don't teach the surrounding industries then there will not be any movement.*
>
> **A representative from a training provider**

The onerous process for Agrément Certification was noted to be a particular challenge in progressing certification for MMC providers

Certification

Agrément Certification is required for the processes of all MMC products in Ireland, with the exception of timber frame products which have their own Irish standard (I.S.440) (however, it is understood that Construct Innovate are working with industry to develop new standards for other MMC products and processes). Agrément Certification is designed specifically for new innovative building materials, products and systems that do not yet have a long history of use and for which there may be no national standard, harmonised European product standard (hEN) or European Technical Assessment (ETA). Given Agrément Certification is specific to a product/process in a specific factory, applications for this certification are detailed and comprehensive.

Industry representatives noted that MMC manufacturers require an improved understanding of the need for Agrément Certification, and of the most efficient way to apply and comply with the National Standards Authority of Ireland (NSAI) requirements. Agrément Certification is essential for offsite manufacturers to be compliant with building regulations, however the process can be arduous, with timelines spanning from 18 to 21 months for a process to become certified. The NSAI does provide a guide to Agrément Certification for MMC[1] although despite this resource, there continues to be issues for both applicants and the NSAI where there may be misalignment of the detail required to complete an application. Increased communication and guidance of exact requirements would be beneficial to the process.

Compliance with certification standards acquires additional importance when bidding for public works contracts, however with only 22 certifications awarded in 2023, competition for certified MMC providers is limited. This may create difficulties for public procurement teams actively seeking to use MMC products for the production of public housing.

The certification process may also act as a deterrent for MMC manufacturers, outside of timber frame production, to produce for the domestic market. Engagement with industry suggests that the majority of MMC products are being exported to markets with ETA-type certification procedures, including the UK, Denmark and the US.

Although an Agrément Certification is approved for a process and output within the factory, there are specific conditions which must also be met when installing products onsite to ensure complete compliance with building regulations. To avoid the risk of becoming non-compliant onsite, manufacturers may be inclined to train staff internally to install products onsite or work exclusively with specified sub-contractors to carry out this task to avoid the risk of being non-compliant.

> *Two products can be individually certified, but when used together onsite the final product is not compliant.*
>
> **A representative from a training provider**

> *This is a resource heavy commitment which requires financial resource allocated, right match for external advice and support and a dedicated resource in house to work across disciplines and lead the project.*
>
> **A representative of the offsite manufacturing industry**

> *There are a limited number of certified MMC enterprises, however certificates are important for risk management and procurement.*
>
> **A representative from a public procurement body**

[1] Guide_to_Agrément_Certification_for_MMC.pdf (nsai.ie)

A number of practical steps relating to training were suggested which could address the attraction and retention of the right skills base

Skill and labour retention

It is understood that retaining labour within the construction sector can be difficult, regardless of whether MMC is used. As the nature of onsite construction labour can be physically intensive, this is not an environment conducive to retaining highly experienced staff as the labour force ages. The transition to greater use of MMC has been cited by stakeholders as a solution to minimise the 'brain drain' within the sector by removing physical constraints, providing a fixed site for the workplace and offering on-the-job training for roles to enhance careers, e.g. process engineers, design technicians and quality control.

The transition of labour from onsite to offsite manufacturing enables the transfer of skills crucial for building on and maintaining expert knowledge within manufacturing facilities. The transfer of skilled 'traditional' construction labour can also boost collaboration between offsite manufacturing and onsite installation, which can aid in improved planning, higher quality processes and alleviating installation errors.

Pathways from traditional construction to offsite manufacturing need to be made clear. Consideration should also be given to the language used by training providers, as workers in this sector may be less willing to engage with further training and education due to, for example, negative schooling experiences. Computer literacy is also a factor that must be considered when offering online training, as well as access to PCs at home and often at work.

Consultations also found that offsite manufacturing facilities located regionally across Ireland have a positive impact on employment in the local community, through offering jobs in construction at a regional level without the need for workers to travel to site, and the ability to avail of in-house training in most cases. Continued efforts, however, must be made to engage local communities to ensure adequate investment in local talent acquisition and retention.

The provision of training can also be delivered at a local level. Training providers, such as Educational Training Boards (ETBs), around the country can enhance the provision of onsite training. Initiatives such as Colleges of the Future, and the training rig provided by Mount Lucas, could be further rolled-out to provide greater community engagement with hands-on training in the sector.

It was cited during consultations, however, that repetition of tasks on a production line within a manufacturing facility may cause fatigue within the labour force and cause a high turnover of staff. While training can be provided across several tasks within a factory setting to minimise this issue, a clear focus must be made on training and communicating a clear career path within a factory setting. It was mentioned that staff working in a production setting should have the opportunity to become managers of the tool operations in time. Although many facilities provide in house training (83% of survey respondents), engagement in continued training, particularly at management and supervisor level, is also required.

> *Investment in retention of staff should be made by offsite manufacturers to ensure high-quality output for onsite installation…correcting onsite quality issues will cost more.*
>
> **A representative of the offsite manufacturing industry**

> *There are highly skilled workers with invaluable knowledge that we cannot afford to keep losing.*
>
> **A representative of the offsite manufacturing industry**

> *People who are leaving the industry as they get older do not understand how valuable their knowledge and skills are and how they can be retrained and upskilled for MMC.*
>
> **A representative from a training provider**

Changes to cultural perspectives for MMC were identified, which accords with the experience of other countries where cultural shifts were an essential component of MMC adoption

Cultural shift and gender diversity

The consultations identified a cultural shift in attitudes towards careers in the construction sector is needed to attract and retain talent, and the same is true for the use of MMC. This issue is widely understood, and steps have already been taken by Government to improve the national attitude towards careers in construction, including placing higher education, further education and training and apprenticeships alongside one another on the CAO website.

Stakeholders consulted affirmed that a career in the construction sector needs to be seen by the public, and particularly by parents of children who are leaving second level education, as a secure job, with longevity and room for progression. Early engagement by the industry at second-level was seen by stakeholders as necessary to promote construction sector/MMC careers, particularly during Transition Year, where students can discover the new and innovative techniques that are currently being using in construction and offsite manufacturing. Demonstrating the use of robotics, 3D printing and Virtual or Augmented Reality to visualise buildings designed using 2D or 3D components that may be assembled and re-assembled would connect a diverse cross section of future workers with the value of Built Environment work. These may be held as interactive sessions with parents to realign perceptions of these careers and demonstrate exciting and transferrable skills.

Promoting the use of MMC within the sector should help to encourage the uptake of construction careers, given the benefits offsite manufacturing can provide, such as a fixed premises, regular hours, and not being exposed to the weather. Improved visibility of the roles and career progression options available are needed to ensure the existing and future labour force engage with the new career offerings.

As mentioned on the previous page, the language used by training providers to encourage engagement in construction sector training is equally as important to attract new entrants to the sector as it is to maintain the labour force. The use of MMC within the industry could be seen as an exciting opportunity for new entrants, particularly with the use of new technological techniques such as BIM and 3D printing. Connecting with the sustainability agenda and the Climate Action Plan resonate strongly with the younger workers and those currently in second level education.

Stakeholders consulted outlined the need for a cultural shift in attitudes towards the sector and say this shift is needed to attract more talent and improve the supply of skilled labour. Although less labour intensity is needed when utilising MMC, this does not negate the need for the development of skilled labour within factories.

Stakeholders also discussed the need for greater gender diversity within the construction sector as a whole. Improved awareness on modern construction techniques and career benefits could improve the participation of women in the construction sector. The need for less physically intensive labour and offering a fixed premises should encourage more women to move into the industry, however there must be increased awareness and visibility for new female entrants.

> *The construction industry is not seen as attractive and needs a rebrand.*
>
> **A representative from a training provider**

> *70,000 additional workers needed by 2030 and we're ruling out half the population because we're focusing on males.*
>
> **A representative from a training provider**

> *The thing with MMC is that there's a lot of high-paying jobs with transferable skills, a point which needs to be relayed to parents.*
>
> **A representative of the offsite manufacturing industry**

Key themes identified in the external consultations (6/6)

Accessibility of skills training

A focus of the stakeholder engagement from the outset was to identify gaps in skilled labour needed for MMC, and the training needed to fill these gaps. Throughout the consultation process, it has emerged that appropriate levels of training are available; however, it is difficult for industry to access these for a number of reasons.

SMEs within the sector find it difficult to provide time for staff who wish to engage with training and upskilling due to their relatively more constrained resources. 83% of survey respondents confirmed they deliver in-house training, while only 14% engaged with Government training initiatives. With an already limited labour force and continued supply of projects, smaller businesses will need supports, additional to the current provision of 100% subsidised courses, to further engage with the training that is being provided.

A dedicated workshop with relevant stakeholders was held to understand how to reduce barriers for industry to engage with State provided training, based on findings from the industry survey and interviews carried out. The provision of subsidised training was discussed as a current initiative which is not achieving a high level of penetration.

It was acknowledged that, as the cost of courses provided are not public knowledge, the value of training provided may not recognised by industry, and which may drive some low engagement. Alternative mechanisms for the provision of training by public providers, such as publication of course cost and limited time offerings to avail of training free of charge, were discussed as potential options for recourse.

The provision of further incentives to encourage more interaction from industry, along with the use of mandates for skilled positions to be developed, were discussed as potential solutions. However, it was noted that imposing new skills mandates may be difficult to understand and comply with for industry, particularly for SME and microbusinesses within the sector.

Cashflow replacement incentives were discussed as a possible solution to allow smaller enterprises to facilitate staff to access training. Larger companies within the industry have the scale to invest in MMC training for their staff, whereas SMEs and microbusinesses, which make up the bulk of the fragmented industry, may get left behind, potentially reducing competition and diversity within the market. Bonus schemes for firms that have a certain number of qualified or certified staff in specific areas of MMC was also suggested as potential incentives to be investigated.

The roll out of regional roadshows was also encouraged to bring training and knowledge sharing to site, as required, particularly for onsite developers and contractors. A good example of this practice are the regional workshops led by DHLGH, the Housing Delivery Coordination Office (HDCO) and the Housing Agency to support local authority procurers in establishing the regional frameworks for the Accelerated Social Housing Delivery Programme under Housing for All.

> *It's not a lack of understanding that training is needed, it's a lack of cash and time.*
>
> **A representative from a training provider**

> *Getting SMEs into a meeting room is close to impossible because the industry is too busy."*
>
> **An industry body representative**

> *If training is provided for free to the industry, the industry may not value it as much and therefore less likely to engage.*
>
> **A representative from a training provider**

6 Case Studies

Building a better working world

In the absence of data to inform on labour force participation in offsite construction, two case studies outline the skills requirements for house and apartment developments using MMC

The skills required to develop traditionally built residential units are well understood and can be measured using publicly available data. The ability to gauge labour force participation in offsite manufacturing, however, is particularly difficult, as data is not disaggregated for construction industry manufacturing.

The shortage of skilled labour in the construction sector has been well documented, however it will be important to measure the key skill needs and the degree to which they are being met for MMC, particularly in offsite construction.

The first requirement is the identification of skills required at each stage of residential construction to ensure the correct skills and professions are captured when collecting and collating any future data.

To obtain information on the levels of skills required in the residential sector, MMC Ireland have provided information from one of their members (a large industry player) to contribute to this case study. This analysis includes the disciplines, skills and knowledge required to develop:

1. One hundred scheme houses using timber frame
2. One hundred apartment units using precast concrete

While the following case studies detail the additional pre-construction and onsite skills required when integrating MMC, it has been identified that construction organisations may need to change their training programs and workforce development plans to incorporate offsite construction–related skills. The below illustrates a summary of the offsite construction skills that need to be included in the training programs for different workforce groups identified by the contributing firm.

Offsite construction related skills to be included in training programmes

Design and engineering

- Fabrication package creation & detailing
- Stability & constructability of components & modules
- Supply chain & procurement (a holistic approach)
- Logistics & transportation
- Offsite construction philosophy
- Design for manufacturing & assembly
- Design freeze
- Offsite typologies

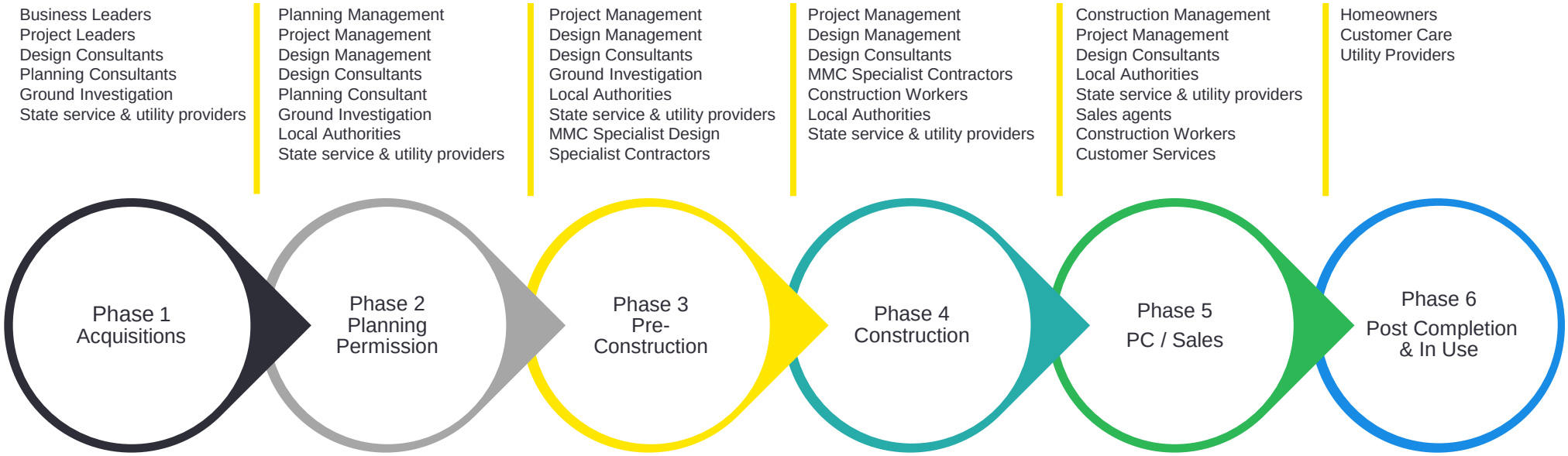
Construction and fabrication

- Automation, robotics, & computer-automated technologies
- Placement, assembly, & installation
- Manufacturing & fabrication process
- Operation management & process planning
- Good manufacturing practices
- Integration of onsite & offsite activities
- Offsite construction philosophy

Administrative

- Manufacturing & factory knowledge
- Offsite construction philosophy
- Systems thinking & integration
- Process streamlining
- Personal information systems

100-unit housing scheme using timber-frame



** Assumptions:
2D timber-frame
Block design to manufacture
4pw construction pace

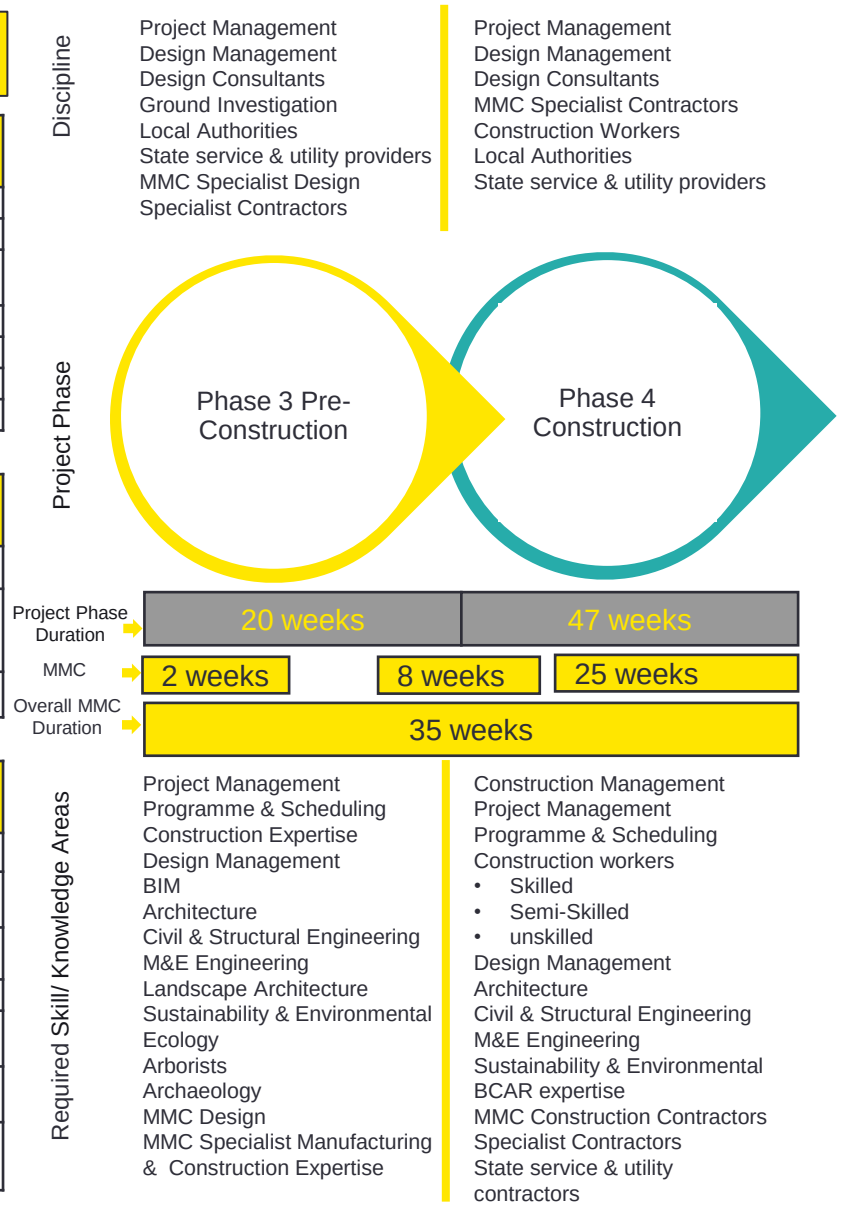
100-unit housing scheme using timber-frame

Additional Pre-Construction Skills to Industry from MMC

Design Requirements	Required Skills / Knowledge Areas
AutoCAD designers	2D Design
BIM Designers	3/4/5d Design
Specialist Production Software Designers	2D Design
Engineers	Design & Review
Engineering Technicians	Drafting
Architectural Technicians	Drafting
TF Product Specialists	Knowledge & expertise

Business Requirements	Required Skills / Knowledge Areas
Management	Management & Leadership
Office & Administration	Organisation, Project Management, Finance Management
Data analysts	Data analysists

Production Requirements	Required Skills / Knowledge Areas
Production Management	Management & Leadership
Trained Machine Operatives	Computer skills - machine special training
Semi-skilled operatives	Tool **skills** - tool special training
Assembly line workers	
Movers & Packers	Crane, forklift, plant & machinery training,
Logistics & Haulage	Planners, Crane, forklift, plant & machinery training & Drivers
Maintenance – Electrical, Mechanical, Machine	Pluming, Mechanical, Electrical, Tool, Welding, Machine Training

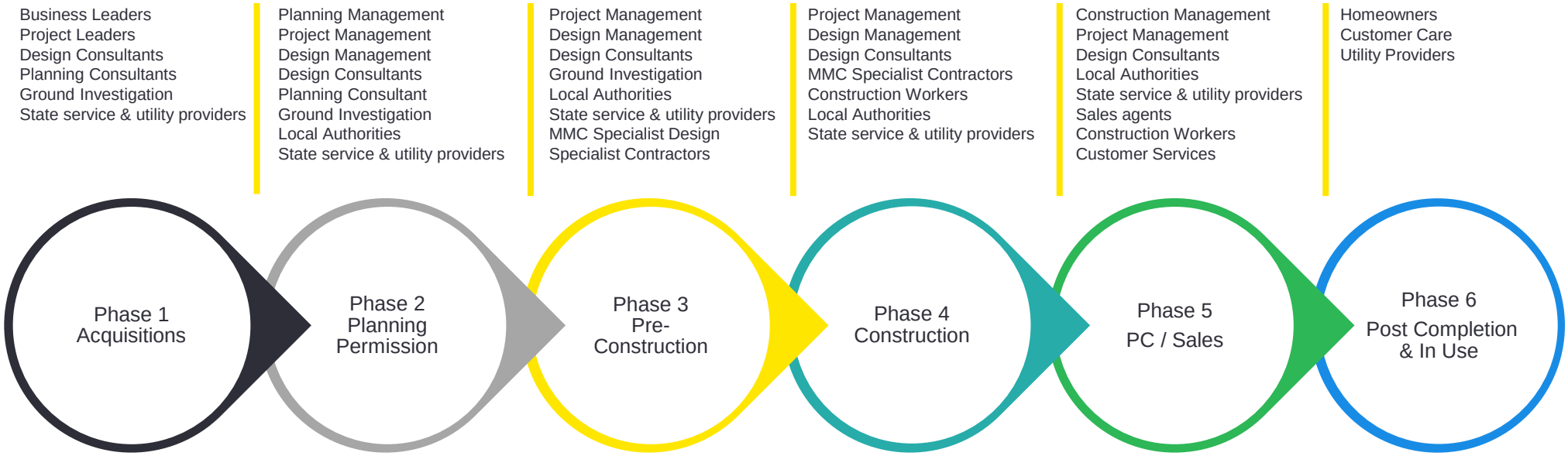


Required Construction Skills to Industry for MMC

Civils & Groundworks incl. Sub-structures	Required Skills / Knowledge Areas
Surveyors & Engineers	Surveying & Engineering
Diggers & Drivers	Driving, tickets, machine specific training, computer training
Dumper Drivers / Machine Drivers	Tickets, machine specific training
Haulage	Lorry drivers & computer skills
Groundworkers	Construction & Specialist training
Floors / Bases	Construction & Specialist training
Utilities workers	Construction & Specialist training

Super-Structure	Required Skills / Knowledge Areas
Product Specialists	Knowledge & expertise
Haulage	Experienced Lorry Drivers
Skilled cranage & banksmen	Experience & Technical Training
Skilled Erectors / Installers (Primary Structure)	Construction & Specialist training (methodology specific)
Skilled technicians and product specialists Joiners, roofers & finishing	Construction & Specialist training
Skilled technicians and product specialists (Fitting / Fireproofing / mastic)	Construction & Specialist training
Internal trades	Technical Training Pluming, Mechanical, Electrical,
Snaggers	Construction & Specialist training

100-unit housing scheme using pre-cast concrete



	Phase 1 Acquisitions	Phase 2 Planning Permission	Phase 3 Pre-Construction	Phase 4 Construction	Phase 5 PC / Sales	Phase 6 Post Completion & In Use
Discipline	Business Leaders Project Leaders Design Consultants Planning Consultants Ground Investigation State service & utility providers	Planning Management Project Management Design Management Design Consultants Planning Consultant Ground Investigation Local Authorities State service & utility providers	Project Management Design Management Design Consultants Ground Investigation Local Authorities State service & utility providers MMC Specialist Design Specialist Contractors	Project Management Design Management Design Consultants MMC Specialist Contractors Construction Workers Local Authorities State service & utility providers	Construction Management Project Management Design Consultants Local Authorities State service & utility providers Sales agents Construction Workers Customer Services	Homeowners Customer Care Utility Providers
Average Duration	20 weeks	74 weeks	26 weeks	97 weeks	16 weeks	0 weeks
	232 weeks					
Required Skill/ Knowledge Areas	Business Management Business Strategy Land Valuation Project Management Programme & Scheduling Planning & Planning Policy Construction Expertise Design Management Architecture Civil & Structural Engineering Sustainability	Project Management Programme & Scheduling Planning & Planning Policy Construction Expertise Design Management Architecture Civil & Structural Engineering M&E Engineering Landscape Architecture Energy Consultancy Sustainability & Environmental Ecology Arborists Archaeology	Project Management Programme & Scheduling Construction Expertise Design Management BIM Architecture Civil & Structural Engineering M&E Engineering Landscape Architecture Sustainability & Environmental Ecology Arborists Archaeology MMC Design MMC Specialist Manufacturing & Construction Expertise	Construction Management Project Management Programme & Scheduling Construction workers • Skilled • Semi-Skilled • unskilled Design Management Architecture Civil & Structural Engineering M&E Engineering Sustainability & Environmental BCAR expertise MMC Construction Contractors Specialist Contractors State service & utility contractors	Construction Management Project Management Programme & Scheduling Construction expertise BCAR & BCMS expertise Construction workers • Semi-skilled (Snaggers) Customer Care Specialists	Customer Care Specialists *(for duration of defects liability period)*

** Assumptions:
Pre-cast
Pods
3 blocks, 5-sotreys

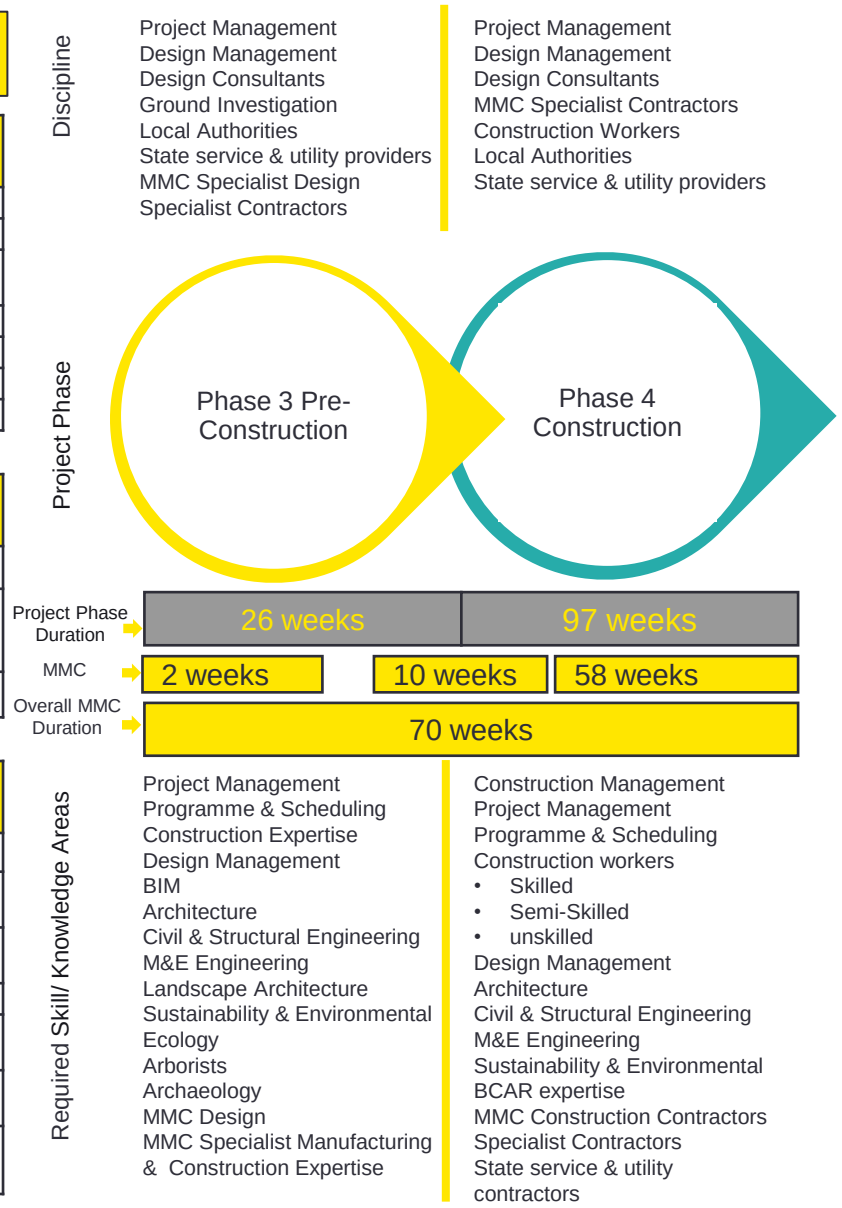
100-unit housing scheme using pre-cast concrete

Additional Pre-Construction Skills to Industry from MMC

Design Requirements	Required Skills / Knowledge Areas
AutoCAD designers	2D Design
BIM Designers	3/4/5d Design
Specialist Production Software Designers	2D Design
Engineers	Design & Review
Engineering Technicians	Drafting
Architectural Technicians	Drafting
TF Product Specialists	Knowledge & expertise

Business Requirements	Required Skills / Knowledge Areas
Management	Management & Leadership
Office & Administration	Organisation, Project Management, Finance Management
Data analysts	Data analysists

Production Requirements	Required Skills / Knowledge Areas
Production Management	Management & Leadership
Concrete & Aggregate Specialists	Concrete & structural engineering
Trained Machine Operatives	Computer skills - machine special training
Semi-skilled operatives	Tool skills - tool special training
Movers & Packers	Crane, forklift, plant & machinery training,
Logistics & Haulage	Planners, Crane, forklift, plant & machinery training & Drivers
Maintenance – Electrical, Mechanical, Machine	Pluming, Mechanical, Electrical, Tool, Welding, Machine Training



Required Construction Skills to Industry for MMC

Civils & Groundworks incl. Sub-structures	Required Skills / Knowledge Areas
Surveyors & Engineers	Surveying & Engineering
Diggers & Drivers	Driving, tickets, machine specific training, computer training
Dumper Drivers / Machine Drivers	Tickets, machine specific training
Haulage	Lorry drivers & computer skills
Groundworkers	Construction & Specialist training
Floors / Bases	Construction & Specialist training
Utilities workers	Construction & Specialist training

Super-Structure	Required Skills / Knowledge Areas
Product Specialists	Knowledge & expertise
Haulage	Experienced Lorry Drivers
Skilled cranage & banksmen	Experience & Technical Training
Skilled Erectors / Installers (Primary Structure)	Construction & Specialist training (methodology specific)
Skilled technicians and product specialists Joiners, roofers & finishing	Construction & Specialist training
Skilled technicians and product specialists (Fitting / Fireproofing / mastic)	Construction & Specialist training
Internal trades	Technical Training Pluming, Mechanical, Electrical,
Snaggers	Construction & Specialist training

Additional skills will be required across the supply chain to adopt MMC, however as the industry evolves traditional trades can be upskilled to transfer from onsite to offsite facilities

As has been demonstrated, the additional skills required for offsite construction spans beyond the offsite component of a residential development. Traditional wet trades will continue to be necessary for any build, particularly for the external leaf, until the adoption of 3D volumetric becomes more prominent in the residential sector. However, the intensity of these trades onsite reduces with the increased inclusion of premanufactured components, for example the removal of first fix carpentry when utilising timber frame.

