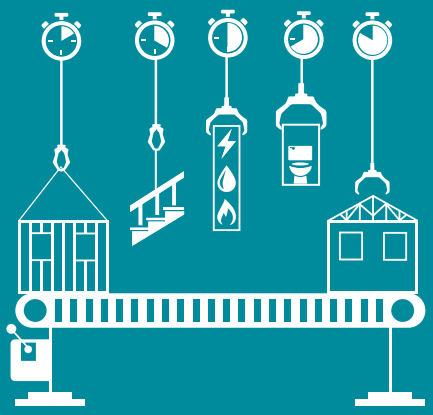
mace

INSIGHTS 2018

CITY LIVING

How modern methods of construction can help Britain build the homes it needs



Mark Reynolds
Chief Executive

Appointed Mace's Chief Executive in January 2013, Mark has been a member of the Group Board since the management buyout of the company in 2001.

His vision is for Mace to lead the industry through innovation, be a major British exporter of construction services, deliver a consistent high quality service to clients and ensure that Mace continues to develop, attract and retain the very best people in our industry. Mark gained his early experience in the commercial sector on the Broadgate and Ludgate developments in London, later moving on to projects with BAA.

He was the Deputy Programme Director for the London 2012 Olympic and Paralympic Games, reported as the best ever delivered venue in the history of the modern Olympics.

Since 2016 Mark has sat on the board of the widely respected business body London First. In 2017 he was appointed to the UK Government's Construction Leadership Council heading up the skills workstream.

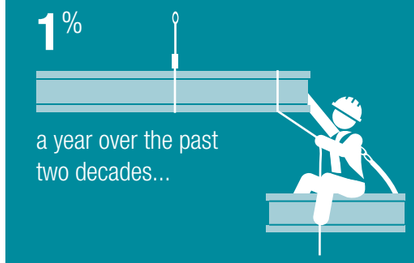
Shaun Tate
Director of High Rise Solutions

With over 25 years experience in the industry and an appetite for innovation, Shaun leads Mace's work on high rise solutions; working with new technology to change the way the industry builds at height. Shaun is overseeing the delivery of East Village's N08 project, delivering two residential towers destined for the private rented sector, and previously led the South Bank Tower project, building 11 new storeys on top of an existing 30 storey tower in the heart of the City of London.

Shaun is driven by his belief that for a project to succeed it is essential that the vision is shared and challenged, such that it develops into something that Mace's delivery teams can embrace and take collective ownership of. He continues to push the boundaries of construction, delivering some of London's most high-profile projects with a vision to drive faster and safer delivery, consistent quality and optimum value.

Globally labour-productivity growth in construction has averaged only...

1%



a year over the past two decades...

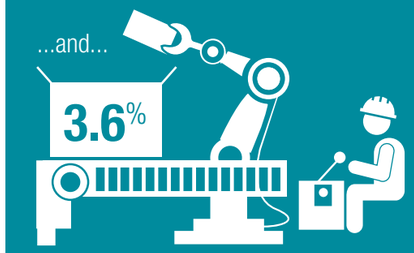
...compared with growth of...

2.8%

for the total world economy...

...and...

3.6%



in the case of manufacturing[xii]

One in **six** of the homes that city areas will need in the next twenty years are yet to be built. Eradicating the shortfall will add...

to their economic output

The construction industry would need to increase its productivity by...

if it is to build the homes that cities need

FOREWORD

The construction industry is in the midst of a perfect storm. The delivery of new homes has consistently fallen behind demand for decades, productivity levels have been stagnant, and the collapse of Carillion raised the profile of a number of issues from project governance to government procurement practices and unsustainable margins.

With 10,500 homes now needing to be built in UK cities every month of every year for the next 20 years, and our social and transport infrastructure playing such an important role in getting the country match-fit for a life outside the European Union, the time for transformational change is now. It also needs to happen at pace.

To meet the demand for new homes in our cities, the construction industry needs to increase its productivity by 30%. Put another way, this means that construction needs to become as productive as manufacturing.

We need to create a culture of measurement and learning, as we did for safety with the AFR and lost time incidents over a decade ago. By having an agreed approach to measurement it means that comparisons across projects and companies can be made and lessons learnt. Since measuring productivity on Mace's sites, we are now averaging £80 GVA per hour worked which is double that of manufacturing and higher than the UK's average.

At our Rising Factory project at East Village in Stratford, London, 98% of the superstructure is prefabricated and the towers are built using a unique climbing mechanism that allows a new floor to be fully externally complete in just one week. And instead of constraining design or needing the use of large factories dotted around the country, we work with our client's design and our local supply chain through a component or 'platform' based approach in a similar way to how the automotive sector assembles cars.

The next evolution of this approach will allow us to deliver tall buildings even faster, using 40% less lorry movements, with 75% less waste and lighter structures. Which means improved productivity and sustainable margins across the board.

This means opportunities for not just our clients, but the UK as a whole. New analysis for this report shows that if the construction industry can eradicate the new homes shortfall in our cities, £53bn would be added to the UK's economic output over the next 20 years.

To achieve these benefits we need the same kind of support as other sectors. We set out seven policy proposals that will support private companies who are investing in innovation in the delivery of these much needed new models.

The opportunity for the construction sector, developers, tax payers, and the country are enormous. We need to work together to make them a reality.

Mark Reynolds
Chief Executive

The only sustainable way to make housing more affordable is to build more new homes where people actually want to live. Both national and local politicians recognise this. The Chancellor has outlined plans to build 300,000 new homes a year in England, city mayors across the country have established housing as a key priority and the devolved nations have acted to try and increase housing supply.

Despite this, more needs to be done if we are to actually deliver on these promises. This is especially true in our cities. If the UK's urban areas are to deliver on their economic potential, sticking with traditional approaches to housebuilding is no longer good enough. The good news is that change is on the way. Innovative construction techniques promise to disrupt outdated methods of building new homes; the transformative effects of these techniques, however, are not guaranteed.

This report looks at how we can give these innovative approaches to housebuilding the best possible chance to succeed and how some 'Modern Methods of Construction' have a role to play in solving the problem.

The problem – Cities need new homes

The world's cities are growing fast, with ever increasing demand for places to live.

Today more than half of the global population lives in urban areas, and billions more people are expected to be living in cities by the middle of the century.[i] This process of urbanisation and agglomeration means that firms can recruit more workers with more skills, share supply chains, infrastructure[ii] and exchange ideas and information.

But significant challenges – such as strain on transport networks and poorer environmental outcomes – must be overcome if the economic benefits of city growth are to be realised.

The UK's own urban renaissance, following decades of urban decline and economic restructuring, has seen significant demands placed on housing affordability and availability.[iv] Despite some cities building more homes than the national average, they have not built anywhere enough to keep up with the growth in their populations.[v]

While it is true that constrained housing availability has not stopped our cities from becoming dynamic engines of commerce, culture and innovation, there is also no doubt that it has and will increasingly restrict their success. More homes in cities bring people closer to jobs markets, allowing companies to have access to a larger pool of talent. In turn, companies become more productive and generate higher levels of economic output.[vi]

The Chancellor has outlined plans to build...

300,000

new homes a year in England

Globally,

54%

of the population lives in urban areas today, and this trend is expected to continue...

...by 2045, the number of people living in cities will increase 1.5 times to

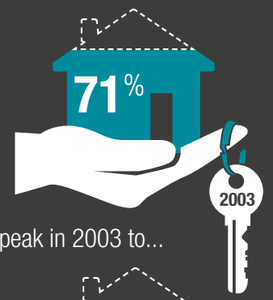
6bn

...adding...

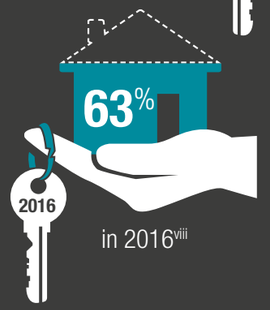
2bn

more urban residents[i]

The proportion of UK households that are owner occupiers has steadily declined from...

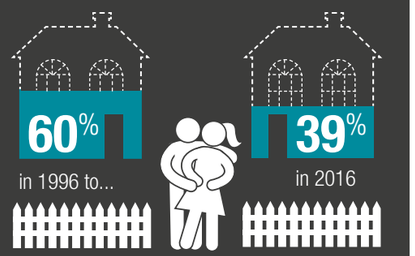


at its peak in 2003 to...

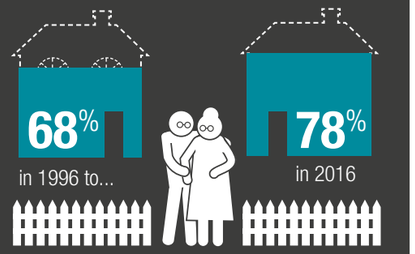


in 2016[viii]

Between 1996–2016 home ownership rates amongst 25–34 year-olds fell from...



However in the same period home ownership amongst 65–74 year-olds rose from...



And just as there is an economic imperative of building more homes in our cities, there is a societal imperative too:

- **The large majority of people want to own their own home.**[vii] Yet the proportion of owner occupiers in the UK has declined from 71% at its peak in 2003 to around 63% now.[viii]
- **It has become harder for young people to own their own home.** In 1996, 54% of households led by a 16-34 year-old were owner-occupiers; by 2016, this figure had fallen to 34%.[ix]
- **Young people are attracted to city centre living.** The number of 20-29 year-old residents living in large city centres almost tripled over the last ten years.[x]

In short, if our cities can address their housing shortages then both the economy and society would benefit.