As structural labour issues persist in the construction sector, industry will be required to evolve their business and delivery models. Transferring site-based construction activities to a factory is a tangible way of overcoming the industry's shortage of skills.

Offsite manufacturing can attract and develop non-skilled resource from across other industries without relying on limited pools of skilled tradespersons. Additionally, skilled labour from other factory environments can also be easily transferred to the offsite industry. This will allow construction to continue development despite labour constraints in accordance with anticipated growth targets.

It is expected that offsite construction workforce occupations will grow in demand as industry adopts modern methods. On the other hand, some (but not all) of the onsite workforce occupations are perceived to also grow including:

- Equipment operators
- Heavy civil works contractors (e.g., earthwork, utilities, highway, etc.)
- Offsite modules/components installation and setup personnel
- Instrumental and control personnel
- Lifting, cranes, hoisting, rigging, and signal personnel

This is logical since heavy civil works contractors and equipment operators will still be required for:

- Site preparation
- Mobilisation works
- Movement of offsite construction parts and pieces on the jobsite

As MMC emphasises precision and efficiency, reducing the need for extensive onsite labour, it necessitates a re-evaluation of workforce requirements. Offsite manufacturing facilities demand skilled workers proficient at operating advanced machinery, robotics, and automated systems.

It is expected that traditional onsite roles will evolve into positions that require expertise in logistics, supply chain management, and quality control within the factory setting. As a result, there is a growing need for cross-disciplinary skills that span both traditional construction practices and modern manufacturing techniques.

Key Skills Needed in MMC

- **Manufacturing Competence:** Expertise in operating advanced machinery, robotics, and automated systems within offsite manufacturing facilities, ensuring efficient and precise production.
- **Logistics and Supply Chain Management:** Skills to manage the streamlined flow of materials, components, and finished products, optimising logistics and supply chain processes in MMC.
- **Quality Control:** The ability to implement and oversee stringent quality control measures in offsite manufacturing settings to ensure the production of high-quality components.
- **Cross-disciplinary Collaboration:** Collaboration skills across diverse disciplines, fostering effective communication and cooperation between traditional construction practices and modern manufacturing techniques.
- **Adaptability to Technology:** A capacity to adapt to evolving technologies and innovations in MMC, staying current with the latest construction methodologies and automation advancements.
- **Construction Management Skills:** Knowledge of construction management principles to oversee projects efficiently, from planning and design to implementation, ensuring seamless integration of MMC practices.
- **Digital Design and 3D Modelling:** Proficiency in digital design tools and 3D modelling software to contribute to the creation and visualisation of MMC projects.
- **Sustainability Awareness:** Understanding of sustainable construction practices and a commitment to integrating eco-friendly solutions within MMC projects.
- **Cultural Adaptability:** The ability to adapt to the cultural shift in the construction industry towards embracing MMC, overcoming resistance to change, and promoting a collaborative mindset.

7

Skill Supply Assessment

July 2024 | Research and Forecast for Skills Required for Modern

Building a better working world

Training providers across Ireland have already begun to roll out MMC specific courses

Industry collaboration and key MMC training courses have already been identified by Irish training providers. Along with digital construction and BIM modules being implemented in third level education, SOLAS and Skillnet Ireland, among other training providers, have bridged a gap for targeted training in MMC.

396 training and education courses have been identified, with the full list provided in Appendix B. Table 2 across demonstrates 112 of these courses that are directly applicable to MMC practices. Other courses contained in Appendix B have been identified through this research as having elements of training that may be applicable to MMC manufacturing.

SOLAS oversees the creation of a further education and training sector in Ireland and one of the focus areas is to upskill the construction labour force to MMC practices. A particular focus is the provision of training through Education Training Boards (ETBs) across the country, but most notably at the Laois & Offaly ETB (LOETB). The LOETB currently provides the National Construction Campus at Mount Lucas, which has become the official site for a demonstration park.

The National Construction Training Campus at Mount Lucas is dedicated to train, develop and upskill the competencies for both Construction machine operators and construction operatives that will enable trainees to develop a career within the Construction Industry. This campus also serves as a retrofitting and Nearly Zero Energy Buildings (NZEB) centre of excellence, offering courses and is the home of home to the National Apprenticeship in Scaffolding run over 2 years.

In July 2022 it was announced by Simon Harris, then Minister for Further and Higher Education, Research, Innovation and Science (DFHERIS), as the site for the National Demonstration Park for MMC. The Park serves as a resource for industry and stakeholders to explore innovative ways to build homes that are sustainable and affordable[1]. Within this, a range of MMC specific programmes were introduced for new and experienced construction personnel to become familiar with MMC technologies from BIM and Offsite Construction, the changing management financing and management techniques for MMC.

Additionally, the Louth & Meath ETB have developed the Advanced Manufacturing Training Centre of Excellence (AMTCE) which supports people reskilling or upskilling in the new emerging technologies used in industry 4.0.

[1] MMC - Mount Lucas Construction Training

Table 2. MMC training providers

	Courses with some aspect of MMC	MMC specific courses
Louth & Meath Education Training Board	59	14
Laois & Offaly Education Training Board	18	16
Other Education Training Boards	74	14
Skillnet Ireland	73	14
Third Level Institutions	127	37
CitA	24	12
Others	21	5
Total	**396**	**112**

Skillnet Ireland and CitA also provide a number of MMC specific training and upskilling opportunities for Level 6 courses and above. These training courses have a particular focus on the digitalisation and reskilling senior roles within the industry.

Other organisations have developed trainings either tailored specifically to MMC or have woven MMC aspects into their trainings, such as Engineers Ireland, RIAI and various institutes of further education. This exemplifies the pivot of training providers towards the provision of training suitable to the transition to MMC.

In this supply side analysis, we omitted general engineering degrees, as while they often contain elements of MMC, the pathway chosen by an individual student can vary in differing professions, some of which have no meaningful construction component. The University of Galway (UG) has recently introduced a postgraduate course on construction innovation. This is specifically geared towards MMC with numerous modules on the topic. Another postgraduate certificate from UG aims to equip students with the key knowledge and skills required for the changing construction landscape. UG continues to act as a leader in the third level institution space in providing students with the right opportunities for MMC.

Skillnet Ireland has also been driving an increased provision of MMC related training and upskilling courses

Skillnet Ireland is the national workforce development agency of the Government of Ireland, with a mandate to advance the competitiveness, productivity, and innovation of Irish businesses through enterprise-led talent development. Skillnet Ireland partners with 59 industry bodies, supporting over 24,700 businesses and more than 92,400 trainees annually, through its 70 Skillnet Business Networks across most sectors and all regions in Ireland.

In December 2022, former DFHERIS Minister Simon Harris announced an expanded mandate for Skillnet Ireland, appointing Skillnet Ireland as the agency with a leadership role for Workforce Development in Ireland. Skillnet Ireland engages with stakeholders to ensure that skills and talent provisions meet the needs of our economy, with priority focus on:

- Digital Skills
- Green Skills for Climate Action (e.g., development of offshore wind sector)
- Skills required for Modern Methods of Construction (MMC)
- Industry 4.0
- SME Leadership and Productivity

In 2022, Construction Professionals Skillnet Ireland published a report into "Modern Methods of Construction – Defining MMC Business", which found that industry requires talent and upskilling supports for senior roles in MMC, particularly if industry is to deliver on the Government's Housing for All and Project Ireland 2040 targets.

In 2023 Construction Professionals Skillnet Ireland launched a series of videos on "What is Modern Methods of Construction (MMC)?" to help increase understanding of MMC and its benefits. In addition to this, new micro credential programmes in MMC are currently in development with Industry 4.0 Skillnet Ireland and the University of Galway.

Skillnet Ireland will also soon launch an industry-led platform to promote MMC skills development. It will include industry case studies, signposting to relevant upskilling programmes and be a core source of information on MMC.

Skillnet Ireland MMC Programmes

On the back of the "Modern Methods of Construction – Defining MMC Business" report, two micro-credential programmes in MMC were developed and launched in 2023. The programmes are highly practical and ensure that participants acquire the knowledge and develop the necessary skills to effectively deliver an MMC project in Ireland:

- Certificate in Strategic Co-ordination and Collaboration for Modern Methods of Construction

This is a Level 8 Micro-credential programme and is aimed at learners who currently hold an NFQ Level 7 qualification, and who wish to achieve a Level 8 qualification in Strategic Collaboration and Coordination for MMC. Applicants must be employed in a construction/related business and have at least one year's experience. The majority of the programme is delivered online. The course is aimed at people with responsibility for the coordination of MMC Projects.

11 learners took part in the programme's first intake in September 2023. The next programme intake will be in September 2024 and will run one day per week over 13 weeks.

- Strategic Supply Management for Modern Methods of Construction

This Level 8 Micro-credential is targeted at those responsible for ensuring the timely supply of product to site and the co-ordination of MMC Projects. The programme aims to develop learners' understanding of how MMC will shape and affect decisions for the operation and sustainable growth of a construction or related organisation and build competitive advantage through strategic supply management.

4 learners took part in the first iteration of the programme in 2023. The next programme intake will be in September 2024 and will run one day per week over 13 weeks.

In addition to this, new micro credential programmes in MMC are currently in development with Industry 4.0 Skillnet Ireland and the University of Galway, which are due to launch in 2024. These are:

- Micro cred 1 - Sustainability Planning in Construction (Level 9)
- Micro cred 2 - Digital Construction Technologies (Level 9)
- Micro cred 3 - Modern Methods of Construction - QA using Digital Twin (Level 9)

While there has been an increase in the number of MMC specific course, there is a lack of engagement from the industry due to time a resource constraints

Although there are a number of available training courses for the industry, there is a discrepancy between the uptake of training and the need from companies to upskill their labour force. As seen in Figure 5, and as discussed in Section 5, 83% of those surveyed have developed in-house training. This may be due to the heterogeneric processes within each facility, however a prevalent theme that arose from the stakeholder engagement exercise was the opportunity cost of time and resources.

It was mentioned that "*resourcing projects on site will not take into account significant time off for training"*, while another organisation stated that additional training availability appears to have the unintended consequence of lower participation as *"apprehension exists regarding the addition of more tasks to the workload… as each individual is occupied with their professional and personal commitments"*.

Figure 6 demonstrates the lack of engagement from industry with training and services set up to be MMC specific and to encourage upskilling and retraining throughout the industry.

However, the large development of in-house training highlights the need to address the discrepancy in the content of the training. 50% of organisations surveyed highlighted the creation of more relevant training as an action to overcome challenges for MMC training opportunities and development. Further liaison between training providers and industry is necessary to overcome this gap.

It is also important to note that from the large supply of training identified, strong industry collaboration currently exists for the development of relevant training, particularly with Skillnet Ireland and SOLAS who develop their training in response to industry need. However, as noted from the stakeholder interviews, the industry is currently *"saturated with trainings"* and *"leading with more trainings is missing the point as to why people get trained"*.

A number of skills have been identified as required in Ireland across all categories of MMC, and are listed in Appendix A. These skills have been ordered by priority according to literature review prevalence and engagements with stakeholders. Twelve of these skills have been identified without training currently. DFHERIS should work with training providers and industry to identify the most efficient measures to promote the speedy delivery of these priority skills.

Figure 5. MMC training providers

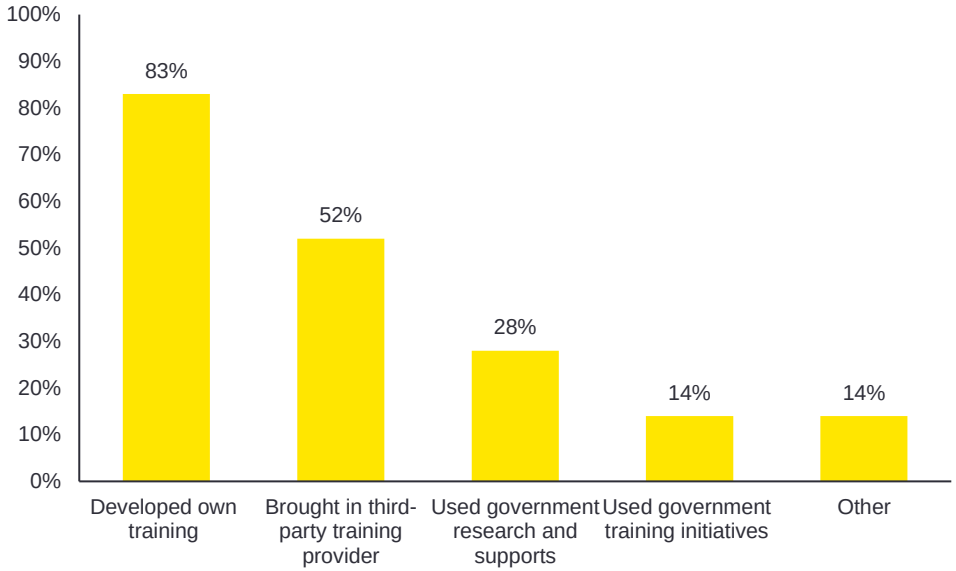
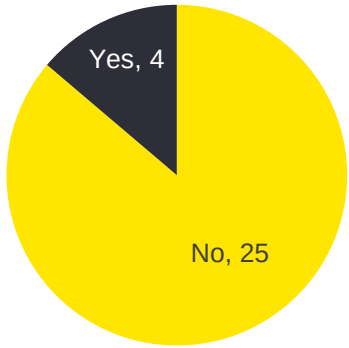


Figure 6. Utilisation of services form Construct Innovate, Build Digital, Mount Lucas, Skillnet Ireland and other industry bodies



MMC related skills gaps appear to be highest among senior positions within the industry, however barriers to access training must be overcome for improvements to be made

Uptake and levels of engagement must also be the focus of training providers, as well as the provision of additional relevant training to drive improved skills penetration in the sector. Training providers must be cognisant of the time and monetary cost for the industry to partake in training and upskilling, particularly with respect to SMEs, which make up 92.8% of the construction sector[2]. This is also further discussed in further in detail in the Section 5 of the report.

Additionally, the wider industry must welcome and build the right knowledge to adopt MMC practices to fully realise the benefits to both the sector and Government targets. As discussed, a knowledge gap rather than particular skills gaps persist, which also must be addressed. This was also noted during the stakeholder consultations: *"familiarising industry professionals with and incentivising them to adopt non-traditional construction methods is a far bigger barrier"* than training.

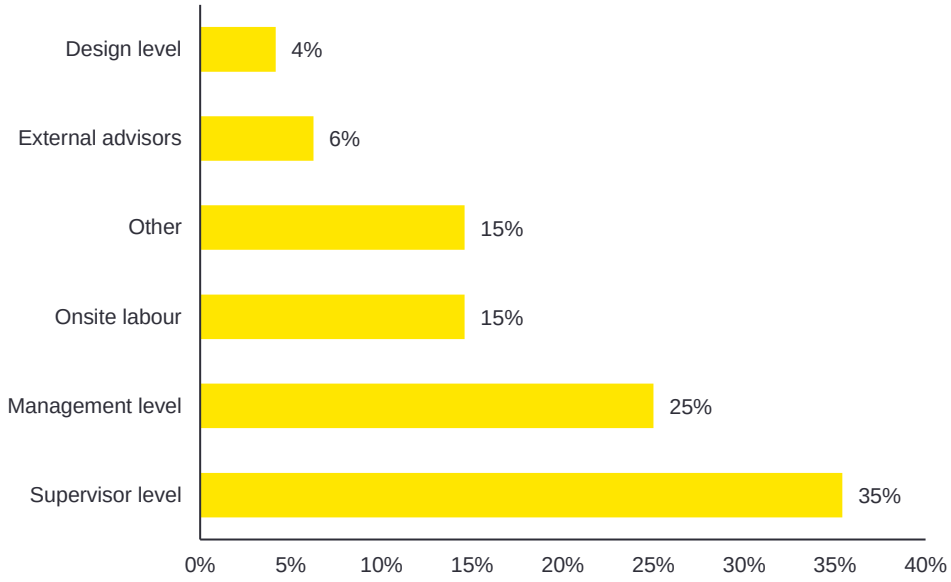
As shown in Figure 7, the skills and knowledge gaps appears to be most prevalent at senior levels, which may exacerbate the low training uptake where perceived importance may be low.

Overall, the supply of training for skills to support the MMC transition in the residential construction industry is substantive, however the uptake remains low as the majority of industry stakeholders consulted develop their own in-house training. Higher levels of engagement in training provided may be rectified through more active engagement with SMEs who may require greater assistance to ensure capacity to engage with courses.

Highlighting the importance of upskilling, making the advantages of utilising MMC clear, aiding in incorporating training and upskilling time into project timelines, or alleviating some of the time and cost constraints by engaging onsite with the organisations are some tools that could be employed by industry and training providers.

If companies continue their preference for in-house training and upskilling, a '*training the trainers'* model may be incorporated at a central location, such as Mount Lucas, ensuring training around the country within construction organisations is uniform and to a high standard.

Figure 7. MMC skill gaps at site, supervisor, management levels and external advisors



> *MMC pipeline creation requires an industry-wide paradigm shift, not just training, due to the industry's historical demand fluctuation.*
>
> **Industry survey respondent**

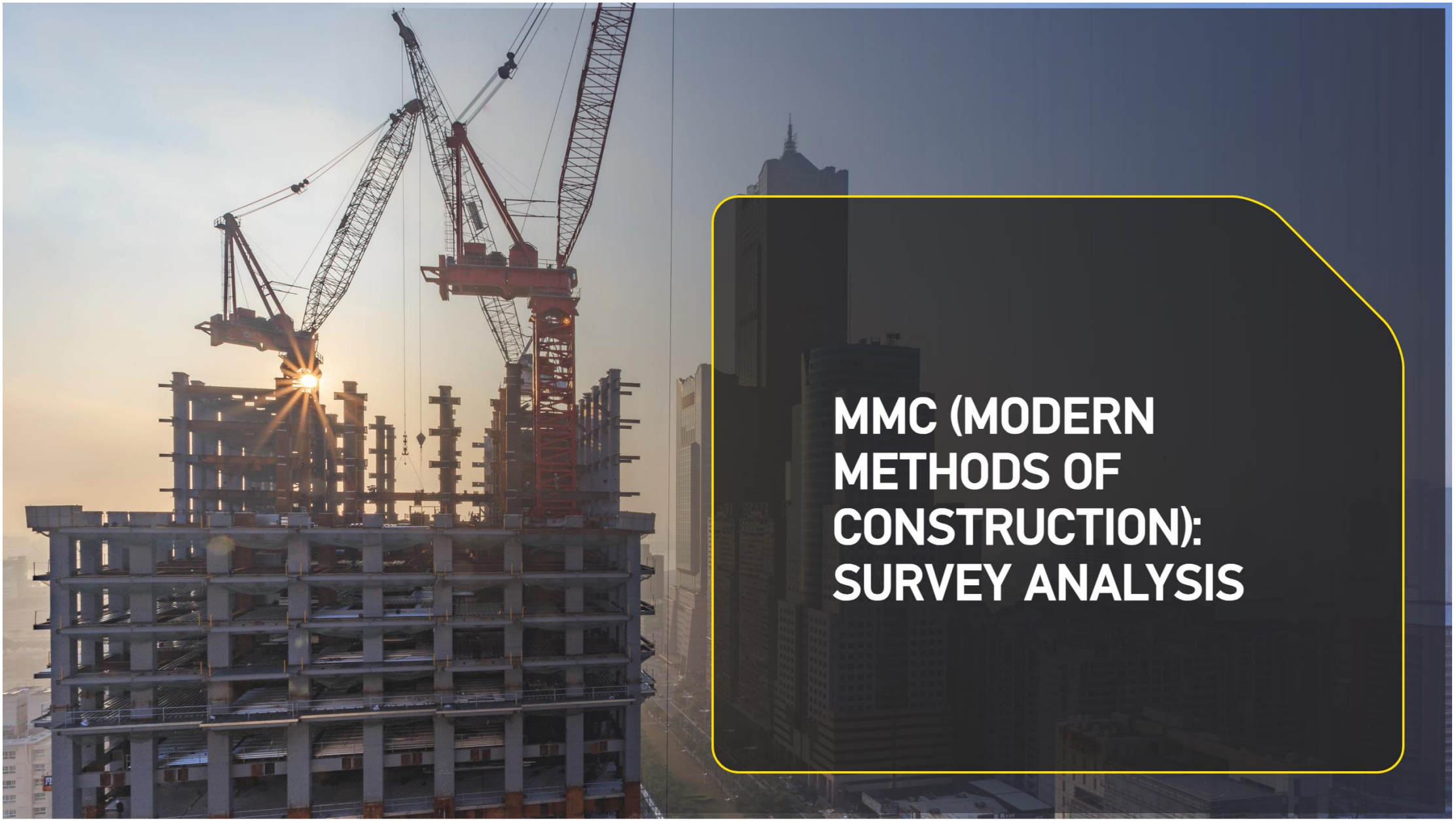
> *Mitigate the risk of MMC training reaching the same cohort over and over – focus on expanding the network to 'harder to reach' organisations who may not realise they need upskilling and make pathways for progression clear throughout the industry.*
>
> **Industry survey respondent**

[2] CSO - Business Demography 2021

8

Appendix A – Survey Results

Building a better working world



MMC (MODERN METHODS OF CONSTRUCTION): SURVEY ANALYSIS

OVERVIEW

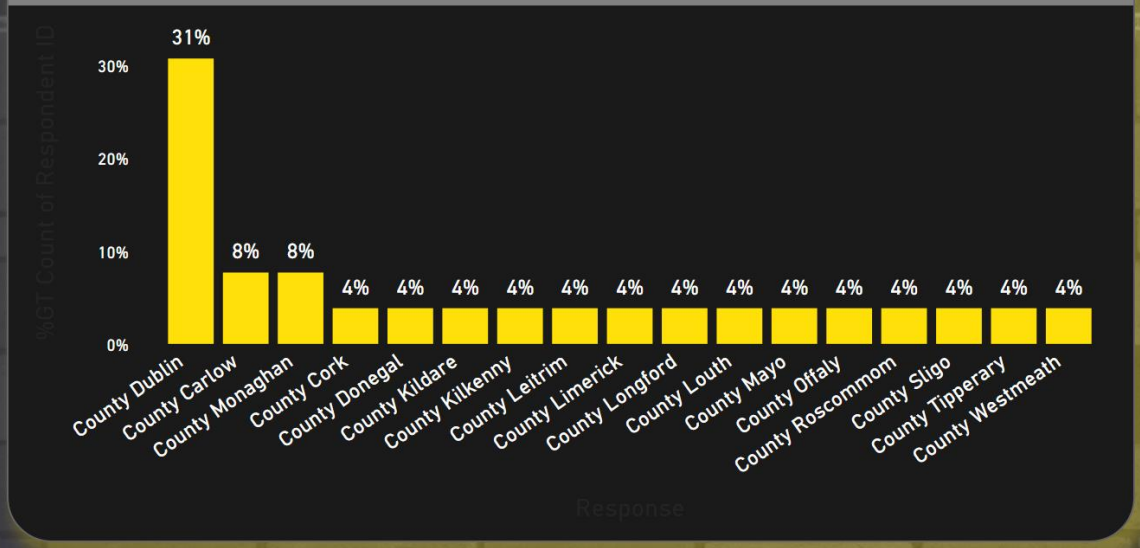
DESCRIPTION

This dashboard visualises responses from the MMC (Modern Methods of Construction) Skills Survey. The survey aimed to understand the skill requirements for short, medium, and long-term widespread adoption of MMC in Ireland. It identifies gaps in education, training, apprenticeship, and labour supply in order to provide in effective evidence base for sector requirements analysis.

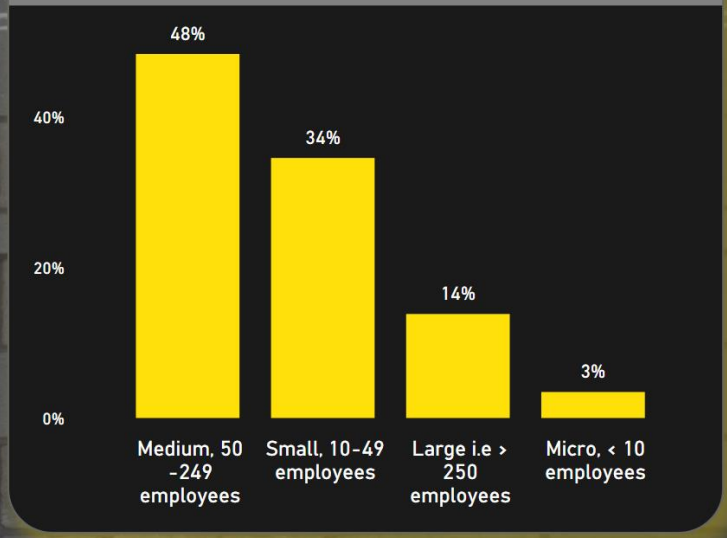
Number of responses

29

Location of the respondent

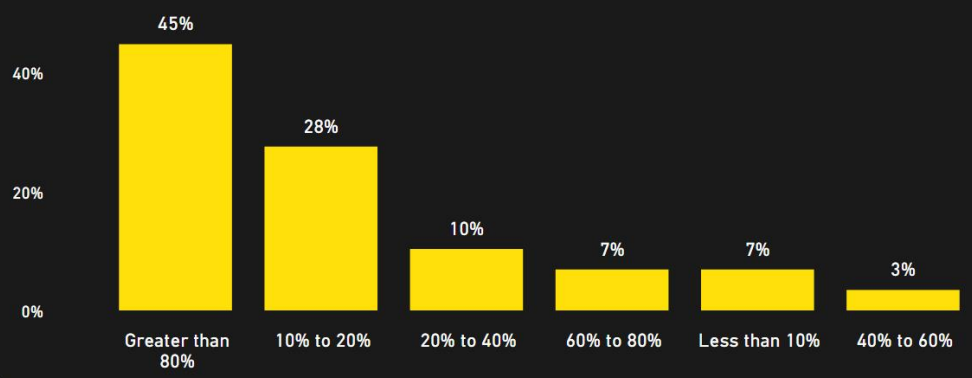


Size of the organisation

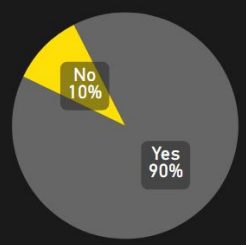


INTRODUCTION

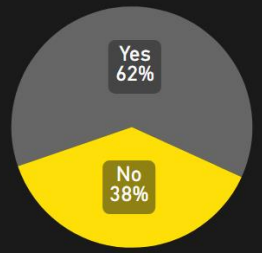
Proportion of business activity relates to building activity using MMC.



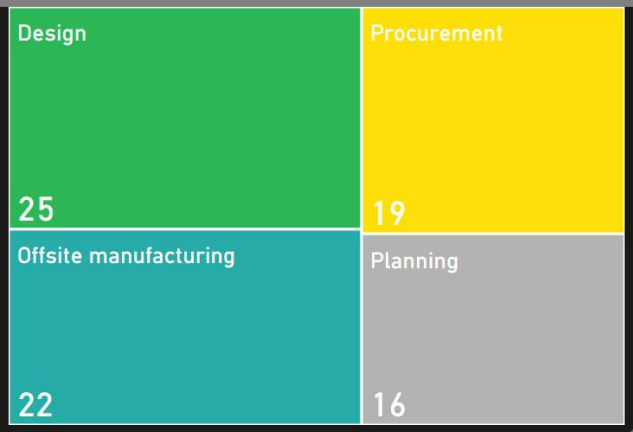
Proportion of organisation observed increase in demand for service relating to MMC



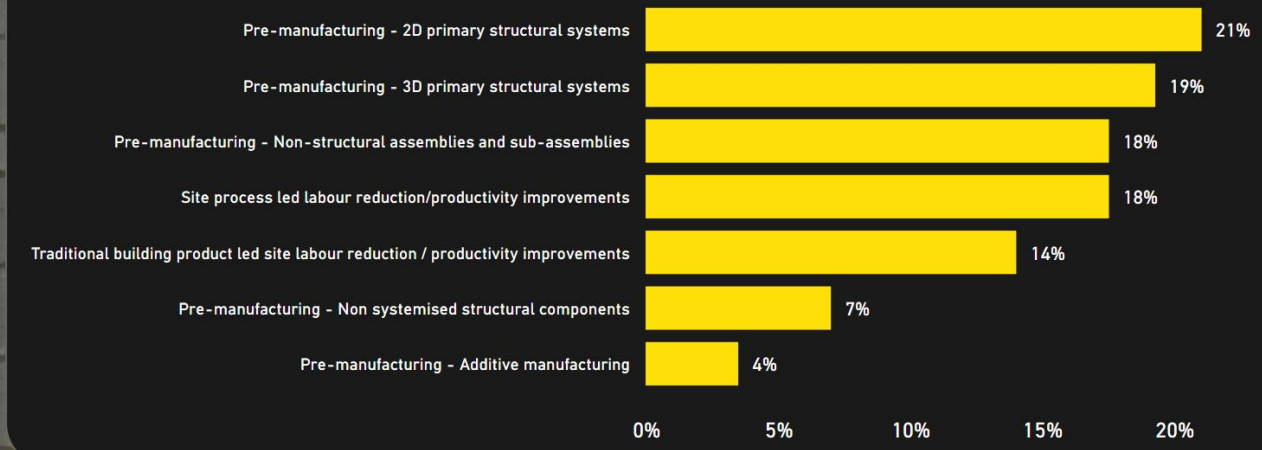
% of organisation staff availability



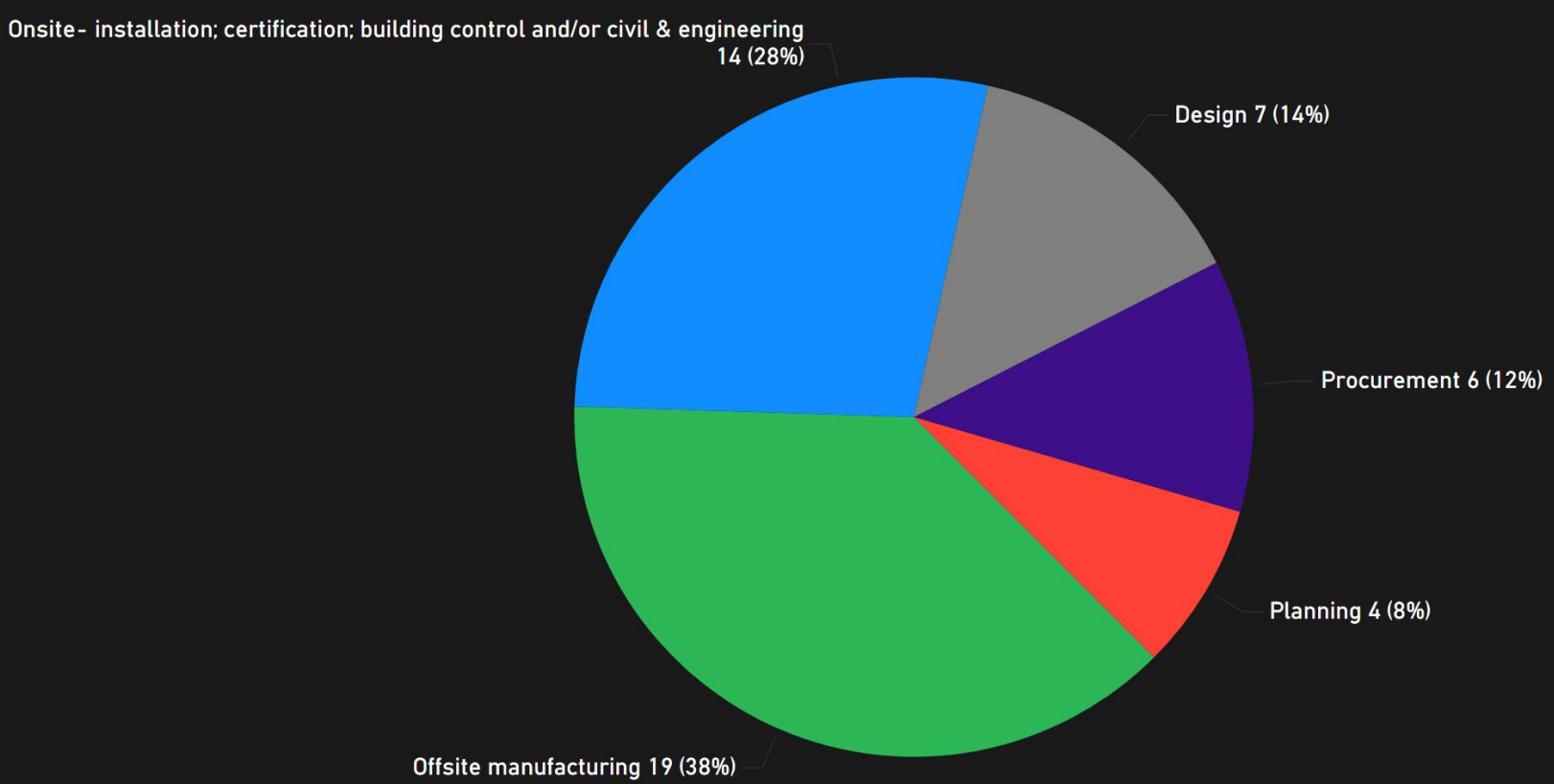
At what point of the supply chain should actions be best targeted to facilitate greater use of MMC in housing delivery?



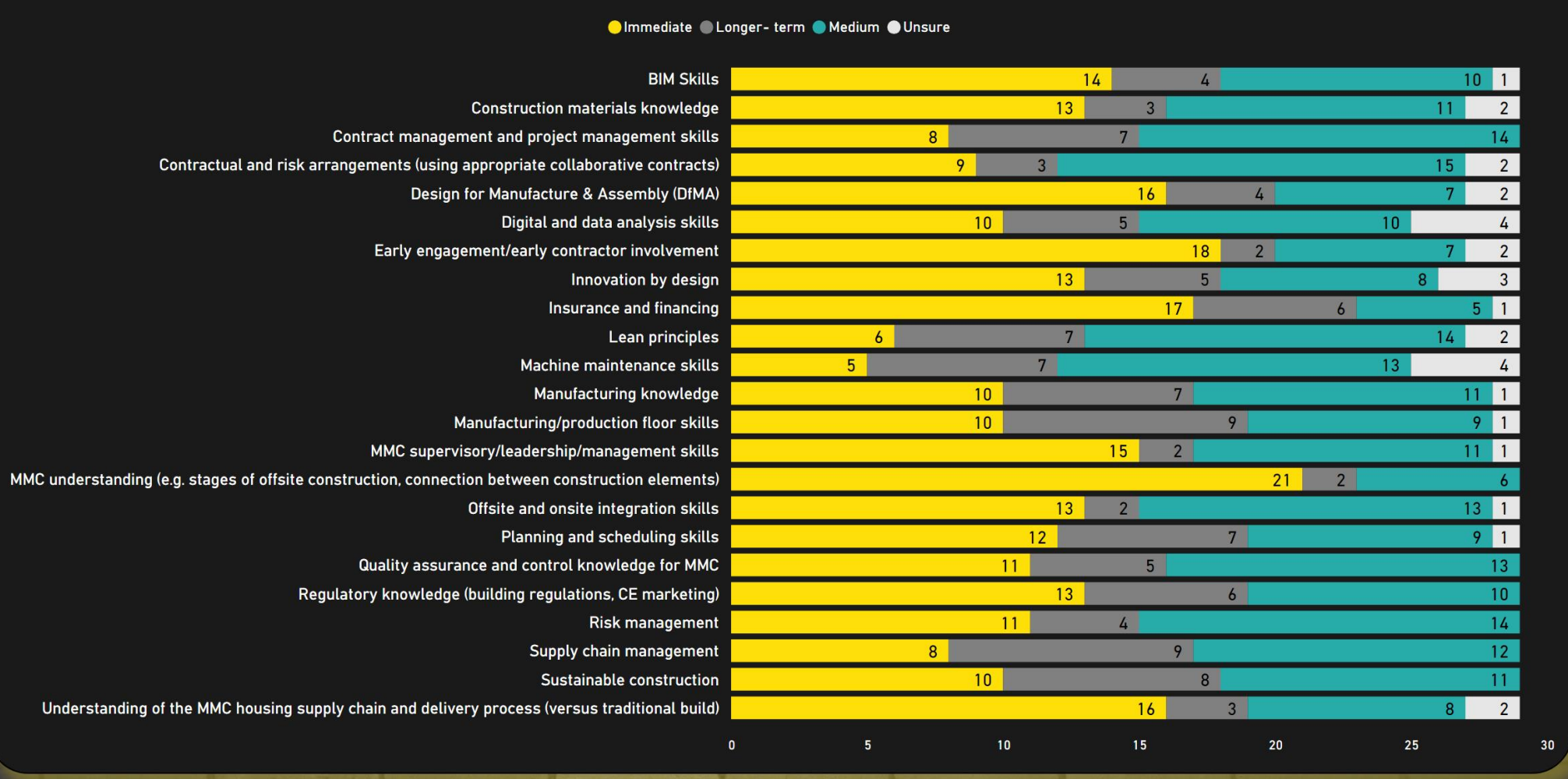
Proportion of organisation involved in following type of MMC



Organisations by supply chain process

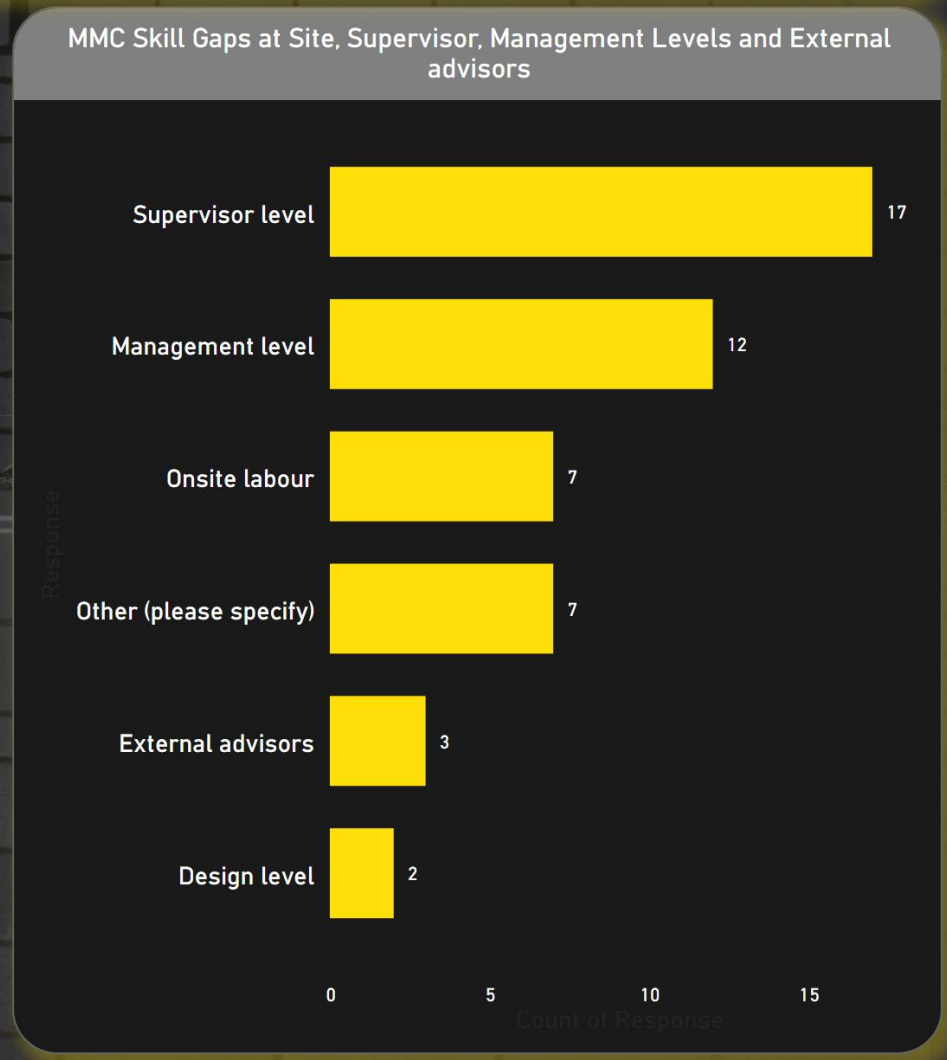


Required skills and expected time-period to support growth of MMC



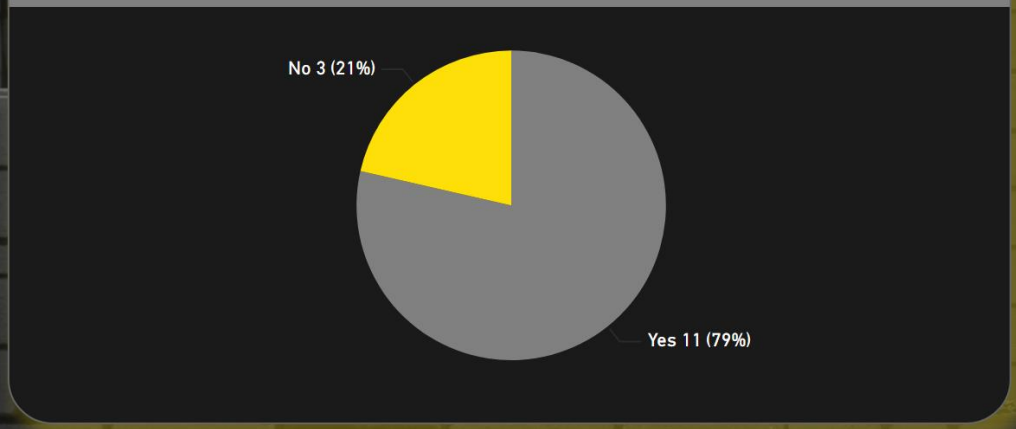
Skill gaps identified among various roles, sectors

Main skill shortage that may impact growth of MMC	Response
Adaptability	2
Building information modeling (BIM) management skills	1
Building information modeling (BIM) engineers and management skills	3
Building information modeling (BIM) with pipework fabrication knowledge	1
Carbon & LCA modelling	1
Client and government understanding of mmc processes and procurement and Design	1
Cost and delays in certification by NSA	1
Cultural bias toward traditional construction in general	1
Demand and supply of skilled personnel	1
Design	7
Design & factory supervision	1
Design integration knowledge of mmc	1
Design skills	1
General construction technician	1
Insurance issue	1
Mechtronics	1
MMC design engineers and technicicans	1
MMC understanding (supplier and users)	2
Mobile experienced digitally aware personnel with high degree of system knowledge	1
Onsite assembly crew	1
Other skills related to Design and the performance of buildings specific to modular and bcar where exisiting professional services need to be unskilled to understand these.	1
Planning	2
Planning authorities understanding of mmc	1
Process automation	1
Promoting MMC adoption by 3rd party industry stakeholders (architects; building control; fire consultants; insurers etc.)	1
Quality assurance and control (onsite and offsite manufacturing)	1
Robotics & AI	1
Sustainable design and innovative construction materials Planning is outside control of MMC operator	1
Traditional trades	4
Training labour force	1

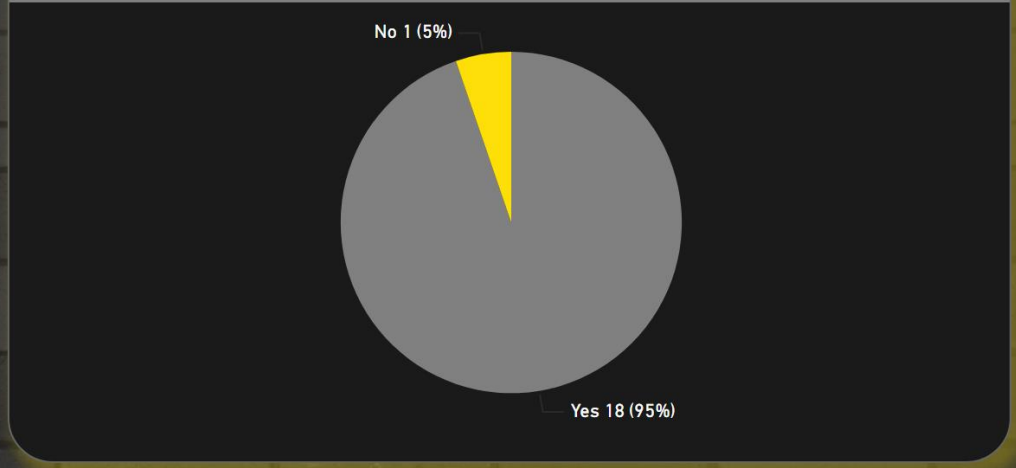


Skill gaps identified among various roles, sectors

Organisation recognised the skill gaps in wider supply-chain (Onsite Installation)



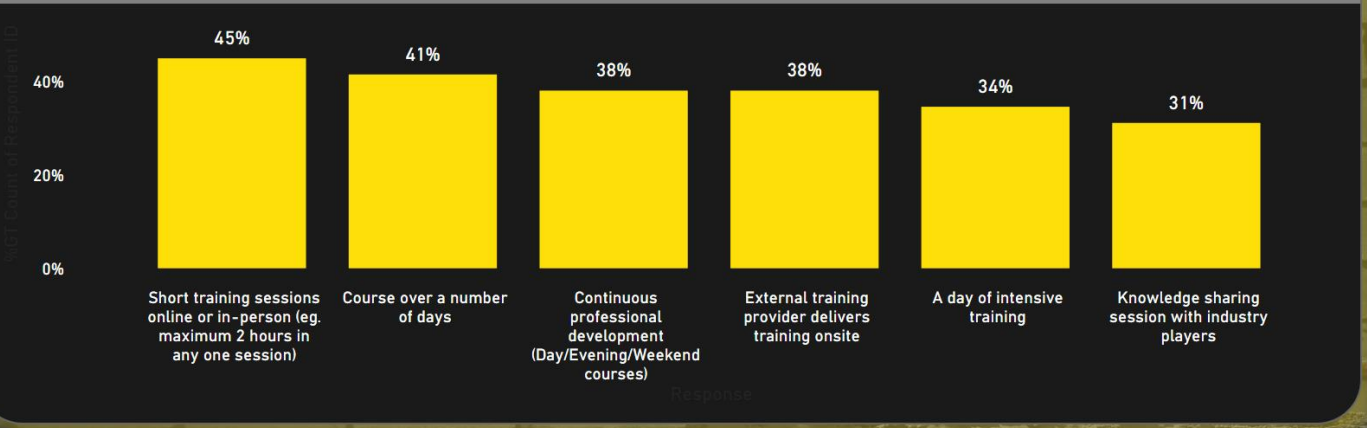
Organisation recognised the skill gaps in wider supply-chain (Offsite manufacturing)



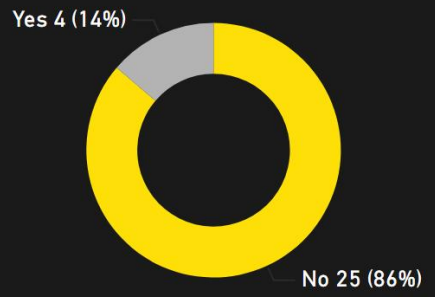
Yes responses	Responses count
Customer - e.g developers	9
Procurers / developers	3
Sub-contactor	3
Insurers and financiers	2
All (Sub-contractor	1
Awareness of how MMC operates.	1
Certifying bodies	1
Client (developers; end users; government bodies) need further training	1
Designers eg. Architects	1
Digital Construction	1
Insurance for contractors during construction and indeed occupiers.	1
Interfacing trades	1
Investments	1
Limited or no knowledge within housing procurement on MMC housing provision	1
Most industry stakeholders were trained in traditional construction methods - significant lack of understanding of MMC	1
Private Clients	1
Procurers/developers	1
Public Procurers	1
Reluctance among industry stakeholders to deviate from traditional methods. Stakeholders have very different	1
Supplier	1
Warranty providers	1

Trainings

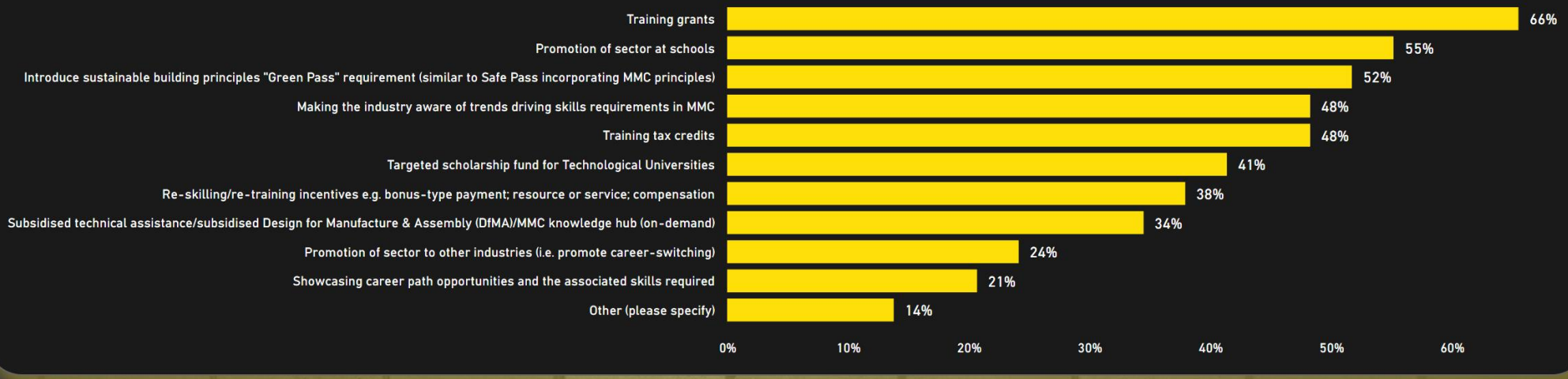
Preferred Training Access Methods by Staff



Utilisation of Services from Construct Innovate, Build Digital, Mount Lucas, Skillnet Ireland and Other Industry Bodies

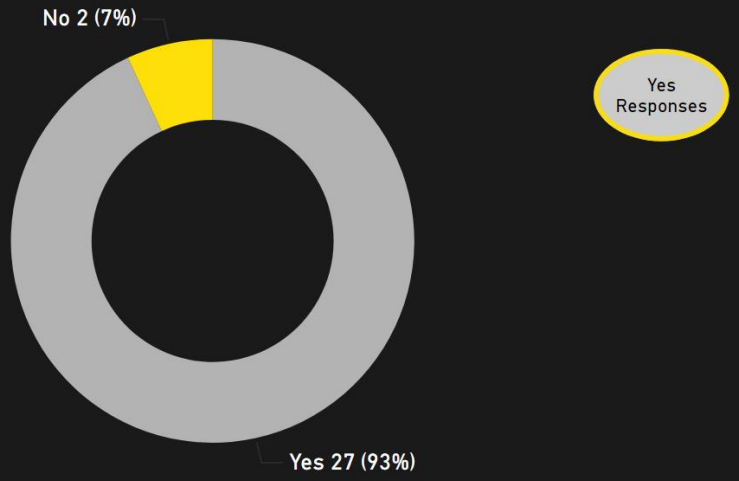


Suggested Public Sector and Educational Support to Address MMC Skill Needs in Construction sector



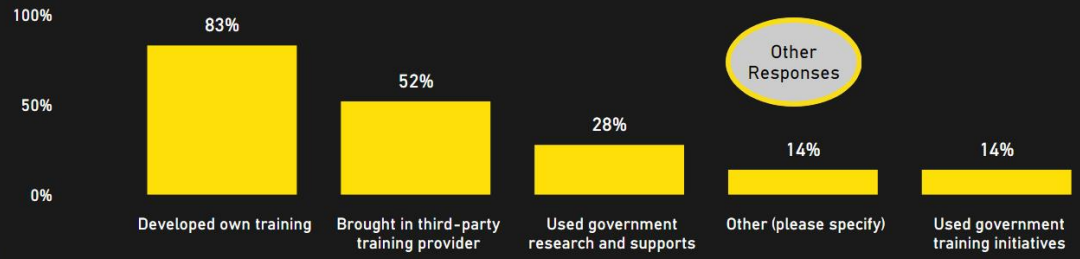
Trainings continued

Organisations invested in MMC related skills / training



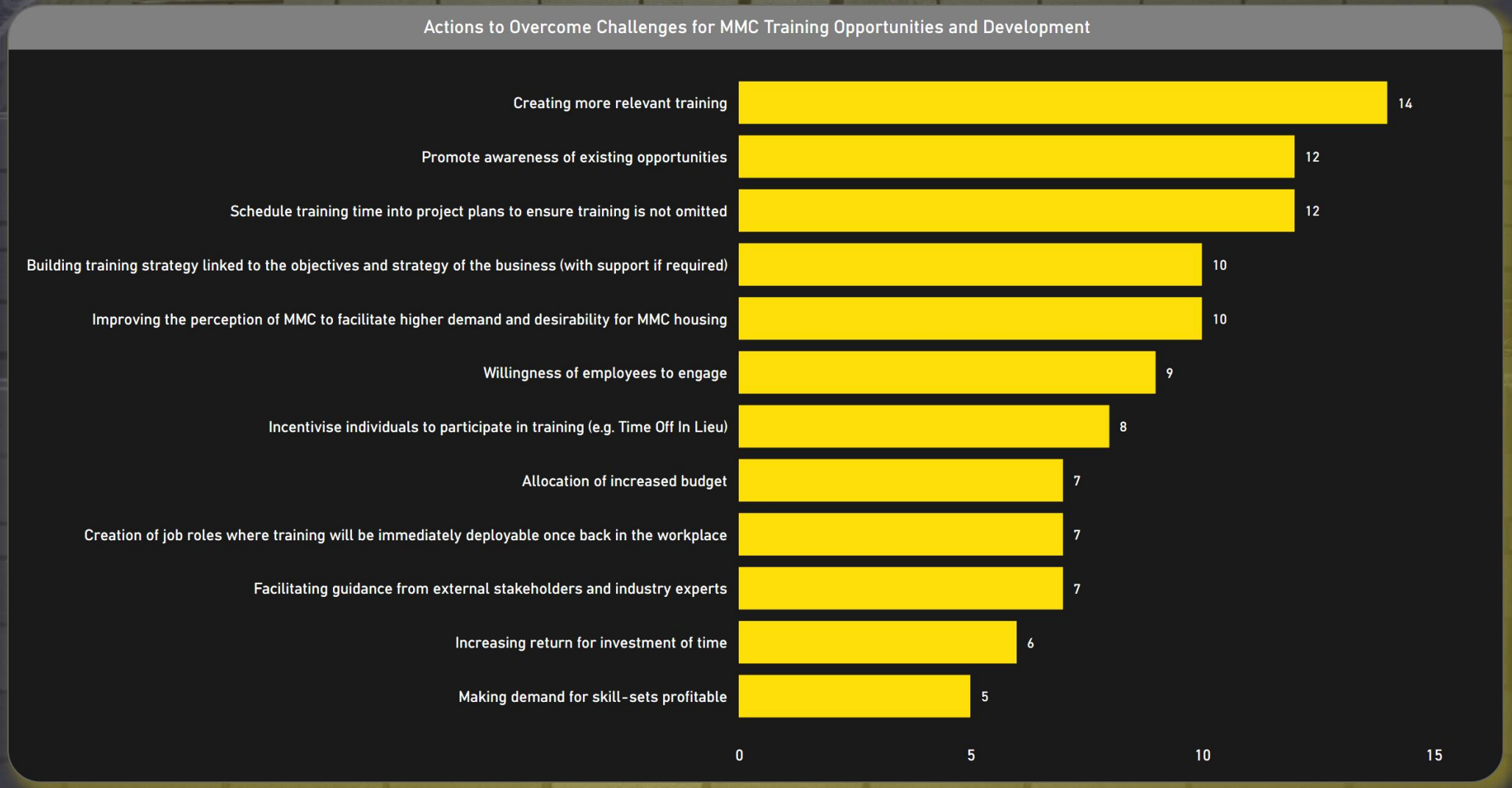
Yes Response	Response
Collaboration (construct innovate)	2
Construction Professionals Skillnet - Green Procurement	1
Construction Professionals Skillnet - Improving Productivity	1
Construction Professionals Skillnet - SPA in Mechanical	1
Construction Professionals Skillnet - Strategic Collaboration and Coordintation for MMC (certificate)	1
Construction Professionals Skillnet - Strategic Supply Management for MMC (certificate)	1
Digital education & training (build digital)	1
Digital leadership & cultural change (build digital)	1
Digital procurement (build digital)	1
Digital standards (build digital)	2
Electrical and Plumbing (BIM Applications)	1
Industry 4.0 Skillnet - Drone Technology	1
Industry 4.0 Skillnet - Programmable Logic Controllers	1
Other (please specify)	1
Skills & training (construct innovate)	1
Sustainability (construct innovate)	1

Initiatives organisations have put in place to address any MMC related knowledge or skills gaps



Others' responses
MMC pipeline creation requires an industry-wide paradigm shift, not just training, due to the industry's historical demand fluctuations
Membership of MMC
Developed suite of BIM Training Packages
Developed in-house capability in MMC integration (strategic and project based) and MMC technical knowledge specialists.