What is the solution?

Innovative construction techniques can increase the supply of homes in our cities, but the widespread adoption of these techniques is by no means a certainty.

'Modern Methods of Construction' (MMC) is a catch-all term for the techniques, approaches and technologies that allow new ways of working within an industry that struggles to move with the times.

There is no doubting the transformative effects that MMC could have:

- **The size and structure of the construction workforce could change.** MMC could fundamentally alter the occupational mix within the construction industry. Indeed, our previous Mace Insights report, Moving to Industry 4.0, estimated that the construction industry will need to reskill over 600,000 employees within the next twenty years in response to technological change.[xi]
- **The geography of construction could change.** The growth in off-site manufacture prior to on-site assembly means that construction activity can take place anywhere in the UK (or even overseas). This means that the economic benefits of a construction project could be felt far from where the final product is built or locally to site depending on client decisions and the available supply chain.
- **The construction industry's productivity performance could dramatically improve.** Techniques could result in more output for the same input. Globally, labour-productivity growth in construction has averaged only 1 percent a year over the past two decades, compared with growth of 2.8 percent for the total world economy and 3.6 percent in the case of manufacturing.[xii]

- **The UK construction industry could export its expertise all over the world.** As evidenced above, the UK is not the only country to experience stagnant productivity performance in its construction industry. If the UK can take the lead in the application of MMC then other countries will want to follow
- **More collaborative behaviours.** Modern Methods of Construction are not just about what physically happens on site, it also includes organisation, collaboration and how to align different suppliers to achieve the same outcome. The work being done by the Institution of Civil Engineers on Project 13[xxvii] looks at how to create the right behaviours, the focus on outcomes and the culture and roles for projects to succeed.

The adoption and use of MMC could change how the construction industry works. And it needs to change how it works. As it currently stands, only 50p in the pound of a construction project is spent on the physical product.[xiii] Up to 15% of materials delivered to sites ends up in skips. Defects and errors in traditional projects add up to 20% to their final cost.[xiv]

The particular focus of this report is how MMC in housebuilding can positively improve how the UK delivers the homes that it needs. Whether it is building apartments in space-constrained urban cores or building the new suburban homes to expand a city's commuter belt, new construction techniques promise the ability to create residential property more quickly, efficiently and to a higher standard than ever before. Not only this, but innovations in homebuilding can help to address the diverse views of what the public want from new housing[xv]:

The public are generally positive about new homes being built near them. According to polling by Survation for Mace, 43% of respondents would feel positive about 1,000 new homes being built in their area (25% were negative and 32% were indifferent). 50% of respondents were positive about 1,000 new homes being built in the area if the homes were well-designed and of good quality (21% were negative and 32% were indifferent).

But new techniques in construction are not guaranteed to transform city living. For decades, policy experts, economists and the construction industry have forecast a revolution in working practices, only for productivity performance to remain sluggish and for potential to be left unfulfilled.

Currently only...

50p

in the pound of a construction project is spent on delivering the physical product[xiii]

Up to...

15%

of materials delivered to sites ends up in skips

Defects and errors in traditional projects add up to...

20%

to their final cost[xiv]

To prevent another false dawn, the leaders within the construction industry and policymakers need to act – a SWOT analysis highlights where action is needed.

Strengths	Weaknesses
• Innovation in construction is not just about time-savings, but about realising benefits across the life cycle of a built asset. • There are indications of more construction industry collaboration on new techniques. • A number of construction firms are adopting new approaches, which is good for competition and innovation.	• New working practices are not widespread enough to realise economies of scale. • Ingrained working practices and cultures hinder the speed at which new working practices are taken up. • There is not enough proofs of concept that show innovations and new techniques can result in material benefits for a construction project.
Opportunities	**Threats**
• The course content of apprenticeships and other qualifications can increasingly incorporate new construction techniques. • Devolved responsibilities provide local areas with greater control over policy, which can support innovation in construction. • Becoming a world-leader in MMC could mean selling UK construction expertise all over the world. • Increased use of MMC should lead to lower energy use, less waste and cheaper homes and workplaces helping to support the Industrial Strategy's Clean Growth Grand Challenge.	• Encouraging the adoption and use of new construction techniques is supported by a dependable pipeline of projects – if this pipeline weakens it would reduce the momentum behind adoption and use of new ways of working. • Events like an economic downturn – or a failed project – could dent enthusiasm to pursue new working practices. • Construction has been slow to embrace innovation and adopt new technology.