Actions to Overcome Challenges for MMC Training Opportunities and Development

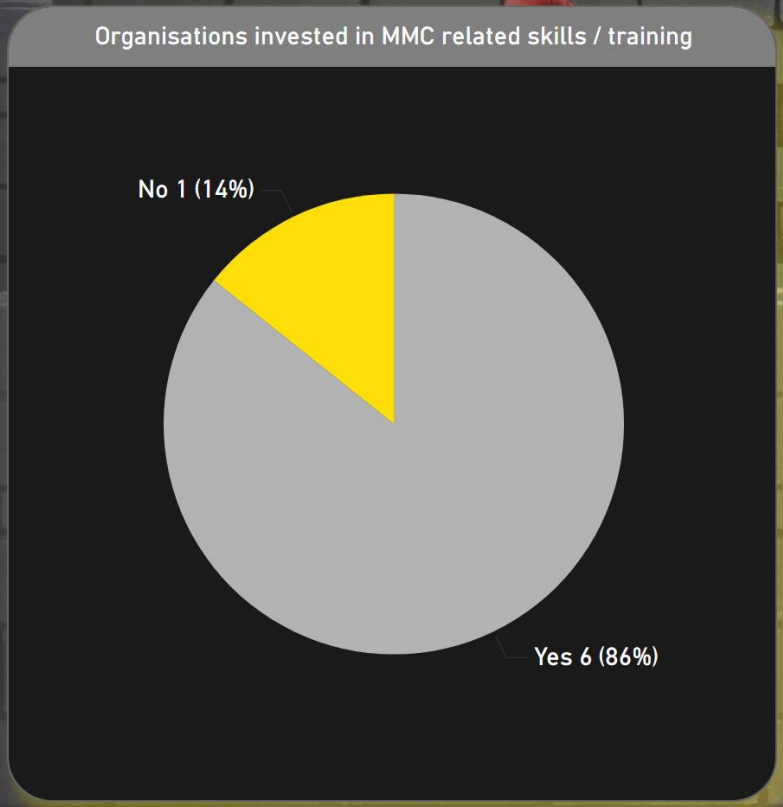


Actions to Overcome Challenges for MMC Training Opportunities and Development- Other responses

Response
Every individual is occupied with their professional responsibilities as well as personal commitments. An apprehension exists regarding the addition of more tasks to their workload.
If MMC are not incorporated into the project design during the early stages (pre-planning), it becomes difficult to re-engineer the project for full MMC integration later on. This is largely due to different short-term priorities taking precedence.
Linking knowledge of MMC skills to clear career paths
NA
One of the biggest damages to the perception of Modular has actually been from government bodies. On numerous occasions, they have commented on the large lifespan and quality of modular. This is based on either a limited knowledge of what can be delivered, or possibly to justify the lack of procurement around modular. However, no reference is being made to the success of Modular in other geographies, which is strange. The industry has decided not to challenge these comments in the media for a number of reasons. However, it's coming to a tipping point. The media has also referenced things like short-term, non-permanent, low quality, cheap options. These remain unchallenged. There has been little or no interaction from standard or building control bodies to understand new systems, feeding into the narrative that these new systems are sub-optimal and questionable. This needs to be addressed urgently to improve perceptions and increase uptake of Modular.
Time and Financial investment requirement
Training overload, Resourcing projects on site will not take into account significant time off for training, Bring training to point of use / correct timing within careers, Bring companies on board to tailor the training and compensate them for their expertise in an advisory capacity, Mitigate the risk of MMC people training the same MMC cohort over and over - focus on expanding the network to 'harder to reach' individuals and organisations who might not realise they need upskilling (eg. clients and local authorities), Make the pathways from education to application clear and agree this with companies, Overreliance on the same people to contribute knowledge - without fully considering that they have full time jobs and will need to demonstrate return on investment to their company for industry engagement that takes time away from the day job, The training needs to be practical not just academic Consider how the skills providers can more successfully engage with the companies they seek to serve and more importantly with the people in those companies who need access to learning. Consider 'in-company' learning platforms as an opportunity to increase engagement with MMC learning and how these might interact with external training provision.

Investments in MMC related technology - Design

Design

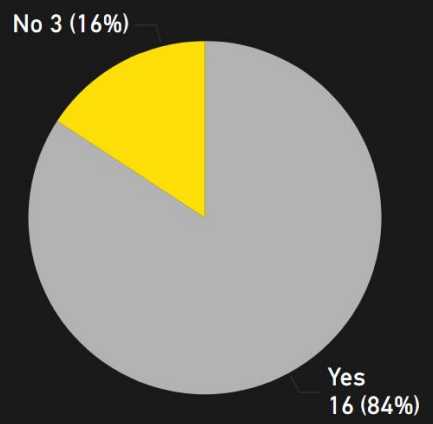


Investments	% Count of organisation	Count of organisation
BIM	60%	3
computing power	20%	1
Field View	20%	1
Invested in Tekla structures BIM software.	20%	1
Revit	40%	2
Software Platform	20%	1
Tools for major facility (elec/mech)	20%	1
View Point	20%	1

Investments in MMC related technology - Offsite manufacturing

Offsite Manufacturing

Organisations invested in MMC related skills / training

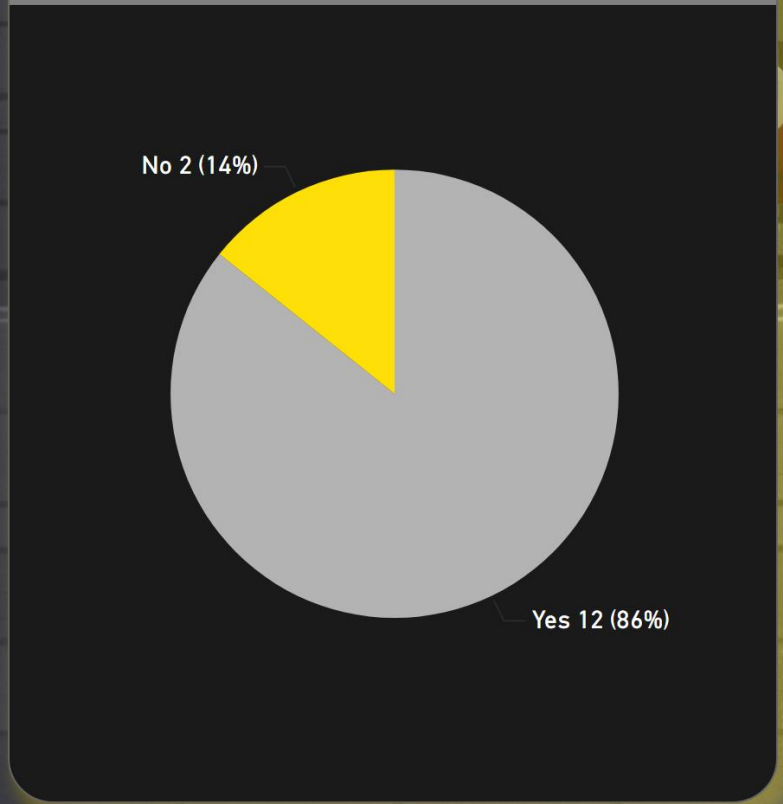


Investments	% Count of organisation	Count of organisation
Whole company is based around the manufacture of a MMC system.	6%	1
Various	6%	1
Two state of the art manufacturing plants for system	6%	1
Transport	6%	1
Technological solutions and advancements will follow in the years to come based on the winning systems employed.	6%	1
Roll forming technology (CAD to CAM)	6%	1
Roll Formers	6%	1
Production lines of various configurations for different build ups	6%	1
Mutliple design softwares for engineers & technicians	6%	1
Major facility and Machines (being completed in Portlaoise)	6%	1
Invested millions of own money (not state funded money) into developing systems and knowledge of how to deliver modular that is BER A1 and yet Net Zero 2030 embodied carbon - a very complex set of skills and methods that requires heavy investment and time measured in years	6%	1
Factory machinery including flipping butterfly tables; straddle carriers; gantry cranes; ERP system along with new scanning systems for materials and product	6%	1
ERP	6%	1
Equipment	6%	1
Different Member Companies would have various systems for production control and on site quality	6%	1
Design Software	13%	2
Cranes	6%	1
BIM software.	6%	1
BIM 360	6%	1
Automation & digitalisation	6%	1
Automated saw and drill line of structural steel	6%	1
3D Construction printer	6%	1
110K sqft manufacturing facility	6%	1

Investments in MMC related technology - Onsite Installation

Onsite Installation

Organisations invested in MMC related skills / training

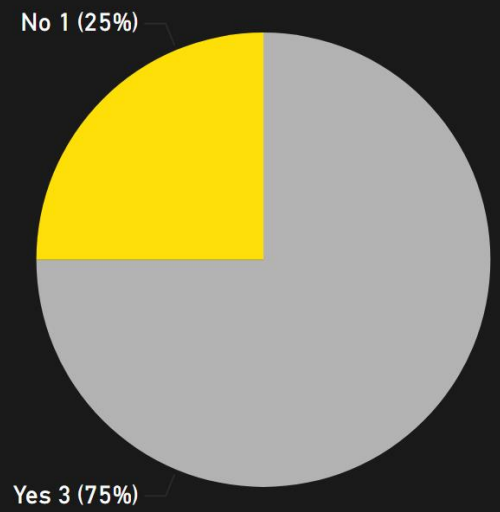


Investments	% Count of organisation	Count of organisation
Viewpoint	8%	1
Software and Machinery	8%	1
Software	8%	1
Snagging Applications	8%	1
Robotics	8%	1
Revit	8%	1
Production software	8%	1
Production machinary	8%	1
Onsite quality control	8%	1
Off-Site Factory for Light Gauge Steel	8%	1
Manufacturing equipment for our 2 Irish based factories	8%	1
Lidar Surveys	8%	1
Fieldview	8%	1
Entire business is an investment in MMC	8%	1
Drones	8%	1
Digital Technologies that are currently our own IP	8%	1
Digital Delivery platforms	8%	1
Currently building a new factory	8%	1
BIM software	8%	1
AR/VR	8%	1

Investments in MMC related technology - Planning

Planning

Organisations invested in MMC related skills / training

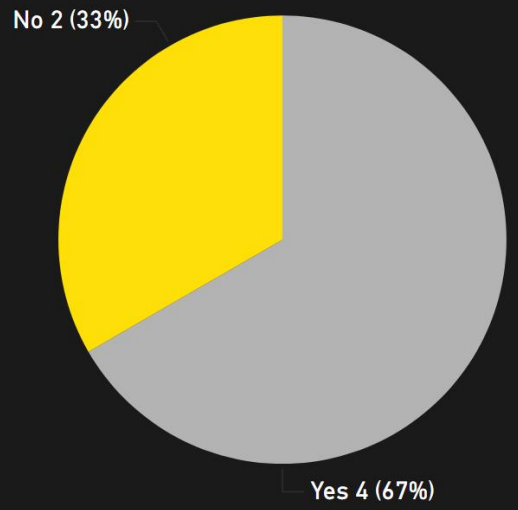


Investments	% Count of organisation	Count of organisation
Software Platform BIM 360	33%	1
BIM	33%	1
3D Construction printer	33%	1

Investments in MMC related technology - Procurement

Procurement

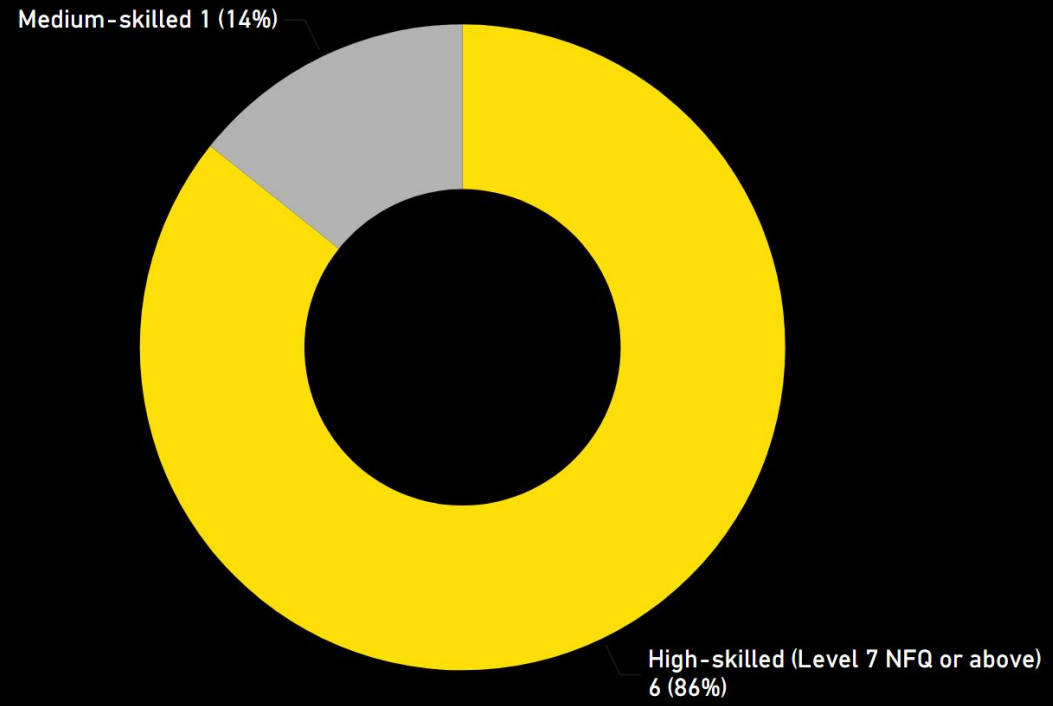
Organisations invested in MMC related skills / training



Investments	% Count of organisation	Count of organisation
Utility Cupboards	25%	1
Revit	25%	1
Pre-cast concrete	25%	1
Onsite tools	25%	1
Off-site reinforcement	25%	1
Mass Timber	25%	1
Light Gauge Steel.	25%	1
Facades	25%	1
Digital Construction Software Platform	25%	1
Commercial tools	25%	1
BIM	25%	1
Bathroom Pods	25%	1
Automated saw and drill lines.	25%	1

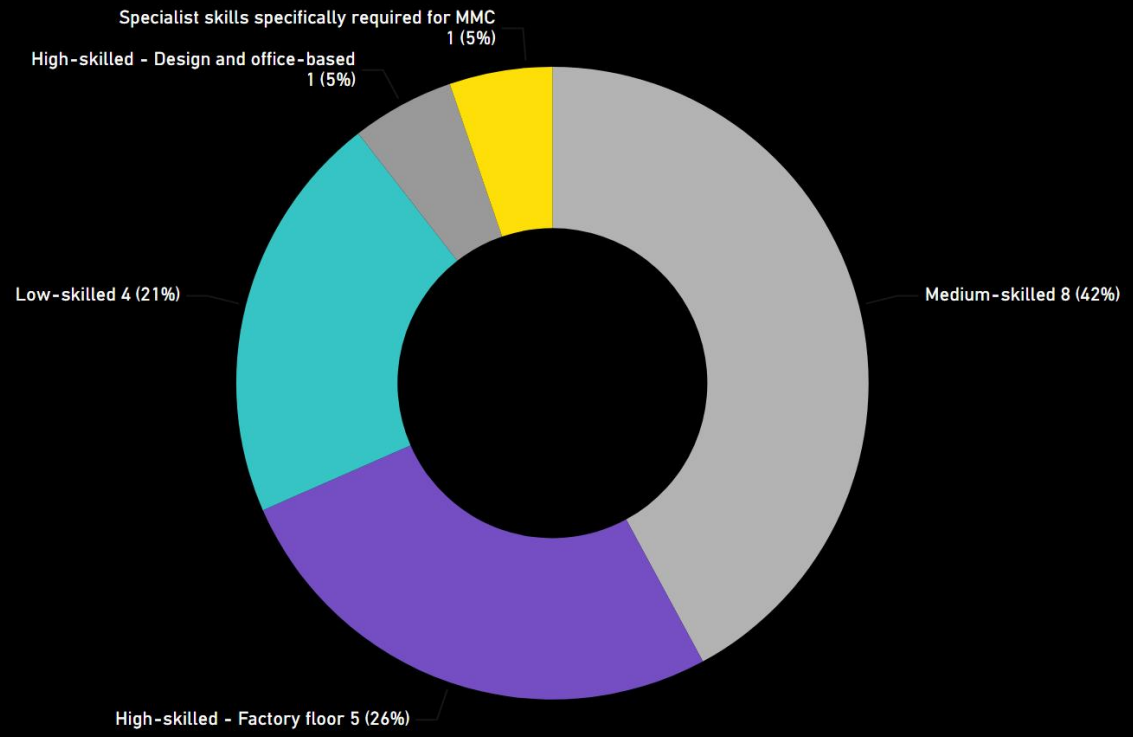
Composition of workforce by skill level - Design

Design



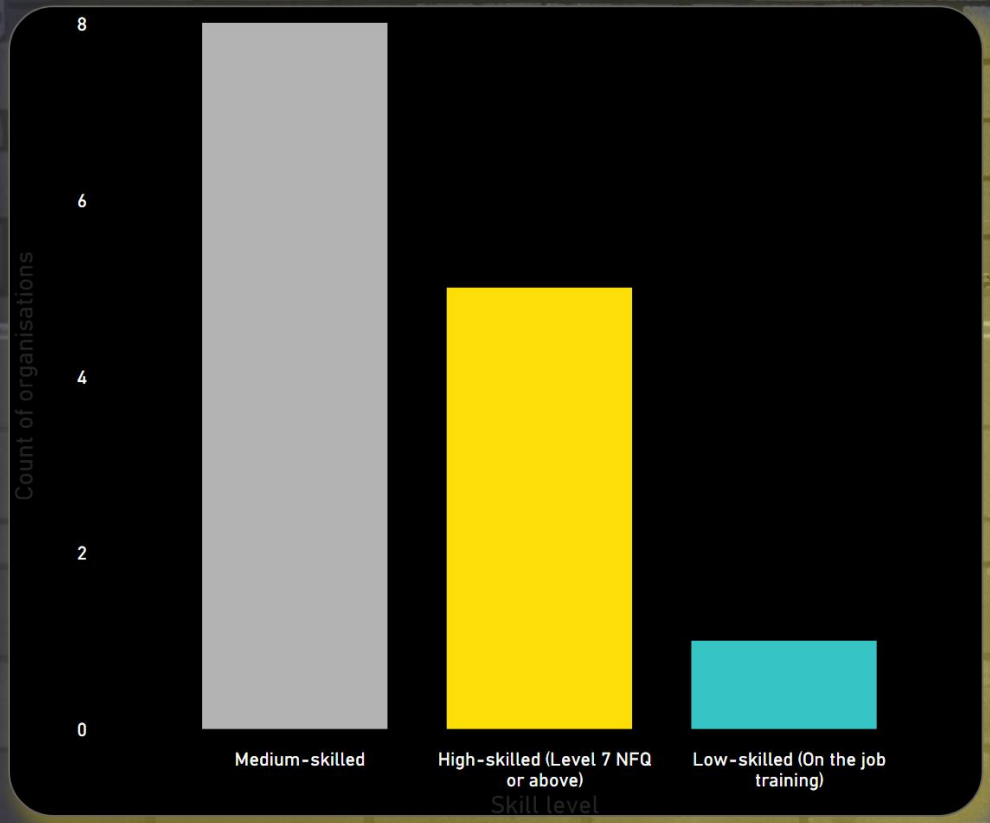
Composition of workforce by skill level - Offsite manufacturing

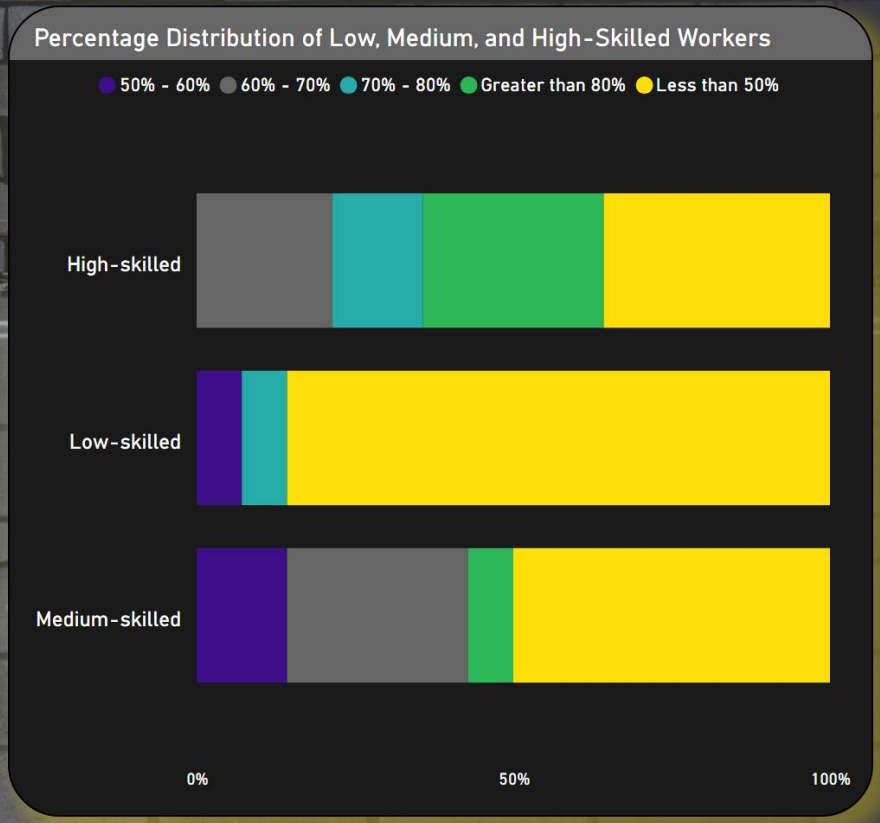
Offsite Manufacturing



Composition of workforce by skill level - Onsite Installation

Onsite Installation

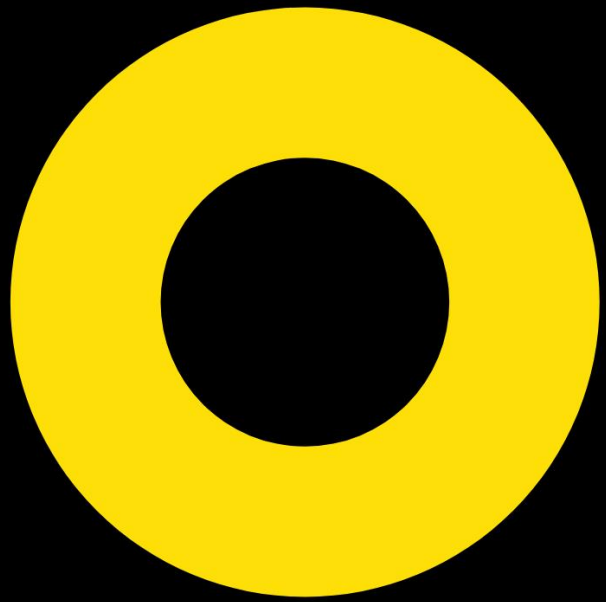




- The graph on the left represents the onsite installation organisations surveyed response to “What type of labour makes up the majority of your workforce in the area of Onsite Installation?”. 8 said medium-skilled, 5 said high-skilled and 1 said low skilled.
- The graph on the right asked the same organisations what approximate percent of their workforce is considered low, medium or high skilled.
- The majority of companies answered that less than 50% of their workforce is comprised of low-skill workers, for example.

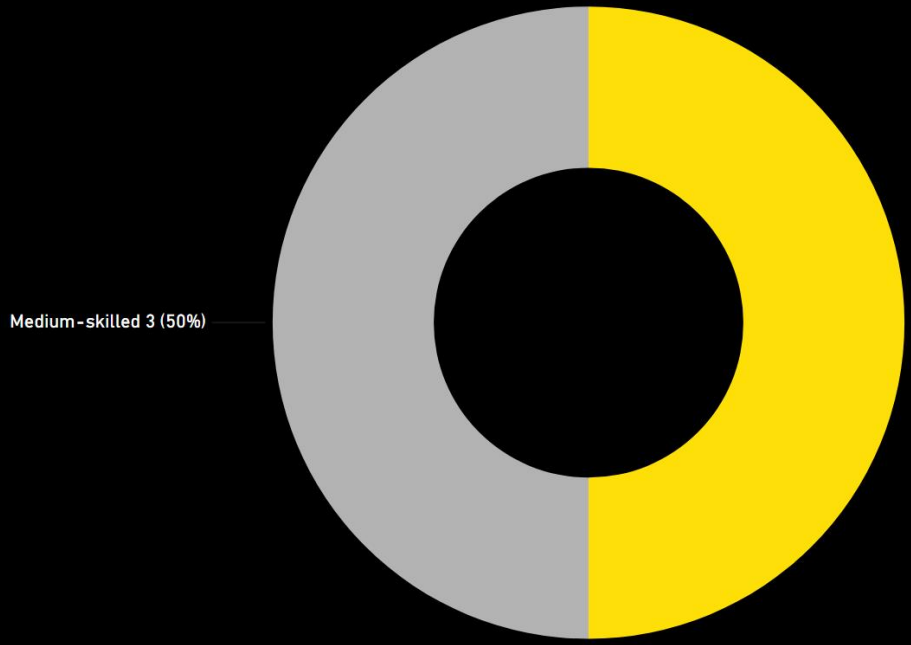
Composition of workforce by skill level - Planning

Planning



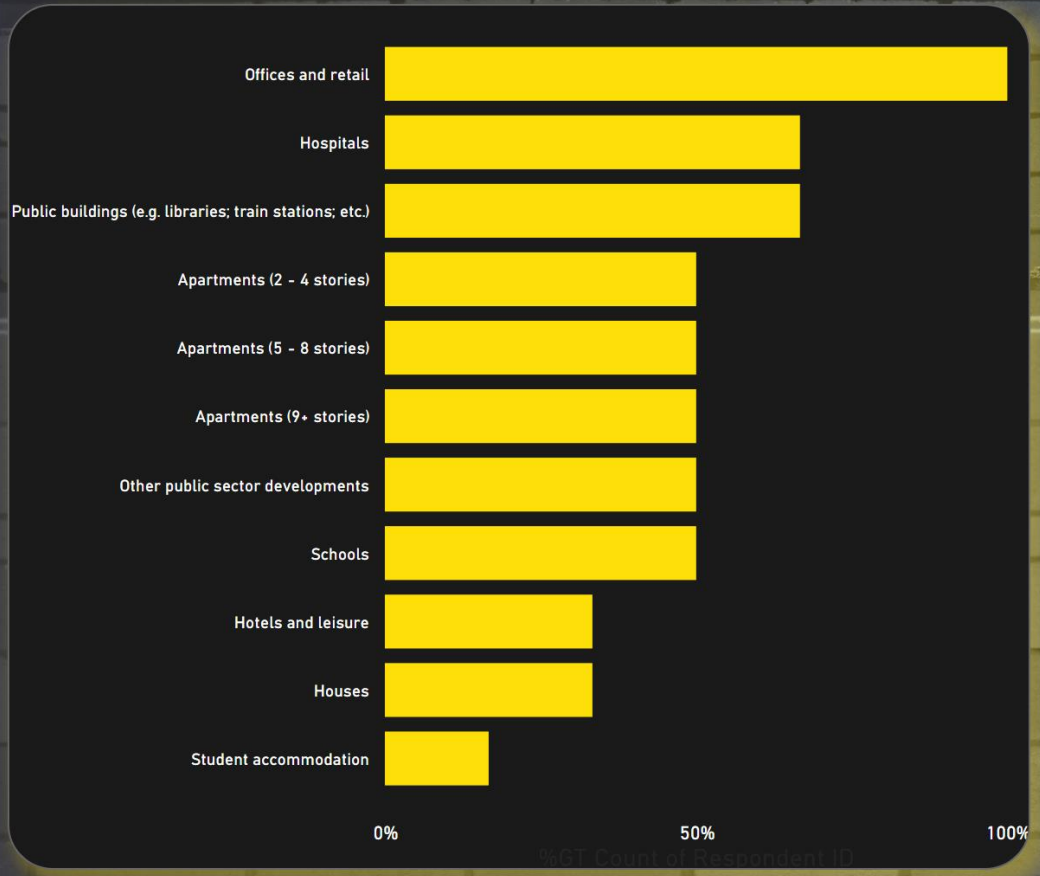
Composition of workforce by skill level - Procurement

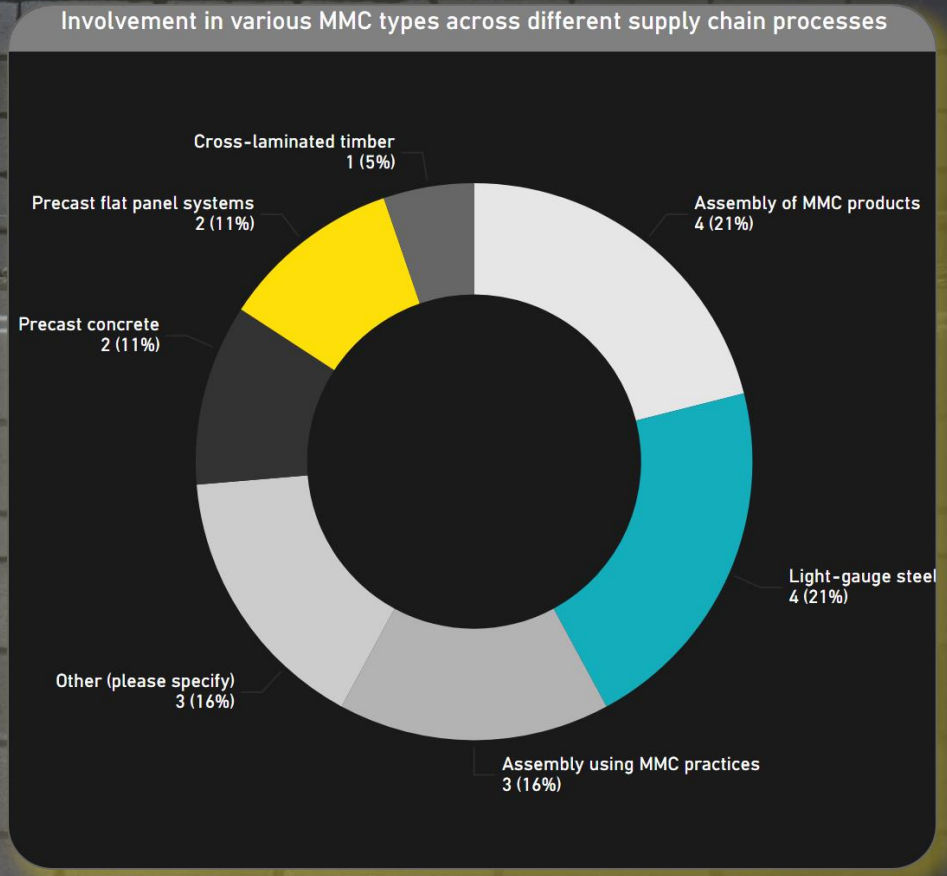
Procurement



Types of development involving MMC practice - Design

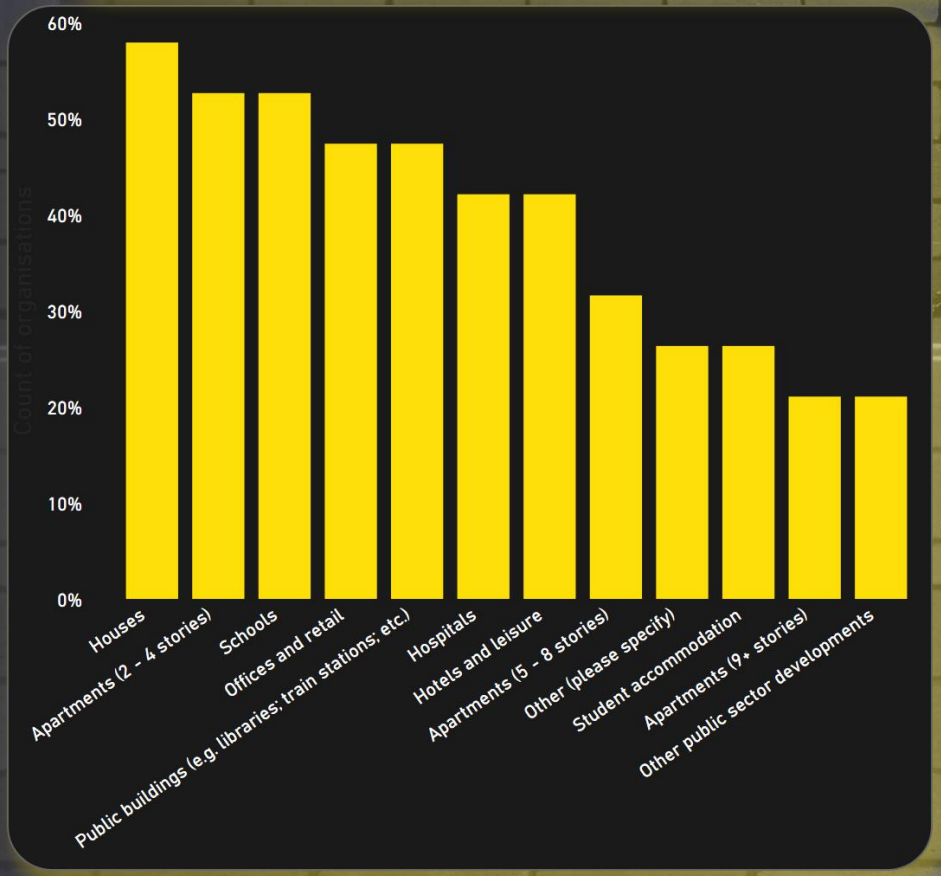
Design

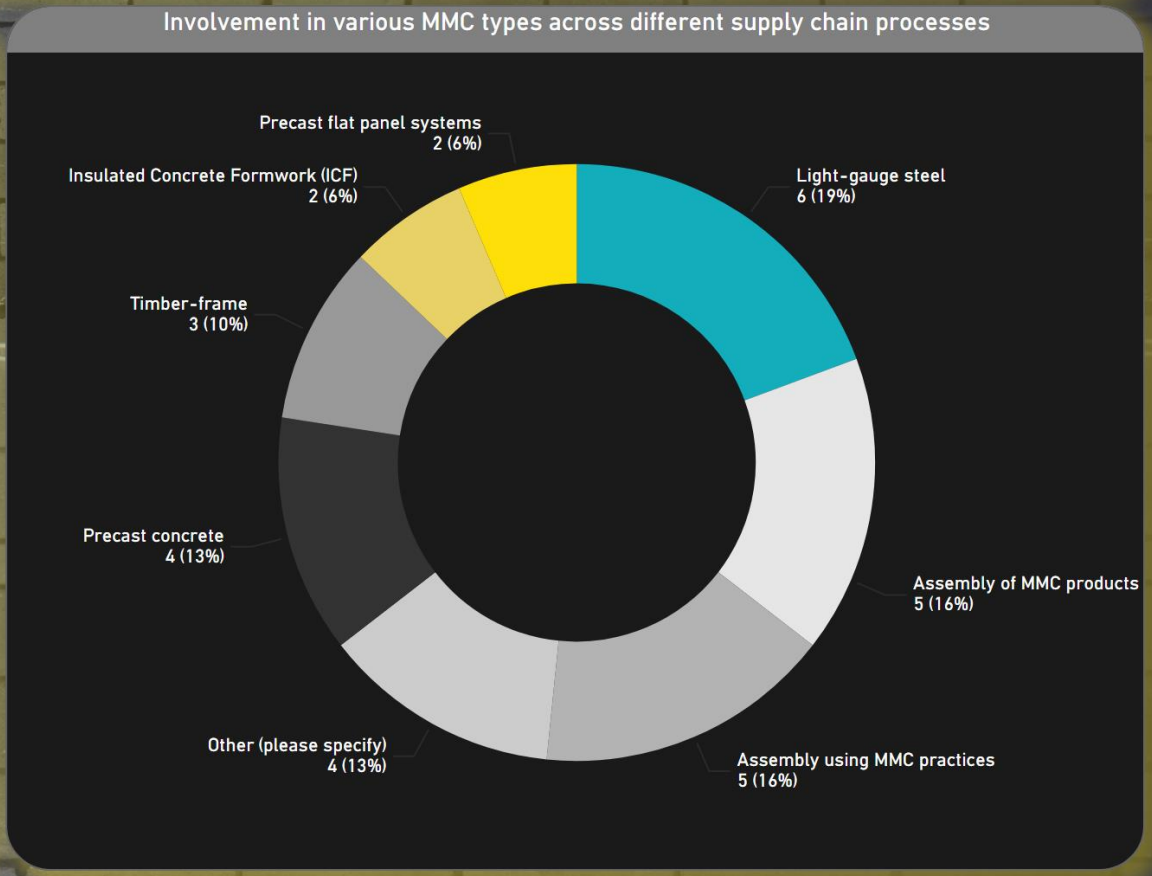




Types of development involving MMC practice - Offsite manufacturing

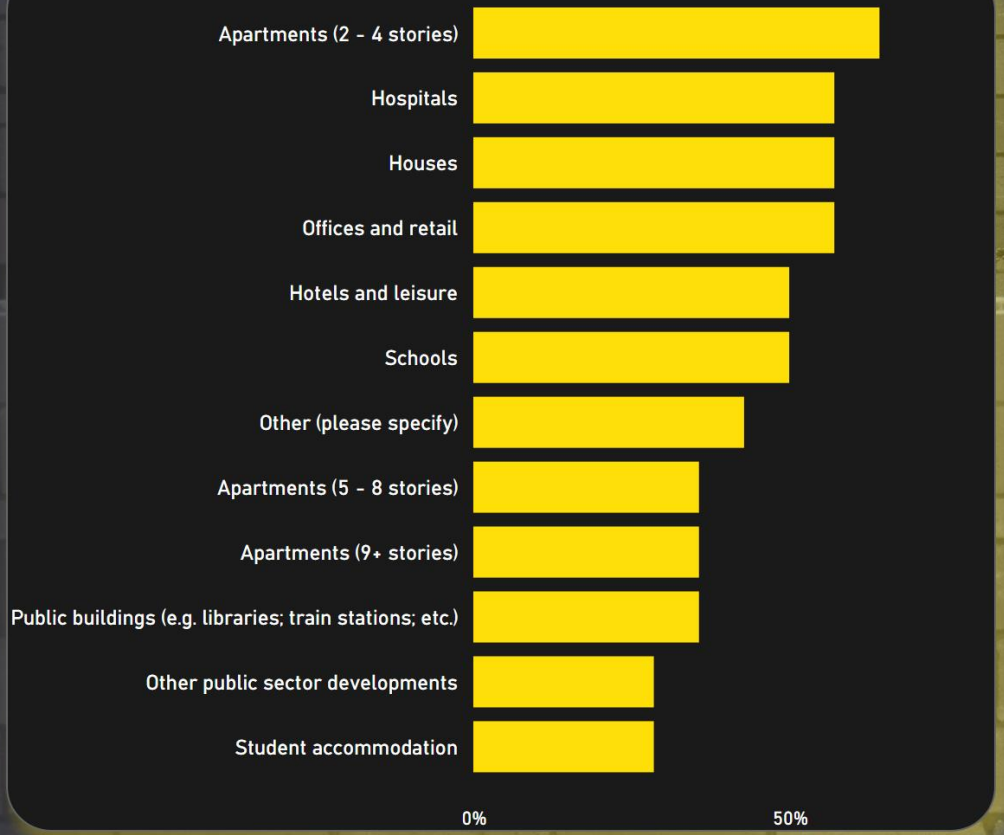
Offsite Manufacturing



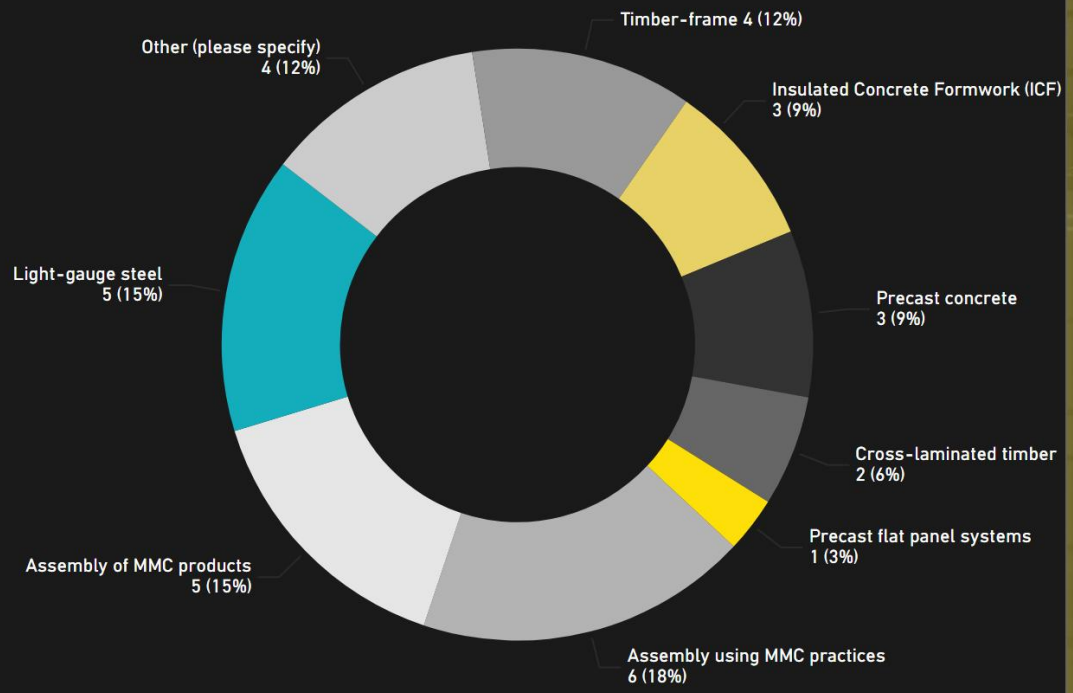


Types of development involving MMC practice - Onsite Installation

Onsite Installation

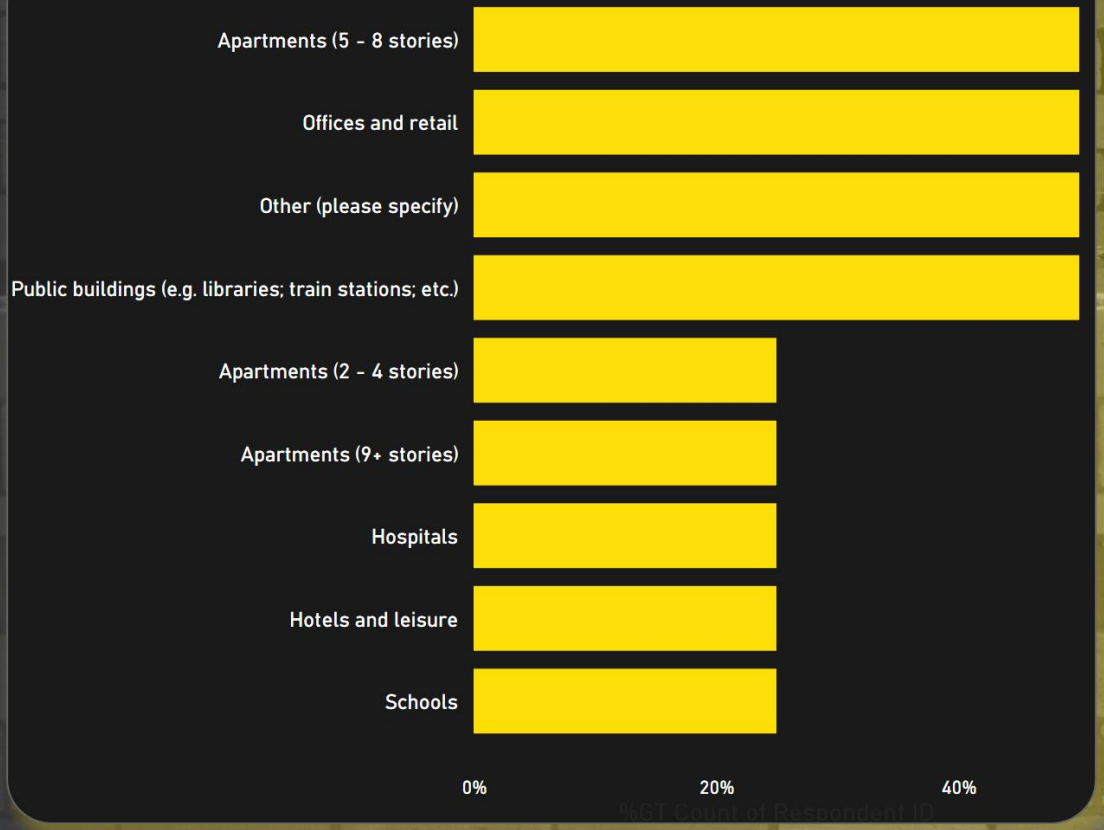


Involvement in various MMC types across different supply chain processes

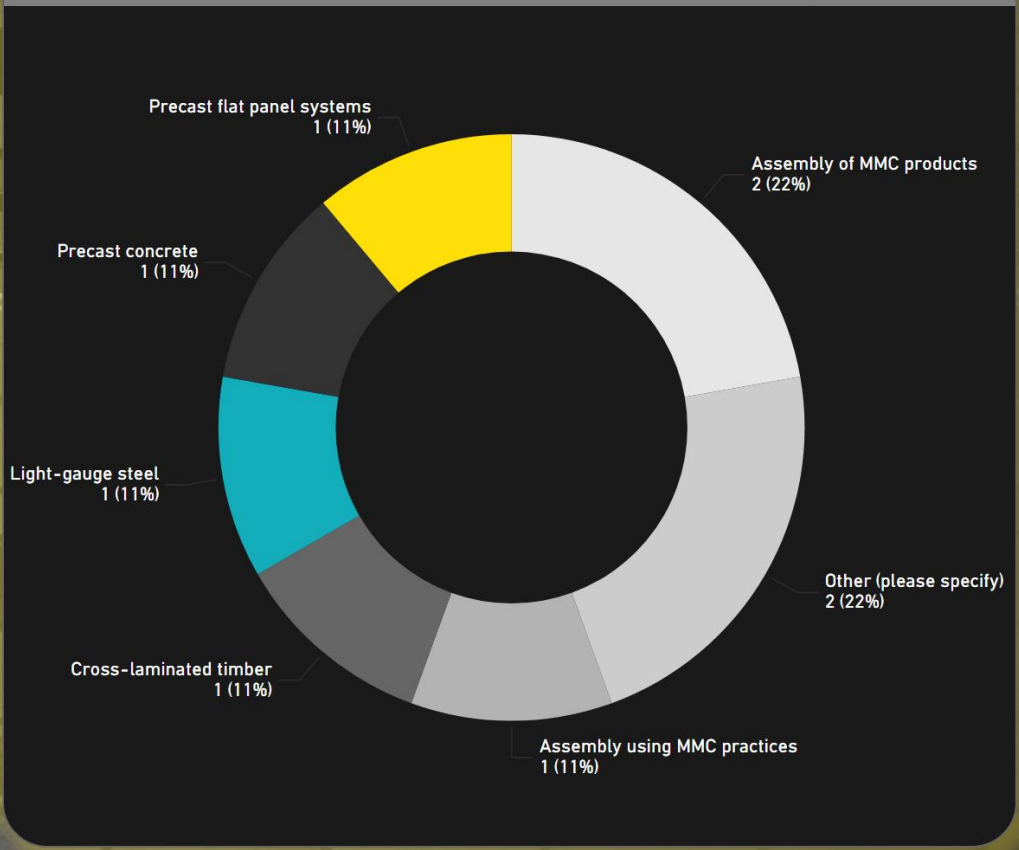


Types of development involving MMC practice - Planning

Planning

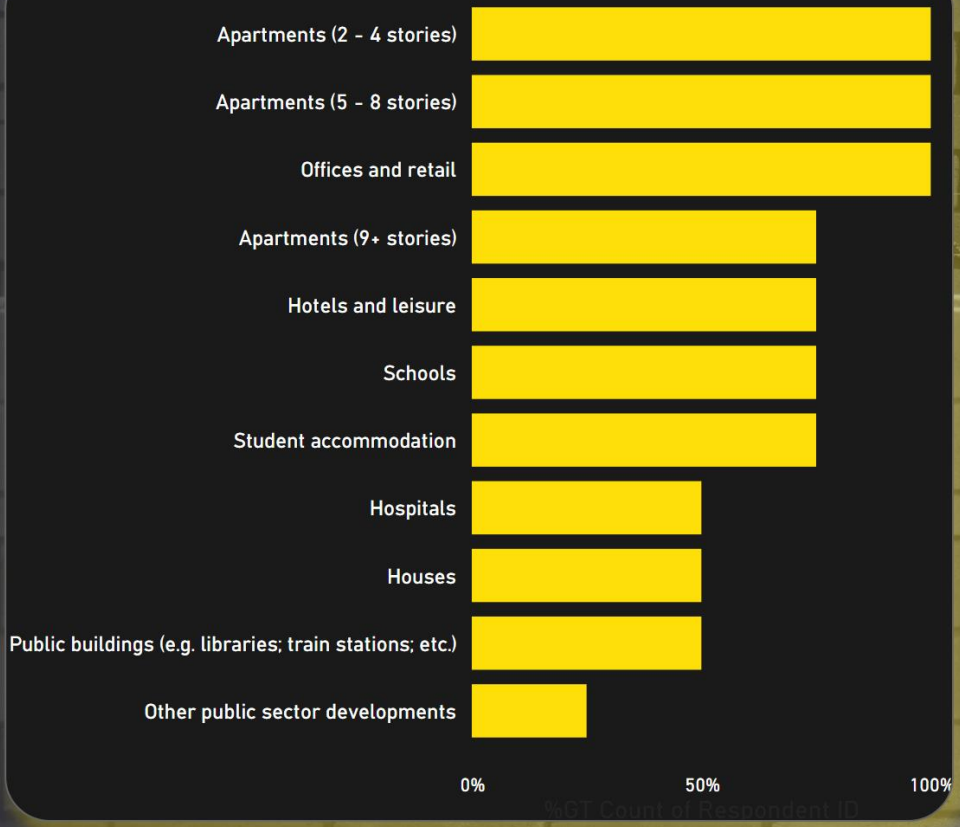


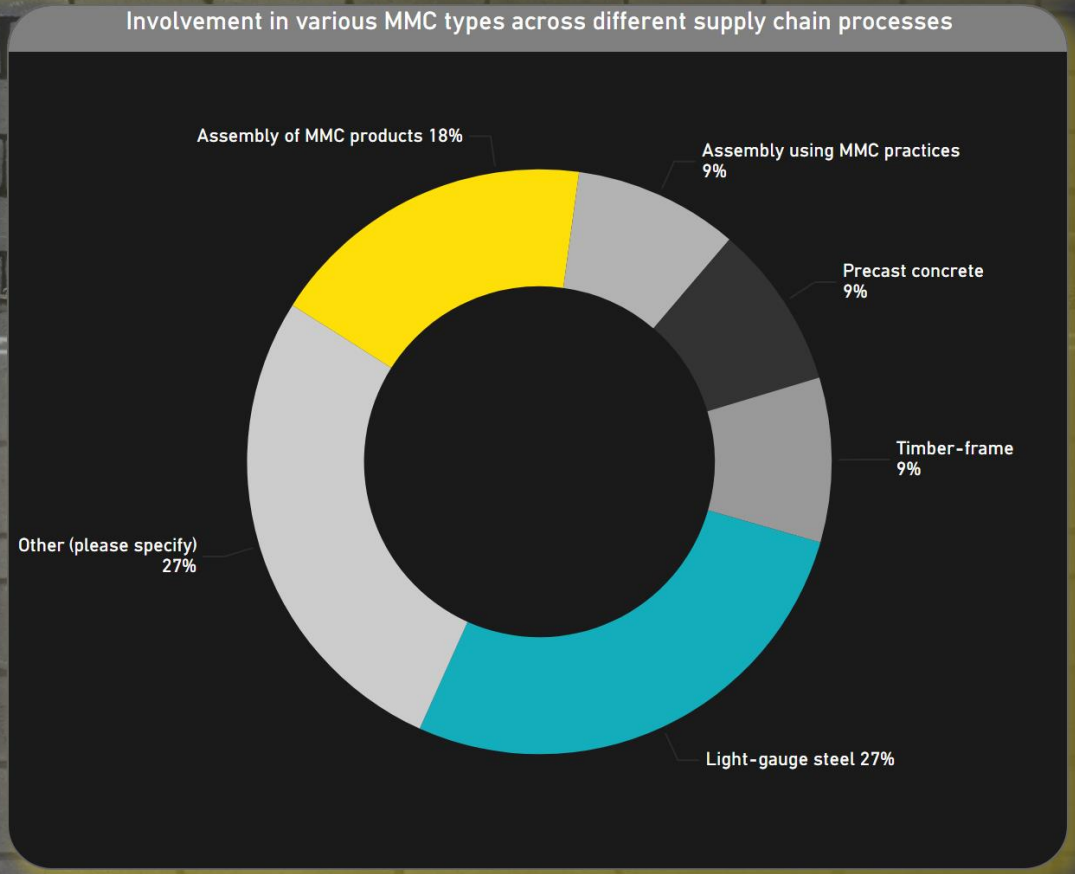
Involvement in various MMC types across different supply chain processes



Types of development involving MMC practice - Procurement

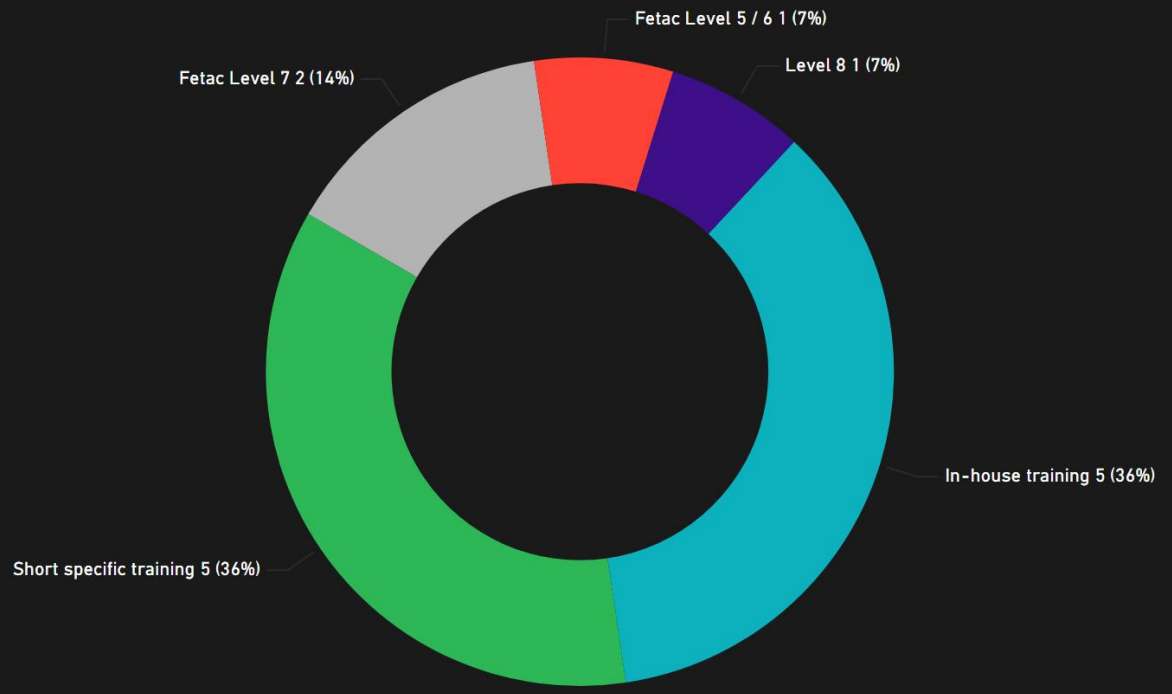
Procurement





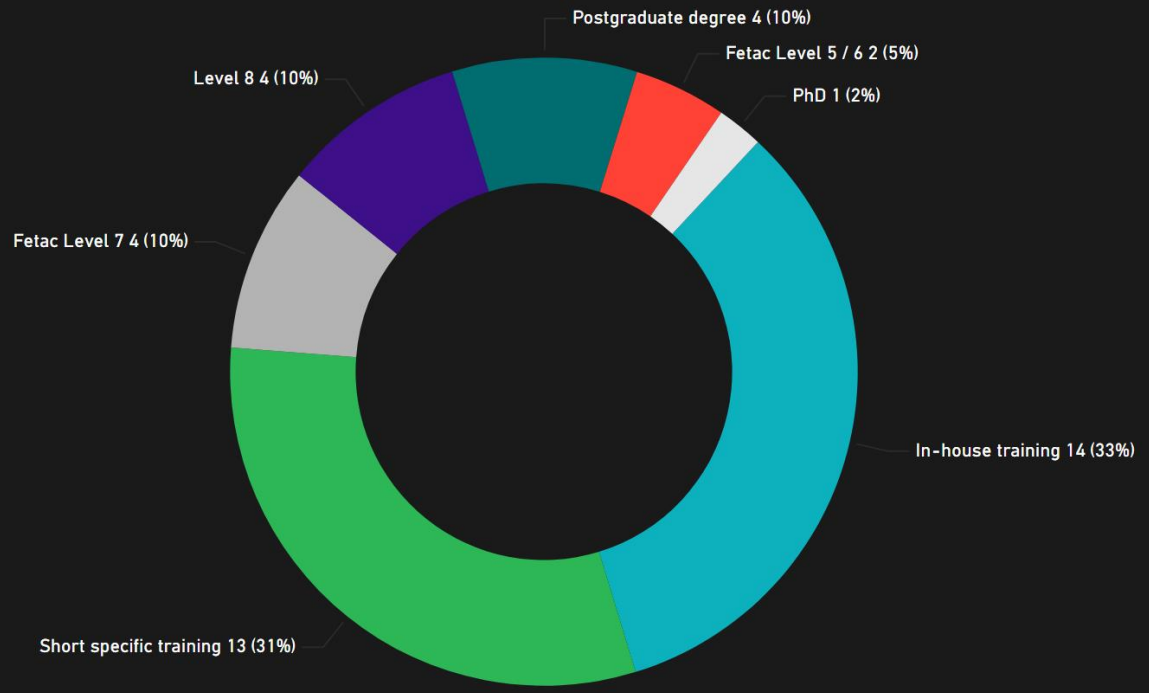
Training intensity requirement for MMC compared to traditional construction

Design



Training intensity requirement for MMC compared to traditional construction

Offsite Manufacturing

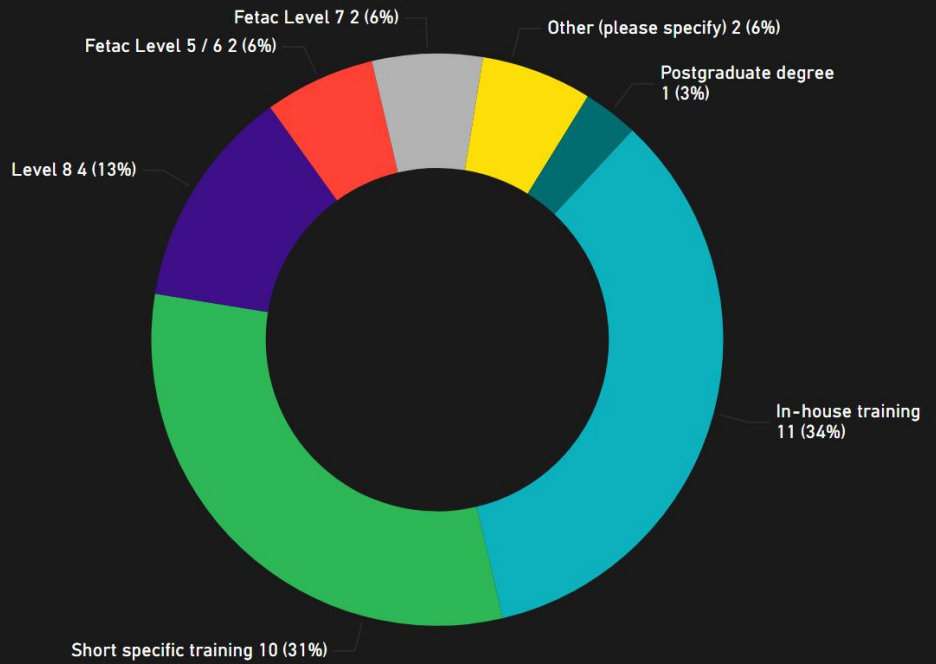


Training intensity requirement for MMC compared to traditional construction

Onsite Installation

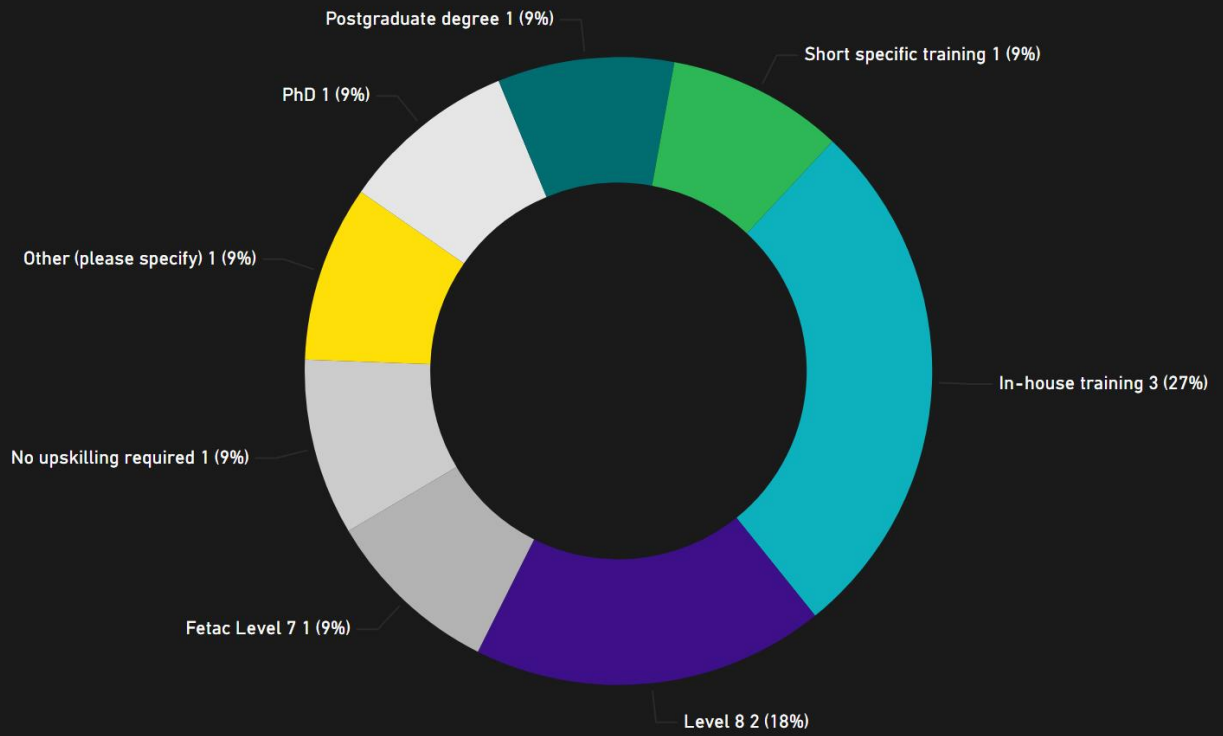
Other response - Onsite Installation category

- Familiarising industry professionals with and incentivising them to adopt non-traditional construction methods is a far bigger barrier.
- Lack of numbers, people not available. You cannot train people unless they exist and are suitable.



Training intensity requirement for MMC compared to traditional construction

Procurement



Procurement

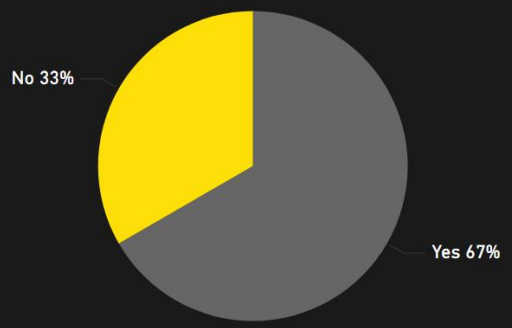
What percentage of your developments are you targeting to be delivered through MMC?

90 - 100%	50 - 60%	<10%
3	2	1

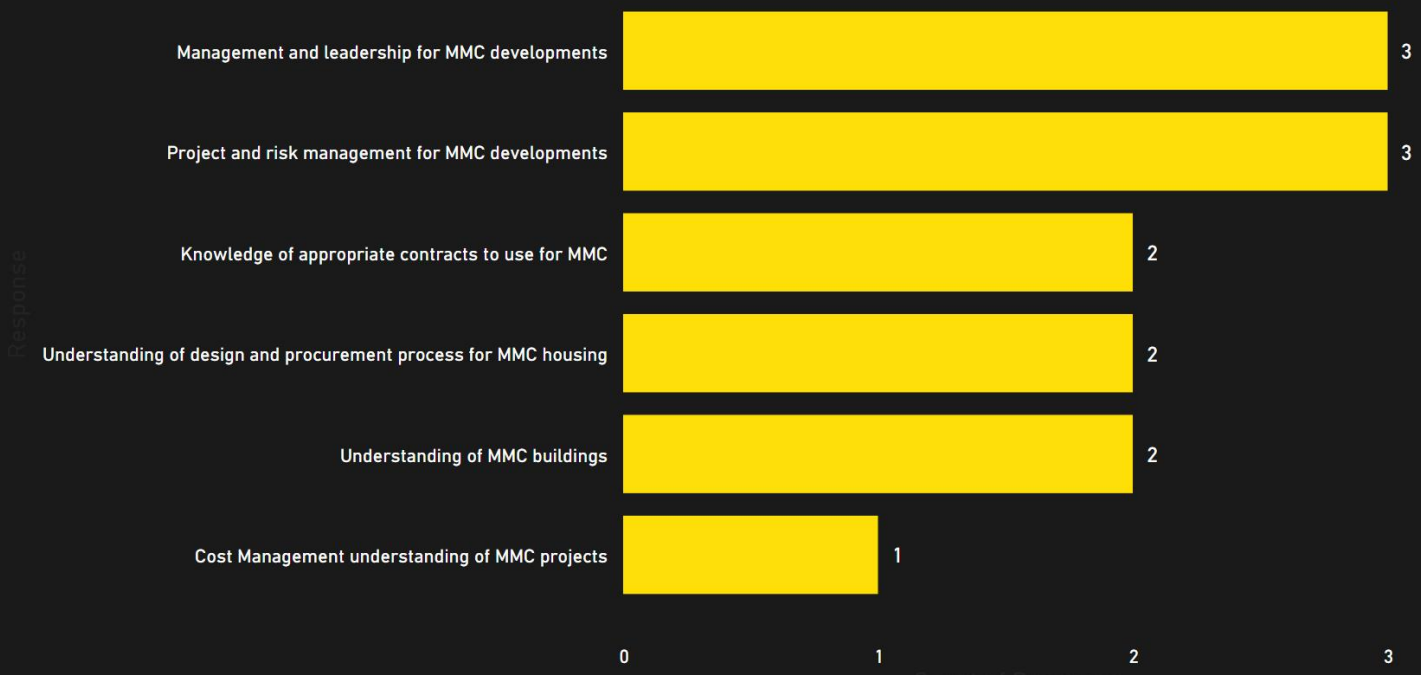
Number of respondent involved in Procurement

6

Does the Procurement of MMC projects require additional / different skills to that of traditional construction projects?



Skills gaps constraining procurement of MMC developments

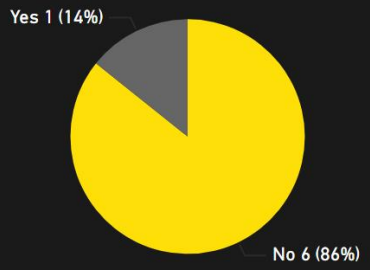


Design

Number of respondent involved in Design

7

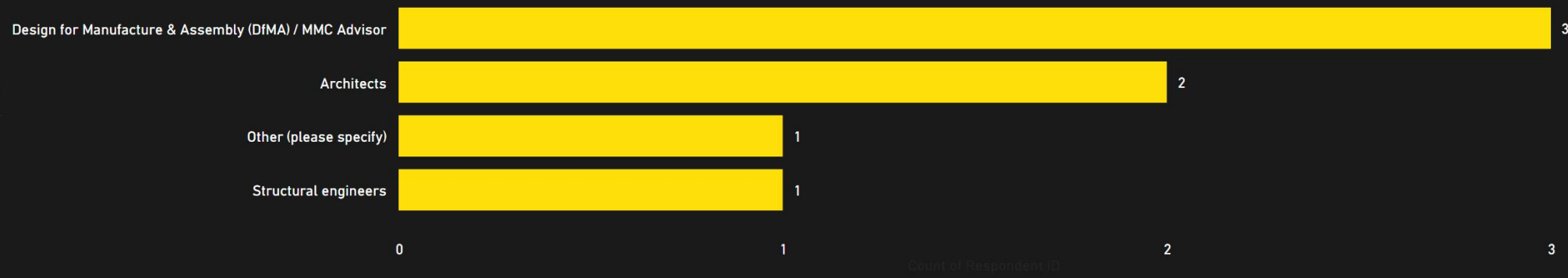
Have you availed of any training courses to upskill your staff for Design for Manufacture & Assembly of MMC products?



Skills gaps in Design that may impact construction industry

Skill gaps
There is no shortage in our teams design skills
Lack of knowledge will lead to designers not proposing MMC
Lack of availability of designers with experience or looking for a career in MMC will impact the ability for MMC products to evolve. The product base has great potential to expand to offer an array of building solutions. All solutions will need resources to develop concepts, protypes and to achieve relevant testing before market entry.
It will affect the "right first time" site assembly.
For MMC to be efficent the level of design corditation ha sto be increased at a far earlier stage than traditional construction.
Could hold back the potential of this initiative.
Because design is involved from the very beginning to the very end of any project its impact is enormous. If a project starts at early design stage as MMC it is much more likely to be constructed using MMC

What function best describe your area of focus in Design

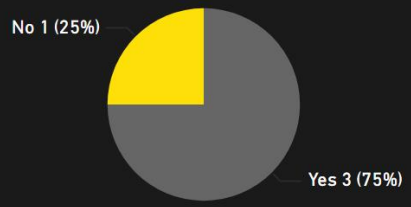


Planning

Number of respondent involved in Planning

4

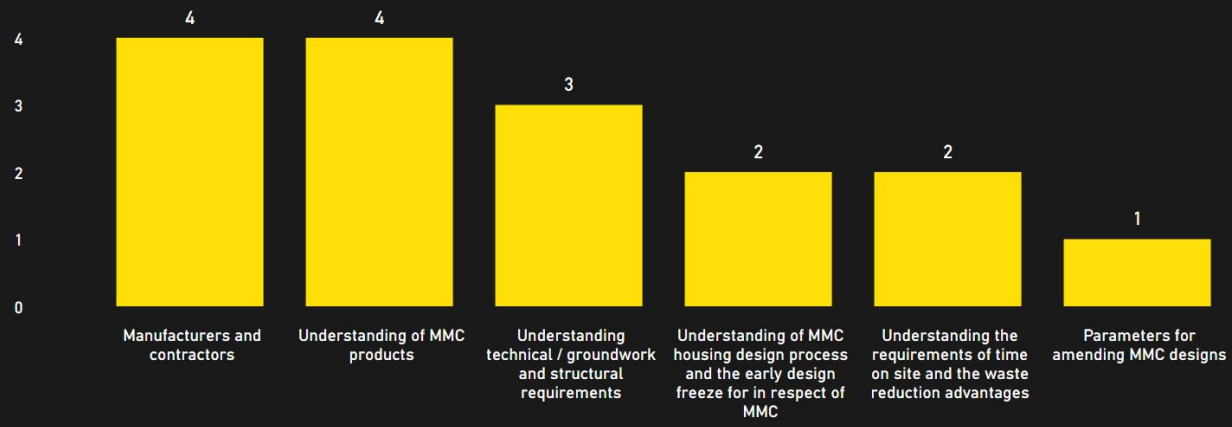
Do your planning staff have the understanding and skills to progress planning applications / assessments for MMC projects?



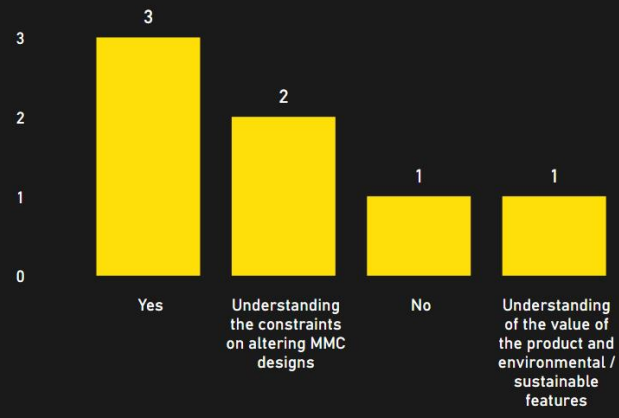
Please state how skills shortages for planners might impact the growth of MMC in the construction industry?

Skill gaps	Response
Delay progress.	1
Not available	1
Slower uptake of MMC advantages	1
Understanding of MMC at planning stage is vital ,for MMC to be efficent planning,design and cordination decions have to be frontloaded.	1

Are there any additional skills that are required that differ for planners for MMC projects compared to traditional construction projects?



Are you aware of shortages of the following skills that may make them difficult to access?



Offsite Manufacturing

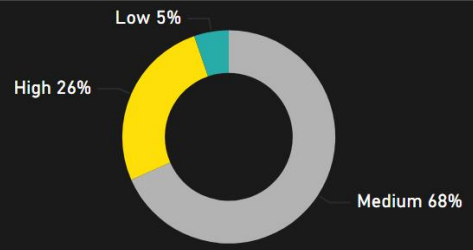
Are delays common in the certification of your MMC products?

Yes, for achieving Agrément certification	Yes, for 'assigned certifier' sign off on-site	No
40%	33%	27%

Number of respondent involved in Offsite manufacturing

19

What level of PMV are you targeting when manufacturing for developments that use MMC?

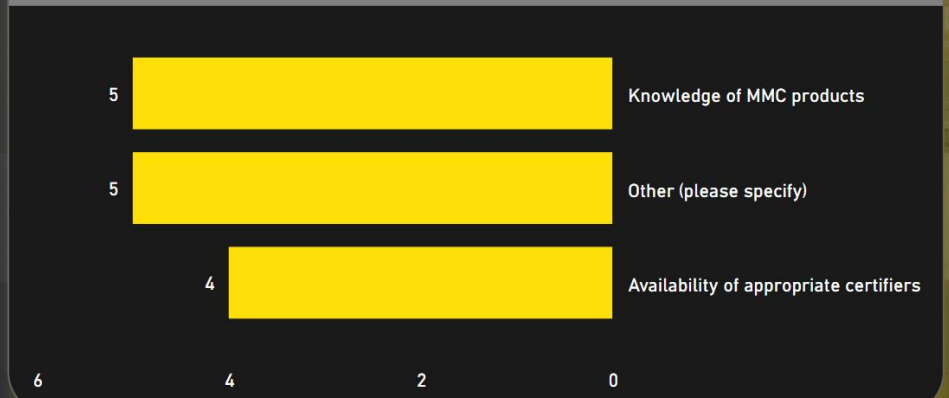


What level of promotion to customers and aftercare / support / maintenance services do you provide?

Response
As expected
Continuous engagement with current client base online and in-person.
Engage as and when required - generally when customer contacts the company
Full FM
High
High level
High level - Quite a lot of our focus is on bringing industry professionals up to speed with the system, and giving them assurances that various building regulations' requirements are met or exceeded. It is getting easier but there is still a significant majority of 3rd party professional stakeholders who are reluctant to deviate from traditional construction methods, due to lack of awareness and due to perceived uncertainty.
High Level as and when required
High level of support
In line with contract conditions ie Defects lability period; warranties etc
Low
No aftercare required with our product
Not available
Public Sector contracts are the same for traditional and MMC, therefore the same support/aftercare. Promotion in terms of the education of MMC is huge. Individual companies (not government held) have had to drive the knowledge of what can be delivered on their own to this point in an effort to generate demand.
Very high level
We design, manufacture and install our products in line with Irish (or other juristiction) building regulations and building controls. Aftercare is provided for a period of 1 year. All commissioned buildings are supported by Handover File and OM manuals including individual warranties for sub elements.
We offer full technical support for the use of our products until project completion.
We will suggest MMC if it will result in any of the following: Saving time; i.e. improve programme delivery; Saving money; Improved safety outcomes
Whatever is required

Offsite Manufacturing continued

Factors driving the delays in certification



Are there specific skills that are required in MMC manufacturing that may be in short supply?

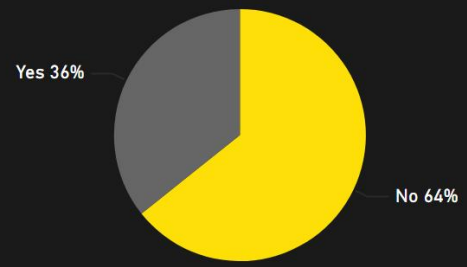
Other responses
This is a resource heavy commitment which requires financial resource allocated, right match for external advice and support and a dedicated resource in house to work across all disciplines and lead the project.
The government has failed to allocate appropriate resources into the NSAI Agrément certification process. Years have been wasted, but there are now signs of progress. However, not a single modular company in Ireland has received an Agrément for system delivery. This is solely due to a lack of government resources, not because the systems involved are too complex. If there's a prevailing narrative otherwise, one must question its source and intent.
Exhaustive and complex process.
Constant queries relating to construction details and practices, related to conservatism, lack of knowledge or in some cases unwillingness to exercise professional judgment due to PI concerns.
Both Agrément certification and assigned certifiers' approval are extremely common in the certification process. However, while the Agrément certification only needs to be conducted once for a product, the assigned certifier's approval is required each time that product is used. The answers to this question are not mutually exclusive.

Onsite Installation

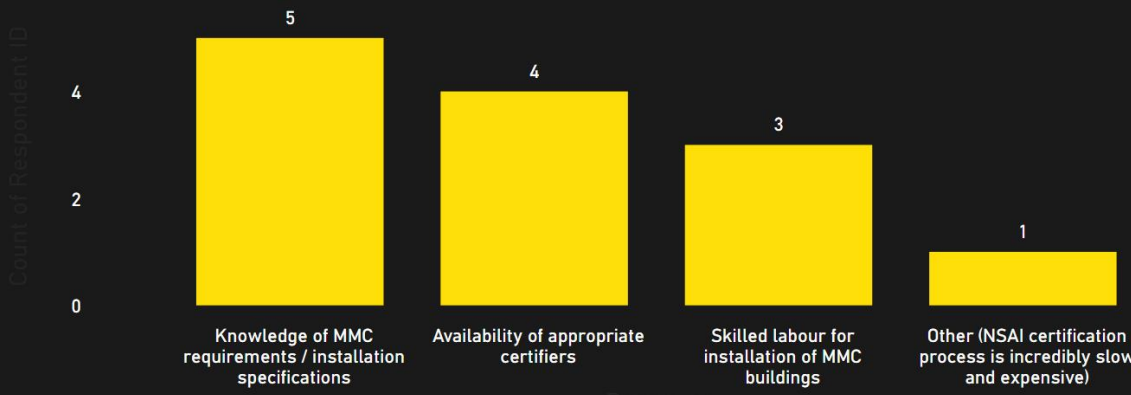
Number of respondent involved in Onsite Installation

14

Are delays common in the certification of your MMC buildings?



What factors are driving these delays in certification?



What best describes your primary activity within the construction sector?

Response	Count of Response
Civils & engineering	2
Design Management	1
Developer	1
First and second fix carpentry works.	1
Main Contractor for both the building and associated civil engineering	1
Manufacturers	1
Mechanical building services contractor	1
MMC Integration	1
Offsite Manufacture	1
Quality and Commissioning	1
Specialist Mechanical and Electrical Engineering Contractor	1
Supplier to installers approved by us to install our system	1
Sustainable Design and Carbon Management	1
Warranty provider	1
We act as full PSCS for the install of modular buildings. Scope of works includes design; build; install; commissioning onsite.	1
Total	14

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Appendix B – Priority Skills Needs

Building a better working world

Appendix B – Priority Skills Needs

Priority	Profession/skill	Description	Supply Chain	MMC Category	Possible Course Provider	Does a course exist?	Where?
1	Embedded product prognostics engineer	Responsible for monitoring a product's performance and anticipating problems or maintenance needs	Offsite Manufacturing	All	CPD/Skillnet Ireland	No	N/A
1	Digital twin architect	Responsible for creating virtual representations (digital twins) of products, processes, and systems	Offsite Manufacturing, Design, planning	All	Level dependent	Yes	Level dependent
1	Digital manufacturing technical educator	Responsible for teaching students the skills required to succeed in digital manufacturing	Offsite Manufacturing, training	Training	Skillnet Ireland	No	N/A
1	Digital Technologists	Digital Twin, BIM, Build stage tracking, O&M platform	ALL	All	Level dependent	Yes	Level dependent
1	Modular Specialists	Offsite construction assembly, precast concrete, ICF, supply chain	Offsite Manufacturing, Planning	1	Further Education and Training System/Skillnet Ireland	Yes	Mount Lucas
1	Design for Automation and DfMA role	Experts will develop and maintain custom nodes or design scripts to automate standard design processes through the use of specific software	Offsite Manufacturing, Design, planning	All	Level dependent	Yes	Level dependent
1	Manufacturing and Assembly expert	Experts to improve efficiency, automation, and customization for the unique design and fabrication process through interpreting the conceptual design and federated model and specifications, identifying constructability issues, and producing fabrication drawings and assemblies	Offsite Manufacturing	1,2,3,4,5,7	Further Education and Training System/Skillnet Ireland	Yes	Mount Lucas and other courses for Skillnet Ireland
1	Innovation and integration expert	Experts will have a knack for technology-driven change, strong communication skills, with the ability to work with different departments to understand key business rules to increase understanding and adoption of new technologies	Planning, Design, Onsite Installation	All	Skillnet Ireland	Yes	Skillnet Ireland Courses

Appendix B – Priority Skills Needs

Priority	Profession/skill	Description	Supply Chain	MMC Category	Possible Course Provider	Does a course exist?	Where?
1	Implementation Consultants/BIM Specialists	These new roles will optimize existing businesses and adapt them to the changing technology environment, giving construction companies a competitive edge. The implementation of new technologies like artificial intelligence or robotics demands new skill sets and will lead to the opening of more technology-based roles within the construction industry. These new IC roles are also more attractive to the next generation and will lead to increased gender diversity within the construction industry.	Planning, Design, Procurement	All	CPD/Skillnet Ireland	Not entirely focussed on this skills area	Need to tailor the upskilling to an MMC focus
1	Building assembly technician	A building assembly technician interprets all the drawings, specs, and other information about a project and use it to assemble elements of the project, sometimes off site. They will use unique software and programs to make sure that everything is built to spec, budget, and on time.	Offsite Manufacturing, Onsite installation	1,2,3,5	Skillnet Ireland/Mount Lucas	Not entirely focussed on this skills area	Expansion on Skillnet Ireland & Mount Lucas
2	Predictive maintenance system specialist	Responsible for monitoring the health of a critical manufacturing asset and figuring out when it might fail.	Offsite Manufacturing	1,2,3,4,5,7	Further Education and Training System	Yes	AMTCE
2	Digital factory automation engineer	Responsible for developing and setting up automation tools that improve manufacturing productivity and product quality.	Offsite Manufacturing	1,2,3,4,5,7	Module in 3rd level	Yes	Modern engineering courses
2	Robotic process automation (RPA) expert	Simply put, this software automates manufacturing tasks carried out by people.	Offsite Manufacturing	1,2,3,4,5,7	Skillnet Ireland	No	N/A
2	Learning management system (LMS) software	This software is an all-in-one solution for operating workplace education and training programs.	Offsite Manufacturing	Training	Skillnet Ireland	No	N/A
2	Drone Operators	Topographic surveys, security surveillance	Onsite Installation	All	Further Education and Training System/Skillnet Ireland	No	N/A
2	Construction Supply Chain Specialists	As modular & additive technologies increase in market, specialists in the new processes become prevalent.	All	All	CPD/Skillnet Ireland	Not entirely focussed on this skills area	N/A
2	Green Construction Professions	As sustainability and environmental responsibility has now taken centre stage, construction businesses are all looking for professionals in green construction	All	All	Further Education and Training System	No	N/A
2	Mechanical Engineers	Needed in greater quantity and with a focus/familiarity with MMC products and processes	All	All	Module in 3rd level/ Apprenticeship	Yes	3rd Level

Appendix B – Priority Skills Needs

Priority	Profession/skill	Description	Supply Chain	MMC Category	Possible Course Provider	Does a course exist?	Where?
3	Digital manufacturing chief technology officer	Responsible for overseeing the digitization, automation, and connectivity of manufacturing systems.	Offsite Manufacturing	All	Further Education and Training System/ Module in 3rd level	Not entirely focussed on this skills area	Level dependent
3	Model-based systems engineer	Responsible for breaking down complex product concepts into smaller chunks.	Offsite Manufacturing	1,2,3	Skillnet Ireland	No	N/A
3	Manufacturing cybersecurity strategist	Responsible for helping prevent threats from hackers and other cyber troublemakers.	Offsite Manufacturing	All	Module in 3rd level	Yes	Need to pair data and computer science modules with construction and engineering courses
3	Artificial Intelligence Specialists	Artificial Intelligence Architect, AI Quarry, Cyber Security quarry	ALL	All	Module in 3rd level	Yes	Need to pair data and computer science modules with construction and engineering courses
3	Data Analytics expert	Experts work closely with the innovation team to fundamentally reinvent the future of construction in the digital age	Planning, Design	All	Skillnet Ireland	Yes	Need to pair data and computer science modules with construction and engineering courses
3	Information manager	The Confederation of British Industry (CBI) estimates that the UK's digital economy is worth over £200 billion, which means roles within the digital area are likely to keep growing and changing. An information manager will essentially make sure that all information relating to a project is accurate, safely stored, and accessible to the right people at the right time. This will make for smooth-running projects that are also more efficient.	Planning	All	All, depending on the degree of security needed	Yes	Across multiple channels
3	Offsite Manufacturer	Working offsite producing building components, working closely with machinery and robotics	Offsite Manufacturing	1,2,3,5,7	Mount Lucas & AMTCE	Yes	Mount Lucas & AMTCE
4	Digital manufacturing analyst	Responsible for combing through data to unearth potential improvements in manufacturing productivity and product quality.	Offsite Manufacturing	7	Skillnet Ireland/Module in 3rd level	Not entirely focussed on this skills area	Level dependent
4	Virtual reality/augmented reality system specialist	Responsible for helping demonstrate a product or process in a virtual setting.	Offsite Manufacturing, Design, planning	Training	Skillnet Ireland/3rd level	No	N/A
4	Machine learning specialist	Responsible for helping emulate the human decision-making processes related to design and development tasks and decisions.	Offsite Manufacturing	All	Module in 3rd level	Yes	Focused in computer science courses
4	Collaborative robotics specialist	Responsible for implementing robotics platforms that "collaborate" with humans and for training robotics operators.	Offsite Manufacturing	1,2,3,4,5,7	Level dependent	Yes	Level dependent AMTCE vs 3rd level

Appendix B – Priority Skills Needs

Priority	Profession/skill	Description	Supply Chain	MMC Category	Possible Course Provider	Does a course exist?	Where?
4	Collaborative robotics technician	Responsible for setting up and maintaining collaborative robotics systems.	Offsite Manufacturing	1,2,3,4,5,7	Further Education and Training System/ Apprenticeship	No	N/A
4	Planning and scheduling software	This product simplifies planning and scheduling by taking into account factors like materials supply, labour availability and production capacity.	Offsite Manufacturing	All	Further Education and Training System	No	N/A
4	Blockchain Specialists	Adapting to a more secure & transparent process throughout the build lifecycle, blockchain in construction finance	ALL	All	Module in 3rd level	Yes	Need to pair data and computer science modules with construction and engineering courses
4	Materials Science specialists	These new roles will optimize existing businesses and adapt them to the changing technology environment, giving construction companies a competitive edge. The implementation of new technologies like artificial intelligence or robotics demands new skill sets and will lead to the opening of more technology-based roles within the construction industry. These new IC roles are also more attractive to the next generation and will lead to increased gender diversity within the construction industry.	ALL	7	Module in 3rd level/Skillnet Ireland	Not entirely focussed on this skills area	Level dependent
4	3D Rebar Detailing Engineers	Specific to steel works in MMC, needed to ensure correct techniques and quality	Offsite Manufacturing, Onsite installation	2,6,7	Further Education and Training System/ Apprenticeship	Not entirely focussed on this skills area	Mount Lucas
5	Additive Manufacturing Operators	3D Construction Printing, 3D design & modelling	Design	4	ACTME	No	N/A
5	Creators of new design configuration apps	These new roles will optimize existing businesses and adapt them to the changing technology environment, giving construction companies a competitive edge. The implementation of new technologies like artificial intelligence or robotics demands new skill sets and will lead to the opening of more technology-based roles within the construction industry. These new IC roles are also more attractive to the next generation and will lead to increased gender diversity within the construction industry.	Design	7	Module in 3rd level	Yes	Need to pair data and computer science modules with construction and engineering courses

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Appendix C – List of Available Courses

Building a better working world

This list of available courses was compiled through extensive desk-based research, and while every effort has been made to reflect all courses available, any errors or omissions are unintentional

Appendix C - Training suppliers – Louth & Meath ETB

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Louth & Meath Education Training Board						
Architectural Technology and Design (Computer Aided Design)	5	Full-time	In person	1 year	✓	https://dunboynecollege.ie/courses/computers-and-design-department/architectural-technology-and-design/
Building Construction (Pre-Apprenticeship)	5	Full-time	In person	1 year		https://www.dife.ie/courses-in-construction/
Architectural Technology & Design	5	Full-time	In person	1 year		https://www.dife.ie/238697-2/
Engineering Technology	5	Full-time	In person	1 year		https://ofi.ie/engineering-technology/
Quantity Surveying	5	Full-time	In person	1 year		https://ofi.ie/quantity-surveying/
Engineering Technology (Pre-Apprenticeship)	5	Full-time	In person	1 year		https://www.dife.ie/courses-in-engineering/
Pre-Apprenticeship Skills (Computer Aided Design)	5	Full-time	In person	1 year		https://ofi.ie/pre-apprenticeship-skills/
Pre-University Architecture (Computer Aided Design)	5	Full-time	In person	1 year		https://ofi.ie/pre-university-architecture/

Appendix C - Training suppliers – Louth & Meath ETB

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Advanced Manufacturing Training Centre of Excellence (LMETB)						
Introduction to Pneumatics	Not Stated	Part-time	Mixed	2 days		220429_AMTCE_Catalogue-V4-2022.pdf
Pneumatic Technologies	Not Stated	Part-time	In person	2 days		220429_AMTCE_Catalogue-V4-2022.pdf
Pneumatic Systems Maintenance	Not Stated	Part-time	In person	4 days		220429_AMTCE_Catalogue-V4-2022.pdf
Mechanical Maintenance	Not Stated	Part-time	In person	5 days		220429_AMTCE_Catalogue-V4-2022.pdf
Preventative Maintenance	Not Stated	Part-time	Mixed	5 days		220429_AMTCE_Catalogue-V4-2022.pdf
Maintenance Planning	Not Stated	Part-time	In person	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
Introduction to PLCs	Not Stated	Part-time	In person	3 days		220429_AMTCE_Catalogue-V4-2022.pdf
Programmable Logic Controllers	Not Stated	Part-time	In person	4 days		220429_AMTCE_Catalogue-V4-2022.pdf
Digital Sensors	Not Stated	Part-time	In person	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
Electrical Principals	Not Stated	Part-time	In person	4 days		220429_AMTCE_Catalogue-V4-2022.pdf
Industrial Electrical Systems	Not Stated	Part-time	Mixed	5 days		220429_AMTCE_Catalogue-V4-2022.pdf
Electrical Systems Troubleshooting	Not Stated	Part-time	In person	2 days		220429_AMTCE_Catalogue-V4-2022.pdf
Systematic Troubleshooting	Not Stated	Part-time	In person	2 days		220429_AMTCE_Catalogue-V4-2022.pdf
Industry 4.0 Automation Pyramid Technologies	Not Stated	Part-time	Online	30+ hours	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Introduction to Robotic Welding	Not Stated	Part-time	In person	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
Robotic Welding	Not Stated	Part-time	In person	5 days		220429_AMTCE_Catalogue-V4-2022.pdf
Robotics – Entry	Not Stated	Part-time	In person	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
Robotics – Intermediate	Not Stated	Part-time	In person	3 days		220429_AMTCE_Catalogue-V4-2022.pdf
Robotics - Advanced	Not Stated	Part-time	In person	5 days		220429_AMTCE_Catalogue-V4-2022.pdf
Innovation through Robotics	Not Stated	Part-time	Mixed	4 Weeks		220429_AMTCE_Catalogue-V4-2022.pdf
Cobotics	Not Stated	Part-time	Mixed	2 days - 5 days		220429_AMTCE_Catalogue-V4-2022.pdf
Cobotics, Programming and Vision Training	Not Stated	Part-time	In person	5 days		220429_AMTCE_Catalogue-V4-2022.pdf
On-boarding Geometric Dimensioning and Tolerance (GD&T) within an Engineering Organisation	Not Stated	Part-time	In person	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
Geometric Dimensioning and Tolerance (GD&T)	Not Stated	Part-time	Online	4 days		220429_AMTCE_Catalogue-V4-2022.pdf
3D Certified User Training	Not Stated	Part-time	In person	2 days		220429_AMTCE_Catalogue-V4-2022.pdf
3D Application Training	Not Stated	Part-time	Mixed	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
3D Advanced Materials	Not Stated	Part-time	Mixed	1 day		220429_AMTCE_Catalogue-V4-2022.pdf

Appendix C - Training suppliers – Louth & Meath ETB

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Advanced Manufacturing Training Centre of Excellence (LMETB)						
Introduction to 3D printing	Not Stated	Part-time	In person	4 days		220429_AMTCE_Catalogue-V4-2022.pdf
3D Printing in Industry	Not Stated	Part-time	In person	4 days		220429_AMTCE_Catalogue-V4-2022.pdf
SolidWorks Essentials	Not Stated	Part-time	In person	4 days		220429_AMTCE_Catalogue-V4-2022.pdf
Advanced Introduction to Additive Manufacturing	Not Stated	Part-time	Online	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
A Guide to Additive Manufacturing for Engineers - Parts 1 & 2	Not Stated	Part-time	Online	2.5 hours		220429_AMTCE_Catalogue-V4-2022.pdf
Best Practice in Process Selection - Intermediate	Not Stated	Part-time	Online	1 hour		220429_AMTCE_Catalogue-V4-2022.pdf
Essential Requirements Capture for Additive Manufacturing	Not Stated	Part-time	Online	0.5 hours		220429_AMTCE_Catalogue-V4-2022.pdf
Additive Manufacturing Health & Safety, Risks and Mitigation	Not Stated	Part-time	Online	1.5 hours		220429_AMTCE_Catalogue-V4-2022.pdf
Technical Insight into Additive Manufacturing	Not Stated	Part-time	Online	1.5 hours		220429_AMTCE_Catalogue-V4-2022.pdf
Introduction to Industry 4.0	Not Stated	Part-time	Online	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
Introduction to IIoT	Not Stated	Part-time	Online	2.5 days	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Introduction to Machine Learning	Not Stated	Part-time	Online	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
User Experience in Manufacturing	Not Stated	Part-time	Online	1 day		220429_AMTCE_Catalogue-V4-2022.pdf
Introduction to Digital Manufacturing	Not Stated	Part-time	Online	0.5 hours	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Introduction to Lean	Not Stated	Part-time	Online	1 day	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Six Sigma Yellow Belt	Not Stated	Part-time	In person	2 days	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Lean Pass for Construction	Not Stated	Part-time	In person	1 day	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Yellow Belt - Construction	Not Stated	Part-time	In person	2 days	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Six Sigma Green Belt	Not Stated	Part-time	In person	5 days	✓	220429_AMTCE_Catalogue-V4-2022.pdf
People/Human side of Lean	Not Stated	Part-time	In person	1 day	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Lean Mentoring and Coaching	Not Stated	Part-time	In person	1 day	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Lean Executive Leadership	Not Stated	Part-time	In person	2 days	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Production and Planning Control	Not Stated	Part-time	In person	1 day	✓	220429_AMTCE_Catalogue-V4-2022.pdf
Good Manufacturing Practices	Not Stated	Part-time	In person	1 day	✓	220429_AMTCE_Catalogue-V4-2022.pdf

Appendix C - Training suppliers – Laois & Offaly ETB

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Laois & Offaly Education Training Board						
Engineering Technology (pre-apprenticeship/pre university)	5	Full-time	In person	1 year		https://www.tullamorefetc.ie/courses/full-time-courses/engineering/engineering-technology-qqi-level-5/
Sustainable Construction Technology	5	Full-time	In person	1 year	✓	https://www.tullamorefetc.ie/courses/full-time-courses/engineering/sustainable-construction-technology-qqi-level-5/
Engineering Technology (Pre-Apprenticeship)	5	Full-time	In person	1 year		https://www.portlaoiseinstitute.ie/?page_id=3031
Mount Lucas (Laois & Offaly Education Training Board)						
Introduction to Tekla Structures (Steel or Precast option)	Not Stated	Full-time	In person	8 days	✓	https://mountlucas.ie/mmc/
BIM	Not Stated	Part-time	In person	1 day per week for 10 weeks	✓	https://mountlucas.ie/mmc/
2D AutoCAD and Drawing Production	Not Stated	Part-time	In person	8 days	✓	https://mountlucas.ie/mmc/
Offsite Construction	Not Stated	Part-time	In person	1 day per week for 10 weeks	✓	https://mountlucas.ie/mmc/
Introduction to BIM & Revit Structures	Not Stated	Part-time	In person	2 weeks	✓	https://mountlucas.ie/mmc/
Management of Construction Projects	Not Stated	Part-time	In person	1 day per week for 10 weeks	✓	https://mountlucas.ie/mmc/
NZEB Retrofit Skills	Not Stated	Part-time	Mixed	2 x 4.5 hours online 5 x 4.5 days onsite	✓	https://mountlucas.ie/nzeb/
NZEB Retrofit	Not Stated	Part-time	In person	2 days in training centre	✓	https://mountlucas.ie/nzeb/
NZEB Ventilation	Not Stated	Part-time	Mixed	3 half days online delivery One day Theory & Practical Assessment	✓	https://mountlucas.ie/nzeb/
NZEB Site Supervisor	Not Stated	Part-time	Mixed	4 days in training centre or 4 half days online and 2 days in training centre	✓	https://mountlucas.ie/nzeb/
NZEB Electrical	Not Stated	Part-time	Mixed	3 days in training centre or 4 half days online and 1 day in training centre	✓	https://mountlucas.ie/nzeb/
NZEB Fundamental Awareness	Not Stated	Part-time	Mixed	1 day onsite or 2 half days online	✓	https://mountlucas.ie/nzeb/

Appendix C - Training suppliers – Laois & Offaly ETB

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Mount Lucas (Laois & Offaly Education Training Board)						
NZEB Fundamental Awareness	Not Stated	Part-time	Mixed	1 day onsite or 2 half days online	✓	https://mountlucas.ie/nzeb/
NZEB Airtightness and Vapour Control Installer	5	Part-time	Mixed	3 days onsite & 2 days online	✓	https://mountlucas.ie/nzeb/
NZEB External Wall Insulation	5	Part-time	Mixed	4.5 days onsite & 2 half days online	✓	https://mountlucas.ie/nzeb/

Appendix C - Training suppliers – ETBs

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Education Training Boards						
Cavan and Monaghan Education Training Board						
Architectural Technology and Design (Year 1)	5	Full-time	In person	1 year		https://www.cavaninstitute.ie/course/architectural-technology-and-design-year-1
Pre-Apprenticeship Building Construction (Construction Technology)	5	Full-time	In person	1 year		https://www.cmetb.ie/fetch-course-finder-advanced/?sfcw-courseId=371757
Construction Engineering and Renewable Energy Technology	5	Full-time	In person	1 year		https://monaghaninstitute.ie/courses/engineering/
Architectural Technology and Engineering with 3D CAD	6	Full-time	In person	1 year	✓	https://monaghaninstitute.ie/courses/traineeships/architectural-technology-and-design
Pre-University Engineering	5	Part-time	In person	1 year		https://monaghaninstitute.ie/courses/pre-university/
Engineering Technology	5	Full-time	In person	1 year		https://www.cavaninstitute.ie/course/engineering-technology
Engineering Technology	5	Full-time	In person	1 year		https://monaghaninstitute.ie/courses/engineering/
Renewable Energy Technology and Control Systems (Year 1)	5	Full-time	In person	1 year		https://www.cmetb.ie/fetch-course-finder-advanced/?sfcw-courseId=414785
Sustainable Energy and Construction Technology	5	Full-time	In person	1 year	✓	https://www.cavaninstitute.ie/course/sustainable-energy-and-construction-technology
Carpentry Techniques	5	Full-time	In person	1 year	✓	https://www.cavaninstitute.ie/course/carpentry-techniques
City of Dublin Education Training Board						
Architectural Design & Technology Foundation	5	Full-time	In person	1 year		https://www.cdcfe.ie/courses/architecture/
Architectural Technology with Sustainable Construction	5	Full-time	In person	1 year	✓	https://pearsecollege.ie/architectural-technology-with-sustainable-construction/
Carpentry and Joinery (Construction Technology)	5	Full-time	In person	1 year		https://plunketcollege.ie/carpentry-and-joinery/
Construction Technology with Draughting	5	Full-time	In person	1 year	✓	https://plunketcollege.ie/construction-technology-with-draughting/
Pre-Apprenticeship - Carpentry and Joinery (Construction)	5	Full-time	In person	1 year		https://plunketcollege.ie/carpentry-and-joinery-pre-apprenticeship/
Building Information Modelling (BIM) with Project Management	6	Part-time	Online	1 year		https://www.cdcfe.ie/courses/building-information-modelling-bim-with-project-management-2/
Engineering Technology (Pre Apprenticeship)	5	Full-time	In person	1 year		https://www.cdcfe.ie/courses/engineering-technology/
Pre-Apprenticeship - Construction	5	Full-time	In person	1 year	✓	https://plunketcollege.ie/construction/
Revit Technician	6	Full-time	In person	1 year		https://finglastrainingcentre.ie/day-courses/revit-technician-traineeship2/
Sustainable Construction Technologies	5	Full-time	In person	1 year	✓	https://plunketcollege.ie/sustainable-construction-technologies/
Architectural Technology with Sustainable Construction	5	Full-time	In person	1 year	✓	https://pearsecollege.ie/architectural-technology-with-sustainable-construction/
Pre-Apprenticeship in Construction and Engineering Technology	5	Full-time	In person	1 year		https://pearsecollege.ie/pre-apprenticeship-in-construction-and-engineering-technology/
PreUniversity Engineering	5	Full-time	In person	1 year		https://pearsecollege.ie/preuniversity-engineering/

Appendix C - Training suppliers – ETBs

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Cork Education Training Board						
Architectural 3D Modelling (BIM/Revit) - Computer Aided Design	5	Full-time	In person	1 year		https://www.douglasstreetcampus.ie/courses-2/construction-engineering/architectural-3d-modelling/
Engineering Technology	5	Full-time	In person	1 year		https://www.douglasstreetcampus.ie/courses-2/construction-engineering/engineering-technology-level5/
Pre Apprenticeship - Construction Technology	5	Full-time	In person	1 year		https://www.douglasstreetcampus.ie/courses-2/pre-apprenticeships/pre-apprenticeship-construction-technology/
Pre Apprenticeship - Engineering	5	Full-time	In person	1 year		https://www.douglasstreetcampus.ie/courses-2/pre-apprenticeships/pre-apprenticeship-engineering/
Sustainable Technology	5	Full-time	In person	1 year	✓	https://www.douglasstreetcampus.ie/courses-2/construction-engineering/sustainable-technology/
Donegal Education Training Board						
Construction Technology	5	Full-time	In person	1 year		https://www.fetchcourses.ie/course/finder?sfcw-courseId=370496
Dublin & Dun Laoghaire Education Training Board						
Engineering Technology	5	Full-time	In person	1 year		https://www.deansrathcommunitycollege.ie/engineering-technology-level-5-full-time
Architectural Design and Technology	5	Full-time	In person	1 year		https://www.bife.ie/full-time-courses/design/architectural-design-and-technology
Architectural Technology and Design	5	Full-time	In person	1 year		https://www.dfei.ie/craft-design-and-construction/architectural-technology-and-design
Advanced Certificate in Architectural Technology and Design	6	Full-time	In person	1 year		https://www.dfei.ie/craft-design-and-construction/advanced-certificate-in-architectural-technology-and-design
Construction Technology - Pre Apprenticeship	5	Full-time	In person	1 year		https://www.dfei.ie/craft-design-and-construction/construction-technology-pre-apprenticeship
Engineering Technology	5	Full-time	In person	1 year		https://greenhillscollege.ie/further-education/course/engineering-technology-level-5/
Engineering Technology with Electronics	5	Full-time	In person	1 year		https://www.dfei.ie/science-technology-engineering-and-maths/engineering-technology-with-electronics-in-conjunction-with-I.-T.-Tallaght
Interior Architecture and Design	5	Full-time	In person	1 year		https://www.bfei.ie/courses/interior-design
Sustainability & the Built Environment (Construction Technology)	5	Full-time	In person	1 year	✓	https://cfedundrum.com/course/sustainability-the-built-environment-full-time/
Sustainable Design Technologies	5	Part-time	In person	1 year	✓	https://cfedundrum.com/course/sustainable-design-technologies-btei-part-time/
Galway & Roscommon Education Training Board						
Computer Aided Design and Architectural Technology	5	Full-time	In person	1 year		https://www.gti.ie/applications/course/detail/course/ACADX
Construction Technology / Civil Engineering	5	Full-time	In person	1 year		https://www.gti.ie/applications/course/detail/course/CCONT
Construction Technology : Renewable Energies and Engineering	5	Full-time	In person	1 year	✓	https://www.gti.ie/applications/course/detail/course/gti-45
Pre-University Engineering	5	Full-time	In person	1 year		https://www.gti.ie/applications/course/detail/course/gti-266
Apprenticeship Preparatory Programme: Carpentry/Plumbing/Electrical	5	Full-time	In person	1 year		https://www.gti.ie/applications/course/detail/course/gti-233

Appendix C - Training suppliers – ETBs

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Kerry Education Training Board						
CAD - Computer Aided Draughting and Design	5	Full-time	In person	1 year		https://kerrycollege.ie/full-time-courses/cad-computer-aided-draughting-and-design-tralee/
CAD 2D Level 3	5	Part-time	In person	14 weeks		https://kerrycollege.ie/part-time-courses/autocad-2d/
Carpentry & Construction (Construction Technology)	5	Full-time	In person	1 year		https://kerrycollege.ie/full-time-courses/carpentry-and-construction-tralee/
Engineering Technology	5	Full-time	In person	1 year		https://kerrycollege.ie/full-time-courses/engineering-technology-tralee/
Kilkenny & Carlow Education Training Board						
Construction & Building	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/construction-and-building/
Construction Trades (Pre-Apprenticeship)	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/construction-trades/
Engineering Technology (Pre Apprenticeship)	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/engineering-technology/?portfolioCats=27%2C14%2C29%2C28%2C16
Engineering (Pre-Apprenticeship)	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/engineering-pre-apprenticeship/?portfolioCats=27%2C14%2C29%2C28%2C16
Kildare & Wicklow Education Training Board						
Architectural Design & Technology	5	Full-time	In person	1 year		https://www.bife.ie/full-time-courses/design/architectural-design-and-technology
Engineering Pre-University	5	Full-time	In person	1 year		https://www.bife.ie/full-time-courses/computing-and-engineering/engineering-pre-university
Computer Aided Design	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/architecture/
Construction Technology	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/construction-and-building/?portfolioCats=27%2C14%2C29%2C28%2C16
Engineering Technology	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/engineering-technology/
Architecture Pre-University (Computer Aided Design)	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/architecture/?portfolioCats=27%2C14%2C29%2C28%2C16
Engineering (Pre-Apprenticeship)	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/engineering-pre-apprenticeship/?portfolioCats=27%2C14%2C29%2C28%2C16
Engineering Technology (Pre-Apprenticeship)	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/engineering-technology/?portfolioCats=27%2C14%2C29%2C28%2C16
Construction and Building (Construction Technology)	5	Full-time	In person	1 year		https://carlowinstitute.ie/courses/construction-and-building/?portfolioCats=27%2C14%2C29%2C28%2C16

Appendix C - Training suppliers – ETBs

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Limerick & Clare Education Training Board						
Pathways to Apprenticeship Construction (Construction Technology)	5	Full-time	In person	1 year		https://www.lcfe.ie/full_time_courses/pathway-to-construction/
Longford & Westmeath Education Training Board						
3D Mechanical Modelling using Solidworks	6	Part-time	Online	18 weeks		http://athlonetrainingcentre.ie/online-courses/3d-mechanical-modelling-using-solidworks.html
BIM Modelling using Autodesk's Revit Architecture	6	Part-time	Blended	14 weeks		http://www.athlonetrainingcentre.ie/pages/course-search.html?sfcw-courseId=397335
Mayo, Sligo & Leitrim Education Training Board						
Building Technology & Design	5	Full-time	In person	1 year		https://www.sligocfe.ie/building_technology__design
Construction Technology with Renewable Energy	5	Full-time	In person	1 year		https://www.sligocfe.ie/construction_technology_with_renewa
Pre-university Engineering	5	Full-time	In person	1 year		https://www.sligocfe.ie/engineering_technology
Sustainable Engineering Technologies	7	Full-time	In person	1 year	✓	https://www.sligocfe.ie/sustainable_engineering_technologie
Construction Technology with Renewable Energy Systems	5	Full-time	In person	1 year	✓	https://www.sligocfe.ie/construction_technology_with_renewa
Tipperary Education Training Board						
Engineering Technology	5	Full-time	In person	1 year		https://www.ctiseniorcollege.ie/plc-courses/civil-mechanical-electronics-engineering/
Waterford & Wexford Education Training Board						
Construction Technology	5	Full-time	In person	1 year		https://www.wwetb.ie/course/construction-technology/
Engineering Technology	5	Full-time	In person	1 year		https://www.enniscorthyccfe.ie/page/Engineering-Technology/59982/Index.html
Pre-Apprenticeship Programme - Construction Technology	5	Full-time	In person	1 year		https://www.wwetb.ie/course/pre-apprenticeship-construction-technology-construction-technology/
Computer Aided Design	5	Full-time	In person	1 year		https://dungarvancollege.ie/images/pdfs/2019/science2019.pdf

Appendix C - Training suppliers – Skillnet Ireland

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Skillnet Ireland – Industry 4.0						
AutoCAD & Auto CAD LT Essentials	6	Part-time	Online	3 days	✓	https://industry4skillnet.com/autocad-autocad-lt-essentials-training-course/
AutoCAD Advanced Blocks -Intermediate AutoCAD Level	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
AutoCAD Blocks – Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
AutoCAD Dynamic Blocks -Intermediate AutoCAD Level	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
AutoCAD intermediate	6	Part-time	Online	2 days		https://industry4skillnet.com/bim-training/
AutoCAD Reference Files – Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
AutoCAD Template Creation-Intermediate AutoCAD Level	6	Part-time	Online	1 day		https://industry4skillnet.com/bim-training/
AutoCAD Electrical Essentials	6	Part-time	Online	2 days		https://industry4skillnet.com/bim-training/
Autodesk BIM Collaborate – Quick Start	6	Part-time	Online	1 day	✓	https://industry4skillnet.com/bim-training/
Autodesk Build Quick Start	6	Part-time	Online	1 day	✓	https://industry4skillnet.com/bim-training/
Autodesk Docs Quick Start	6	Part-time	Online	1 day		https://industry4skillnet.com/bim-training/
Autodesk Revit MEP Essentials	6	Part-time	Online	3 days		https://industry4skillnet.com/revit-mep-essentials-course/
Autodesk Inventor Parts 1 & 2	6	Part-time	Online	4 days		https://industry4skillnet.com/autodesk-inventor-course/
BIM Awareness for Executives	6	Part-time	Online	1 day		https://industry4skillnet.com/bim-awareness-for-executives/
Managing Clashes with Autodesk Navisworks - Beyond the Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
BIM Collaborate Pro Quick Start	6	Part-time	Online	1 day		https://industry4skillnet.com/bim-training/
BIM Process for Building Services	6	Part-time	Online	1 day		https://industry4skillnet.com/bim-training/
Civil 3D Grading Essentials – Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
Collaboration in Civil 3D with Data Shortcuts – Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
Dynamo for Revit Overview – Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
Introduction to Autodesk Navisworks– Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
Introduction to BIM Project Management	6	Part-time	Online	1 day	✓	https://industry4skillnet.com/introduction-to-bim-project-management-training-course/
Revit Architecture Coordinates– Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/
Revit Architecture Essentials	6	Part-time	Online	3 days		https://industry4skillnet.com/revit-architecture-essentials-course/
Revit Architecture Visibility and Graphic Controls – Beyond The Basics	6	Part-time	Online	Half day		https://industry4skillnet.com/bim-training/

Appendix C - Training suppliers – Skillnet Ireland

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Skillnet Ireland – Industry 4.0						
Site Simulation with Autodesk Navisworks – Beyond The Basics	6	Part-time	Online	Half day	✓	https://industry4skillnet.com/bim-training/
Virtual Revit Structures Essentials	6	Part-time	Online	3 days	✓	https://industry4skillnet.com/bim-training/
Skillnet Ireland – Industry 4.0 (Siemens)						
S5 System 1 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S5 System 2 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Service 1 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Service 2 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Service 3 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Service Technician 1 Refresher Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Service Technician 1 Examination Module	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Service Technician 2 Refresher Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Service Technician 2 Examination Module	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Programming 1 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Programming 2 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Programming 3 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Programmer Refresher Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Programmer Examination Module	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 Graph / PDiag / ProAgent Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
SIMATIC Programming 1 with S7-SCL	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
SIMATIC Programming 2 with S7-SCL	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
S7 1200 Basic Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal System Retraining Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal Service 1 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal Service 2 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal Programming 1 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal Programming 2 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal Programming 3 Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course

Appendix C - Training suppliers – Skillnet Ireland

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Skillnet Ireland – Industry 4.0 (Siemens)						
Siemens Certified Programmer	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal WinCC – Machine Level Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
TIA Portal WinCC SCADA Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Programming Safety Related S7 PLC via STEP 7 Safety Advanced for SIMATIC TIA Portal	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
SIMATIC programming with S7-Graph	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Sinamics S120 – Parameterizing and Commissioning in TIA Portal	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Sinamics S120 Service and Commissioning Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Sinamics G150/G130/S150 Diagnostics and Service Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Sinamics G120 Parameterizing & Commissioning Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Sinamics G120P for Heating, Ventilation and Airconditioning Systems Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Sinamics DCM Parameterizing & Commissioning Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Sinamics S120 Safety Integrated Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Simotion System and Programming Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Simotion and Sinamics S120 Diagnostics and Service Course	Not Stated	Not Stated	Not Stated	Not Stated		https://industry4skillnet.com/siemens-training-programmes/#complete-course
Skillnet Ireland – Construction Professionals						
CIOB - Managing Sustainable Construction	6	Part-time	Online	4 days	✓	https://www.cpskillnet.ie/training/ciob-managing-sustainable-construction-2/
CIOB - Managing the Technology of Modern and Traditional Construction Works	6	Part-time	Online	4 days	✓	https://www.cpskillnet.ie/training/ciob-managing-the-technology-of-modern-and-traditional-construction-works/
CIOB - Organisation of the Construction Site	6	Part-time	Online	4 days	✓	https://www.cpskillnet.ie/training/ciob-organisation-of-the-construction-site-3/
CIOB - Project Planning, Control, Monitoring and Risk for Construction	6	Part-time	Online	4 days	✓	https://www.cpskillnet.ie/training/ciob-project-planning-control-monitoring-and-risk-for-construction-2/
BIM Project Information Management		Part-time	Online	1 day	✓	https://www.cpskillnet.ie/training/bim-iso-19650-delivering-information-management/
Certificate in Strategic Supply Management in MMC	8	Part-time	Mixed	1 day per week for 13 weeks	✓	https://www.cpskillnet.ie/training/certificate-in-strategic-supply-management-for-mmc/
Green Procurement		Part-time	Online	1 day	✓	https://www.cpskillnet.ie/training/green-procurement-2/
Certificate in Strategic Collaboration and Co-ordination for MMC	8	Part-time	Online	1 day per week for 3 months	✓	https://www.cpskillnet.ie/training/certificate-in-strategic-collaboration-and-co-ordination-for-mmc/

Appendix C - Training suppliers – ATU

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Atlantic Technological University						
Advanced Wood and Sustainable Building Technology (with CIOB)	7	Full-time	In person	3 years		https://www.itsligo.ie/courses/bsc-advanced-wood-and-sustainable-building-technology/
Applied Construction Technology	6	Full-time	In person	2 years		https://www.itsligo.ie/courses/higher-cert-applied-construction-technology/
Architectural Technology	8	Full-time	In person	4 years		https://www.gmit.ie/bachelor-of-science-in-architectural-technology
Architectural Technology	8	Full-time	In person	4 years		https://www.lyit.ie/CourseDetails/D302/LY_CARCH_B/ArchitecturalTechnology
BIM & Lean Construction Management	9	Part-time	Online	1 year	✓	https://www.itsligo.ie/courses/certificate-bim-lean-construction-management-online/
Building Engineering (& Renewable Energy or Fire Safety)	7	Full-time	In person	3 years		https://www.lyit.ie/CourseDetails/D302/LY_CBSRV_D/BuildingEngineering(&RenewableEnergyorFireSafety)
Building Information Modelling	8	Part-time	Blended	2 years	✓	https://www.gmit.ie/higher-diploma-in-engineering-in-building-information-modelling
Building Information Modelling	8	Part-time	Blended	1 year	✓	https://www.gmit.ie/certificate-in-engineering-in-building-information-modelling
Building Information Modelling and Digital Leadership	9	Part-time	Blended	2 years	✓	https://www.gmit.ie/postgraduate-diploma-in-science-in-building-information-modelling-and-digital-leadership
Civil Engineering	7	Full-time	In person	3 years		https://www.itsligo.ie/courses/beng-in-civil-engineering/
Civil Engineering	8	Full-time	In person	4 years		https://www.itsligo.ie/courses/beng-hons-in-civil-engineering/
Civil Engineering	7	Full-time	In person	4 years		https://www.gmit.ie/bachelor-of-engineering-in-civil-engineering
Civil Engineering	8	Full-time	In person	4 years		https://www.gmit.ie/bachelor-of-engineering-honours-in-civil-engineering
Civil Engineering	7	Full-time	In person	3 years		https://www.lyit.ie/CourseDetails/D302/LY_CCIVL_D/CivilEngineering
Computer Aided Design - Parametric Modelling	6	Part-time	Blended	1 year		https://www.gmit.ie/certificate-in-computer-aided-design-parametric-modelling
Construction (Architectural Tech or Construction Management)	7	Full-time	In person	3 years	✓	https://www.lyit.ie/CourseDetails/D302/NC_1040/Construction(ArchitecturalTechorConstructionMgmt)
Construction Economics	6	Part-time	Online	2 years		https://www.itsligo.ie/courses/higher-certificate-construction-economics-online/
Construction Management	8	Full-time	In person	4 years	✓	https://www.gmit.ie/bachelor-of-science-honours-in-construction-management
Construction Management	8	Full-time	In person	4 years		https://www.lyit.ie/CourseDetails/D302/LY_CCONS_B/ConstructionManagement
Construction Management BSc (with CIOB)	7	Part-time	Online	2 years		https://www.itsligo.ie/courses/bsc-in-construction-management/
Construction Project Management	8	Full-time	In person	1 year		https://www.itsligo.ie/courses/bsc-hons-construction-project-management/
Construction Project Management and Applied Technology	8	Full-time	In person	4 years	✓	https://www.itsligo.ie/courses/bsc-hons-construction-project-management-applied-technology/
Digital Construction Technology	7	Part-time	Online	1 year	✓	https://www.itsligo.ie/courses/certificate-in-science-in-digital-construction-technology/
Project Management	9	Part-time	Online	2.5 to 3 years		https://itsligo.ie/courses/master-science-project-management-online/
Quantity Surveying	7	Full-time	In person	2 years		https://www.itsligo.ie/courses/bsc-quantity-surveying-online/
Quantity Surveying	8	Full-time	In person	4 years		https://www.lyit.ie/CourseDetails/D302/LY_CSURV_B/QuantitySurveying

Appendix C - Training suppliers – ATU

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Atlantic Technological University						
Quantity Surveying and Construction Economics	8	Full-time	In person	4 years		https://www.gmit.ie/bachelor-of-science-honours-in-quantity-surveying-and-construction-economics
Built Environment Regulation	9	Full-time	Blended	1 year	✓	https://www.gmit.ie/master-of-science-in-built-environment-regulation
Circular Economy Leadership for the Built Environment	9	Part-time	Online	1 year	✓	https://www.gmit.ie/certificate-in-circular-economy-leadership-for-the-built-environment
Revit & 4D BIM	7	Part-time	Online	2 x 13 weeks		https://www.lyit.ie/CourseDetails/D302/LY_4DBIM_CE/CertificateinRevitand4DBIM

Appendix C - Training suppliers – DKIT

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Dundalk Institute of Technology						
Architectural Technology	7	Full-time	In person	3 years		https://www.dkit.ie/courses/school-of-engineering/built-environment/bsc-in-architectural-technology.html
Building Information Modelling (using Autodesk Revit)	6	Part-time	Online	8 weeks		https://www.dkit.ie/courses/school-of-engineering/built-environment/building-information-modelling-using-autodesk-revit.html
Building Surveying	7	Full-time	In person	3 years		https://www.dkit.ie/courses/school-of-engineering/built-environment/bsc-in-building-surveying.html
Building Surveying	8	Full-time	In person	4 years		https://www.dkit.ie/courses/school-of-engineering/built-environment/bsc-(hons)-in-building-surveying.html
Building Surveying	9	Full-time	In person	1 year		https://www.dkit.ie/courses/school-of-engineering/built-environment/master-of-science-(m.sc.)-in-building-surveying.html
Building Surveying	9	Full-time	In person	1 year		https://www.dkit.ie/courses/school-of-engineering/built-environment/postgraduate-diploma-in-building-surveying-(full-time).html
Building Surveying	9	Part-time	In person	2 years		https://www.dkit.ie/courses/school-of-engineering/built-environment/master-of-science-(m.sc.)-in-building-surveying.html
Computer Aided Design	6	Part-time	In person	8 weeks		https://www.dkit.ie/courses/school-of-engineering/built-environment/computer-aided-design.html
Construction Management	7	Full-time	In person	3 years		https://www.dkit.ie/courses/school-of-engineering/built-environment/bsc-in-construction-management.html
Construction Management	8	Full-time	In person	4 years		https://www.dkit.ie/courses/school-of-engineering/built-environment/bsc-(hons)-in-construction-management.html
Construction Project Management (add-on)	8	Full-time	In person	1 year		https://www.dkit.ie/courses/school-of-engineering/built-environment/bsc-(hons)-in-construction-project-management-(add-on)-one-year.html

Appendix C - Training suppliers – Griffith College

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Griffith College						
Advanced Rendering - Certificate	8	Part-time	In person	2 weeks		https://www.griffith.ie/faculties/design/courses/certificate-advanced-rendering
BIM & BIM Collaboration - Advanced	8	Part-time	Blended	1 semester		https://www.griffith.ie/faculties/design/courses/certificate-advanced-bim-and-bim-collaboration
Building Information Modelling (BIM) & Graphic Illustration - Certificate	8	Part-time	In person	1 semester		https://www.griffith.ie/faculties/design/courses/certificate-building-information-modelling-bim-and-graphic-illustration
Building Information Modelling (BIM) & Graphic Illustration - Diploma	8	Part-time	In person	1 year		https://www.griffith.ie/faculties/design/courses/diploma-building-information-modelling-bim-graphic-illustration
Industrial & Systems Engineering	7	Part-time	Blended	1 year		https://www.griffith.ie/faculties/engineering/courses/bachelor-engineering-industrial-and-systems-engineering-beng
Introduction to BIM (using Revit)	8	Part-time	In person	1 semester		https://www.griffith.ie/faculties/design/courses/certificate-introduction-bim-using-revit

Appendix C - Training suppliers – MTU

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Munster Technological University						
3D CAD and Solid Modelling	6	Part-time	In person	1 year		https://www.mtu.ie/courses/crecadm6/
Applied Building Information Modelling and Digital AEC	9	Part-time	Online	2 years	✓	https://www.mtu.ie/courses/crcabim9/
Applied Building Information Modelling and Management	8	Part-time	In person	2 years	✓	https://www.mtu.ie/courses/crcabim8/
Architectural Technology	7	Full-time	In person	3 years		https://www.mtu.ie/courses/mt759/
Architectural Technology	8	Full-time	In person	4 years		https://www.mtu.ie/courses/mt859/
Architecture	8	Full-time	In person	4 years		https://www.mtu.ie/courses/ck606/
Building Information Modelling and Digital AEC	9	Part-time	Online	2 years		https://www.mtu.ie/courses/crcbimd9/
Building Information Modelling and Management	8	Part-time	In person	1 year		https://www.mtu.ie/courses/crcbimm8/
Building Information Modelling (BIM) with Revit	6	Part-time	Online	1 semester	✓	https://www.mtu.ie/courses/tlebimru/
Construction Management	8	Full-time	In person	4 years		https://www.mtu.ie/courses/mt856/
Construction Management	7	Part-time	In person	1 semester		https://www.mtu.ie/courses/crccmne7/
Construction Project Management	9	Part-time	In person	2 years		https://www.mtu.ie/courses/crccopm9/
Engineering Common Entry (Level 8)	8	Full-time	In person	4 years		https://www.mtu.ie/courses/mt830/
Environmental Engineering	7	Full-time	In person	3 years		https://www.mtu.ie/courses/mt761/
Interior Architecture	7	Full-time	In person	3 years		https://www.mtu.ie/courses/mt760/
Interior Architecture	8	Full-time	In person	4 years		https://www.mtu.ie/courses/mt860/
Mechanical & Electrical Quantity Surveying	8	Part-time	In person	1 semester		https://www.mtu.ie/courses/crcmeqs8/
Mechanical, Electrical and Plumbing - BIM Applications	7	Part-time	Online	1 year	✓	https://www.mtu.ie/courses/cremepb7/
Quantity Surveying	8	Full-time	In person	4 years		https://www.mtu.ie/courses/mt857/
Quantity Surveying	7	Part-time	In person	1 Semester		https://www.mtu.ie/courses/crccece7/
Quality Management, Tools and Techniques in Practice	7	Part-time	Online	1 year	✓	https://www.mtu.ie/courses/tleqmttu/
Construction	6	Part-time	In person	1 year		https://www.mtu.ie/courses/crccone6/
Strategic Building Information Modelling & Management	8	Part-time	In person	1 semester		https://www.mtu.ie/courses/crcsbim8/
Structural Engineering	8	Full-time	In person	4 years		https://www.mtu.ie/courses/mt831/
Structural Engineering	9	Full-time	In person	2 years		https://www.mtu.ie/courses/crcsten9/

Appendix C - Training suppliers – SETU

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
South East Technological University						
Advanced CAD And 3D Modelling	7	Part-time	Flexible	12 weeks		https://www.itcarlow.ie/study/lifelong-learning/parttime-courses-september21/certificate-in-advanced-cad-and-3d-modelling.htm
Architectural & Building Information Modelling Technology	8	Full-time	In person	4 years		https://www.wit.ie/courses/bsc_hons_in_architectural_building_information_modelling_bimtechnology
Architectural Technology	7	Full-time	In person	3 years	✓	https://www.wit.ie/courses/bsc_in_architectural_technology
Architectural Technology	8	Full-time	In person	4 years	✓	https://www.itcarlow.ie/courses/type/undergraduate-cao-courses/built-environment-extended-campus-courses/cw468.htm
Architectural Technology	7	Full-time	In person	3 years	✓	https://www.itcarlow.ie/courses/type/undergraduate-cao-courses/built-environment-extended-campus-courses/cw407.htm
BIM and Construction Project Management	9	Part-time	Online	1 year		https://www.itcarlow.ie/study/lifelong-learning/parttime-courses-september21/certificate-in-bim-and-construction-project-management.htm
BIM Management	9	Part-time	TBC	1 year		https://www.itcarlow.ie/study/lifelong-learning/parttime-courses-september21/certificate-in-bim-management.htm
Construction Management	8	Full-time	Blended	1 year	✓	https://www.wit.ie/courses/bsc-hons-in-construction-management#modules
Construction Management	7	Full-time	In person	3 years	✓	https://www.itcarlow.ie/courses/type/undergraduate-cao-courses/built-environment-extended-campus-courses/cw417.htm
Construction Management	8	Full-time	In person	4 years	✓	https://www.itcarlow.ie/courses/type/undergraduate-cao-courses/built-environment-extended-campus-courses/cw438-construction-management.htm
Construction Management & Engineering	8	Full-time	In person	4 years		https://www.wit.ie/courses/bsc_hons_inconstruction_management_engineering
Introduction to CAD and 3D Modelling	6	Part-time	Flexible	12 weeks		https://www.itcarlow.ie/study/lifelong-learning/parttime-courses-september21/certificate-introduction-to-cad-and-3d-modelling.htm
Management in the Built Environment	9	Full-time	In person	1 year		https://www.itcarlow.ie/study/postgraduate-rd/postgraduate-programmes-taught/engineering-postgrad/master-of-science-mgt-built-env.htm
Quantity Surveying	8	Full-time	In person	4 years		https://www.wit.ie/courses/bsc_hons_in_quantity_surveying
Quantity Surveying	8	Full-time	In person	4 years		https://www.itcarlow.ie/courses/type/undergraduate-cao-courses/built-environment-extended-campus-courses/cw488-quantity-surveying-qsy.htm
Sustainable Energy Engineering	8	Full-time	In person	4 years	✓	https://www.wit.ie/courses/beng-hons-in-sustainable-energy-engineering-degree-option
Sustainable Energy Engineering	9	Full-time	In person	1 year	✓	https://www.wit.ie/courses/msc_in_sustainable_energy_engineering_full_time
Sustainable Energy Engineering	9	Part-time	In person	2 years	✓	https://www.wit.ie/courses/msc_in_sustainable_energy_engineering_part_time

Appendix C - Training suppliers – TCD

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Trinity College Dublin						
Engineering with Management	8	Full-time	In person	4 or 5 years		https://www.tcd.ie/Engineering/undergraduate/engineering-management/
Engineering with Management	9	Full-time	In person	1 year		https://www.tcd.ie/Engineering/undergraduate/engineering-management/
Environmental Science and Engineering	8	Full-time	In person	5 years	✓	https://naturalscience.tcd.ie/undergraduate/environ-eng/year1.php

Appendix C - Training suppliers – TUD

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Technological University Dublin						
Applied Building Information Modelling and Management	9	Part-time	In person	2.5 years	✓	https://www.tudublin.ie/study/postgraduate/courses/building-info-model-manage-applied/?courseSubjects=Architecture%2C%20Built%20Environment&keywords=&courseType=
Architectural Technology	8	Full-time	In person	4 years		https://www.tudublin.ie/study/undergraduate/courses/architectural-technology-tu831/?keywords=Architectural%20Technology&courseType=Undergraduate
BIM (Digital Construction)	8	Part-time	Blended	1 year	✓	https://www.tudublin.ie/study/part-time/courses/bim-digital-construction-tu174/?keywords=bim&courseType=
Building Engineering	7	Full-time	In person	3 years	✓	https://www.tudublin.ie/study/undergraduate/courses/building-engineering-tu703/?courseSubjects=Engineering&keywords=&courseType=
Building Engineering	8	Full-time	In person	3 years	✓	https://www.tudublin.ie/study/undergraduate/courses/building-engineering-tu825/?keywords=Building%20Engineering&courseType=Undergraduate
Construction Management	8	Full-time	In person	4 years	✓	https://www.tudublin.ie/study/undergraduate/courses/construction-management-tu833/?courseSubjects=Architecture%2C%20Built%20Environment&keywords=&courseType=Undergraduate
Electrical Services & Energy Management	8	Full-time	In person	4 years		https://www.tudublin.ie/study/undergraduate/courses/electrical-services---energy-management-(tu802)/?keywords=Electrical%20Services%20%26%20Energy%20Management&courseType=Undergraduate
Quantity Surveying	9	Part-time	Blended	2 years		https://www.tudublin.ie/study/postgraduate/courses/quantity-surveying/?courseSubjects=Architecture%2C%20Built%20Environment&keywords=&courseType=
Quantity Surveying and Construction Economics	8	Full-time	In person	4 years		https://www.tudublin.ie/study/undergraduate/courses/quantity-surveying-and-construction-econ-tu837/?courseSubjects=Architecture%2C%20Built%20Environment&keywords=&courseType=
Quantity Surveying and Construction Economics	8	Part-time	In person	5 years		https://www.tudublin.ie/study/part-time/courses/quantity-surveying-construction-economics-tu087/?courseSubjects=Architecture%2C%20Built%20Environment&keywords=&courseType=

Appendix C - Training suppliers – TUS

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Technological University Shannon						
Building Information Modelling - BIM with Revit MEP	6	Part-time	Online	10 weeks		https://tus.ie/courses/certificate-building-information-modelling-with-revit-mep/
Construction Management - Add on	8	Full-time	In person	18 months		https://www.ait.ie/courses/bsc-hons-construction-management-skills-such-as-lean-management-building-in
Construction Management	8	Full-time	In person	4 years	✓	https://www.tus.ie/courses/US884
Construction Management	8	Full-time	In person	4 years	✓	https://tus.ie/courses/us885/
Quantity Surveying	8	Full-time	In person	4 years		https://www.ait.ie/courses/US880
Quantity Surveying	8	Full-time	In person	4 years		https://lit.ie/Courses/LC243
Quantity Surveying	9	Full-time	In person	1 year		https://tus.ie/courses/msc-pgdip-quantity-surveying/

Appendix C - Training suppliers – UCC

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
University College Cork						
Architecture	8	Full-time	In person	4 years		https://www.ucc.ie/en/ck606/
Architecture	9	Full-time	In person	1 year		https://www.ucc.ie/en/ckr42/
Engineering	8	Full-time	In person	4 years		https://www.ucc.ie/en/ck600/

Appendix C - Training suppliers – UCD

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
University College Dublin						
Architecture	8	Full-time	In person	3 years		https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=MAJR&MAJR=SSS1
Digital Construction	7	Full-time	In person	1 semester	✓	https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=MODULE&MODULE=CVEN3006W
Engineering	8	Full-time	In person	4 years		https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=MAJR&PROG=BHENG001
Structural Engineering	9	Part-time	In person	2 years		https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=PROG&MAJR=T279
Structural Engineering with Architecture	8	Full-time	In person	3 years		https://www.myucd.ie/courses/architecture/structural-engineering-with-architecture/

Appendix C - Training suppliers – UG

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
University of Galway						
Engineering (Civil)	8	Full-time	In person	4 years		https://www.universityofgalway.ie/courses/undergraduate-courses/civil-engineering.html#course_outline
Project and Construction Management	8	Full-time	In person	4 years		https://www.universityofgalway.ie/science-engineering/undergraduateprogrammes/project-and-construction-management.html#course_outline
Construction Innovation	9	Part-time	In person	1 year	✓	postgraduate-prospectus.pdf (universityofgalway.ie)
Bachelor of Science (Project and Construction Management)	8	Full-time	In person	4 years		Bachelor of Engineering (Project and Construction Management) - University of Galway
Sustainability Planning in Construction	9	Full-time	In person	1 semester	✓	Sustainability Planning in Construction - University of Galway
Digital Construction Technologies	9	Full-time	In person	1 year	✓	Digital Construction Technologies - University of Galway
Modern Methods of Construction PG Cert	8	Part-time	In person	1 year	✓	Modern Methods of Construction (PG Cert) - University of Galway

Appendix C - Training suppliers – UL

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
University of Limerick						
Construction Management and Engineering	8	Full-time	In person	4 years		https://www.ul.ie/courses/bachelor-science-construction-management-and-engineering#about-course
Technology Management	8	Full-time	In person	4 years		https://www.ul.ie/courses/bachelor-science-technology-management#about-course

Appendix C - Training suppliers – CitA

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Construction IT Alliance (CitA)						
AutoCAD 2D Essentials - Online (Option 1: 6 half days)	6	Part-time	Online	6 days		https://www.cita.ie/cita-skillnet/autocad-2d-essentials-online/
AutoCAD 2D Essentials - Online (Option 2: 4 days)	6	Part-time	Online	4 days		https://www.cita.ie/cita-skillnet/autocad-2d-essentials-online
AutoCAD 2D Intermediate	6	Part-time	Not stated	4 days		https://www.cita.ie/cita-skillnet/autocad-2d-intermediate-2-2/
AutoCAD MAP 3D GIS for CAD users	6	Part-time	Not stated	2 days		https://www.cita.ie/cita-skillnet/autocad-map-3d-gis-for-cad-users/
Autodesk Infraworks Essentials	6	Part-time	Not stated	4 days	✓	https://www.cita.ie/cita-skillnet/autodesk-infraworks-essentials/
BIM - Information Management Practitioner - ISO 19650 Curriculum	6	Part-time	Online	12 hours	✓	https://www.cita.ie/cita-skillnet/bim-information-management-practitioner-iso-19650-curriculum-operam-academy/
BIM - Information Management Professional IM Bootcamp Programme	6	Part-time	Online	10 hours	✓	https://www.cita.ie/cita-skillnet/bim-information-management-professional-im-bootcamp-programme-operam-academy/
BIM Certificate - BIM-PIM-TIM (BRE)	6	Part-time	Blended	10 hours	✓	https://www.cita.ie/cita-skillnet/bim-certificate-bip-pim-tim-bre/
BIM Coordinator Mentor Programme	6	Part-time	Online	10 hours	✓	https://www.cita.ie/cita-skillnet/bim-coordinator-mentor-programme/
BIM in Company Tailored Training	6	Part-time	Online	8 days	✓	https://www.cita.ie/cita-skillnet/bim-training-in-company-training/
BIM ISO 19650 Delivering Information Management	6	Part-time	Online	1 day	✓	https://www.cita.ie/cita-skillnet/bim-iso-19650-bim-essentials-and-information-management-bre/
BIM360 Tools	6	Part-time	Online	10 days	✓	https://www.cita.ie/cita-skillnet/bim360-tools/
Civil 3D Essentials	6	Part-time	Online	12 hours		https://www.cita.ie/cita-skillnet/civil-3d-essentials/
Introduction to BIM Principles	6	Part-time	Online	1 day	✓	https://www.cita.ie/cita-skillnet/introduction-to-bim-principles/
Introduction to BIM Tools	6	Part-time	Online	3 days	✓	https://www.cita.ie/cita-skillnet/introduction-to-bim-tools/
Introduction to BIM using Revit	6	Part-time	Online	1 day	✓	https://www.cita.ie/cita-skillnet/introduction-to-bim-using-revit/
Navisworks Essentials	6	Part-time	Online	12 hours		https://www.cita.ie/cita-skillnet/navisworks-essentials/
Revit Additional Topics	6	Part-time	Online	10 days		https://www.cita.ie/cita-skillnet/revit-additional-topics/
Revit Advanced BIM Management	6	Part-time	Not stated	2 days		https://www.cita.ie/cita-skillnet/revit-advanced-bim-management/
Revit Architecture Essentials	6	Part-time	Online	10 hours		https://www.cita.ie/cita-skillnet/revit-architecture-essentials/
Revit Architecture Professional Blended	6	Part-time	Blended	Not stated		https://www.cita.ie/cita-skillnet/revit-architecture-professional/
Revit Families	6	Part-time	Online	10 days		https://www.cita.ie/cita-skillnet/revit-families/
Revit Structure Essentials	6	Part-time	Online	10 hours		https://www.cita.ie/cita-skillnet/revit-structure-essentials/
Twinmotion Essentials	6	Part-time	Online	5 days	✓	https://www.cita.ie/cita-skillnet/twinmotion-essentials/

Appendix C - Training suppliers – Engineers Ireland

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Engineers Ireland						
AutoCAD 2D Essentials	6	Part-time	Online	6 days		https://diatec.ie/products/utocad-2d-essentials-online-course
AutoCAD Advanced	6	Part-time	Online	6 days		https://diatec.ie/products/autocad-advanced-online-course
Autodesk Infraworks Essentials	6	Part-time	Online	4 days	✓	https://diatec.ie/products/autodesk-infraworks-essentials-online-course
Civil 3D Essentials	6	Part-time	Online	4 days	✓	https://diatec.ie/products/civil-3d-essentials-online-course
Construction Contracts, BIM and Digital Technology	6	Part-time	online	1 day	✓	https://www.engineersireland.ie/Professionals/CPD-Careers/CPD-training-courses-by-theme/Procurement-and-Contracts-Training-Courses/Construction-Contracts-BIM-and-Digital-Technology
Introduction to BIM Principles	6	Part-time	Online	6 hours		https://www.engineersireland.ie/Professionals/CPD-Careers/CPD-training-courses-by-theme/Digital-Training-Courses/Introduction-to-BIM-Principles
Inventor Pro Essentials	6	Part-time	Online	8 hours		https://diatec.ie/products/inventor-professional-essentials-online-course
Navisworks Essentials	6	Part-time	Online	8 hours		https://diatec.ie/products/navisworks-manage-essentials-online-course
Revit Architecture Essentials	6	Part-time	Online	6 days		https://diatec.ie/products/revit-architecture-essentials-online-course
Revit MEP Essentials	6	Part-time	Online	8 hours		https://diatec.ie/products/revit-mep-essentials-online-course
MAP 3D Essentials	6	Part-time	Online	6 hours		https://diatec.ie/products/autocad-map-3d-gis-for-cad-users-online-course
Revit Structure Essentials	6	Part-time	Online	8 hours		https://diatec.ie/products/revit-structure-essentials-online-course-1

Appendix C - Training suppliers – CIAT

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Chartered Institute of Architectural Technology (CIAT)						
BIM Level 2 Essentials	6	Part-time	Online	14 hours	✓	https://architecturaltechnology.com/learning/cpd/cpd-register/bim-level-2-essentials.html
BIM Level 2 for Information Managers	6	Part-time	Online	12 hours	✓	https://architecturaltechnology.com/learning/cpd/cpd-register/bim-level-2-for-information-managers.html

Appendix C - Training suppliers – RICS

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Royal Institute of Chartered Surveyors (RICS)						
BIM - The Fundamentals	6	Part-time	Online	3 hours		https://www.rics.org/training-events/online-training/on-demand/bim-the-fundamentals
Certificate in Building Information Modelling	6	Part-time	Online	90 hours		https://www.rics.org/training-events/online-training/scheduled/certificate-in-building-information-modelling-bim-project-management

Appendix C - Training suppliers – Symetri

Course	NFQ	Part-time/Full-time	Delivery	Duration	MMC Specific	Link
Symetri						
AutoCAD Essentials	6	Part-time	Online	10 hours		https://www.symetri.ie/courses/autocad-essentials-online-training/
AutoCAD Intermediate	6	Part-time	Online	6 hours		https://www.symetri.ie/courses/autocad-intermediate-online-training/
Plant 3D	6	Part-time	Online	5 days		https://www.symetri.ie/courses/plant-3d-online-training/
Revit Architecture	6	Part-time	Online	5 days		https://www.symetri.ie/courses/revit-architecture-online-training/
Revit MEP	6	Part-time	Online	5 days		https://www.symetri.ie/courses/revit-mep-online-training/


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Appendix D – Group on Future Skills Needs
EY
Building a better working world

Members of the Expert Group on Future Skills Needs

Name	Organisiation
Tony Donohoe (Chair)	Formerly Ibec
Marcus Breathnach	Head of Secretariat and Principal Officer, Labour Market and Skills Unit, Department of Enterprise, Trade and Employment
Gary Tobin	Assistant Secretary, Department of Enterprise, Trade and Employment
William Beausang	Assistant Secretary, Department of Further Education and Training and Higher Education, Research, Innovation and Science
Stephanie O'Brien	Principal Officer, Department of Further and Higher Education, Research, Innovation and Science
Donal Leahy	Enterprise Ireland
Dr Vivienne Patterson	Higher Education Authority
Breda O'Toole	IDA Ireland
Dr Laura Bambrick	Irish Congress of Trade Unions
Shauna Dunlop	SOLAS
Joan McNaboe	Skills and Labour Market Research Unit, SOLAS

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Appendix E – Members of the Steering Group

Building a better working world

Name	Organisation	Name	Organisation
Sarah-Jane Pisciotti [Chair]	MMC Ireland	Pranash Ramanundh	Royal Institute of the Architects of Ireland
Marcella Murphy	Construction Sector Group	Peter de Lacy Staunton	Irish Timber Frame Manufacturers Association
Caroline O'Laochdha	Vision Built	Jim Patterson	Alexanders Timber Design Limited
Liam Berney	Irish Congress of Trade Unions	Gary Smith	KTF - Keenan Timber Frame
Liz Thomas	Skillnet	Linda Kane	Department of Enterprise, Trade and Employment
Shauna Dunlop	SOLAS	Celine McHugh	Department of Enterprise, Trade and Employment
Denise Tuffy	Construction Industry Federation	Manus O'Donnell	Department of Enterprise, Trade and Employment
Aisling Soden	IDA Ireland	Sandra O'Reilly	Department of Enterprise, Trade and Employment
Ross O'Colmain	Enterprise Ireland	Sarah Miley	Department of Further and Higher Education, Research, Innovation and Science
Martin Murray	Procon Modular	Damien Henehan	Department of Further and Higher Education, Research, Innovation and Science
Dan Lidan	Smart Offsite Association	Éadaoin Ní Fhearghail	Department of Housing, Local Government and Heritage
Hugh O'Connor	DTE Manufacturing Ltd	Catherine Higgins	Department of Environment, Climate and Communications

EY

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