Playing to these strengths, addressing the weaknesses, harnessing its opportunities and nullifying the threats will go a long way to improving the construction industry's productivity performance. And as much as the construction industry needs to nurture current innovations in housebuilding, it needs to encourage new innovations too. Ultimately, this will mean better design outcomes which leads to better quality homes.

The UK faces a number of challenges in the construction of tall or higher density buildings – labour supply is constrained, commodity and material costs are rising, exchange rates are volatile, there is an ever-increasing demand for housing and productivity growth is lacklustre.

Recognising the importance of improving productivity, Mace started to track the GVA per hour worked on our sites. The average GVA per hour worked for construction is £25.50, for manufacturing it is £35.50, and for services it is £31.50.

Since measuring productivity on our sites since the start of 2018, the average that we are achieving is £80 of GVA per hour worked. This is double the UK's average and higher than the average for construction and manufacturing. This is evidence of our drive to innovate and the pursuit of a better way.

The good news is that innovations in construction industry have the potential to transform how buildings are created. This revolution will radically improve productivity levels, quality, safety and environmental outcomes.

But to deliver this, a more collaborative approach within the construction industry is needed, moving away from transactional relationships to instead drive smarter and more holistic solutions. We are now seeing an acceleration in the deployment of digital collaboration between the supply chain, and a focus on modular off-site manufacturing.

We appreciate that there are a number of different 'factory' approaches in the market. Either volumetric, kit of parts or a sub-assembly (or platform) manufacturing approach. To summarise:

Volumetric/modular

This is where prefabricated units are assembled and transported to site as a fully finished and enclosed space.

This approach is effective in low-rise lower density developments that require a 'high volume' of standardised units to be produced, and increasingly in medium to high-rise projects. The economies of scale lower cost but can impact on the design.

Platforms/sub-assemblies

A platform is commonly a specific area or aspect within a building type. For examples a school may consist of classrooms, a hall and a kitchen.

Kit of parts

This approach is where elements are manufactured off-site, packed and delivered for on-site assembly. It is similar to Ikea's approach to furniture.

This is normally a more 'self build' approach, which offers opportunity to broaden the workforce and lower skills barriers, but commonly has design and future flexibility constraints.

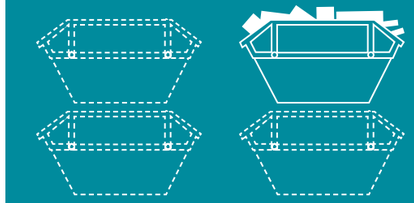
Mace's new patented construction technique will allow us to deliver tall buildings **faster** using...

40%

less lorry movements and...

75%

less waste



In London, Mace's rising factory allowed us to build...

18 storeys in **18** weeks

on both towers of our East Village project in Stratford

Across Mace's projects we are producing...

£80

of GVA per hour worked

Mace's sub-assembly approach

Learning from automotive

The process of manufacturing is not particularly new, with key principles dating back over 100 years to the days of the Model T Ford. Over the years the process has become ever more efficient and productive with the different required components being produced by the car manufacturers supply chain and delivered within tightly defined time slots in a 'just-in-time' approach. In construction this is referred to a sub-assembly or platform approach.

Delivering high-rise projects

Building tall buildings and towers involves a wide-variety of considerations. Foundations, stability of frame, column thickness, structural rotation and transfer structure, swaying and damping issues and choices around thermal massing and structural materials can all impact on whether a project is deliverable.

In this context, Mace has developed a new way of delivering high rise. At our Rising Factory project at East Village in Stratford, London, 98% of the superstructure is prefabricated and the towers are built using a climbing mechanism that allows a new floor - including structure, cladding, horizontal and vertical service modules, bathrooms and utility cupboards - to be fully externally complete in just one week. No tower cranes are used.

We are now evolving what we learned at our East Village project and launching a new and patented construction technique. This will allow us to deliver tall buildings faster, using 40% less vehicle movements, 75% less waste and deliver potentially lighter structures.

Evolving the approach to high-rise

High Rise Solutions (HRS) is an evolution of our Rising Factory approach. We believe it is driving innovation such as the application of the HRS system that will allow us to deliver the homes the UK needs, reduce risk, bring products faster to market and allow us to revolutionise the way we build tall buildings both here in the UK and internationally.

Each iteration of our model brings better and better productivity improvements. If we are able to deliver an average of 2% productivity improvements year on year, the shortfall of homes in our cities can be eradicated by 2030.

One of the key benefits of our approach is flexibility around design, which is also important to the general public. According to private polling done by Survation for Mace, people are 15% more likely to accept large new developments of new homes near them if they are designs of high quality.

A summary of key benefits are detailed in the table below:

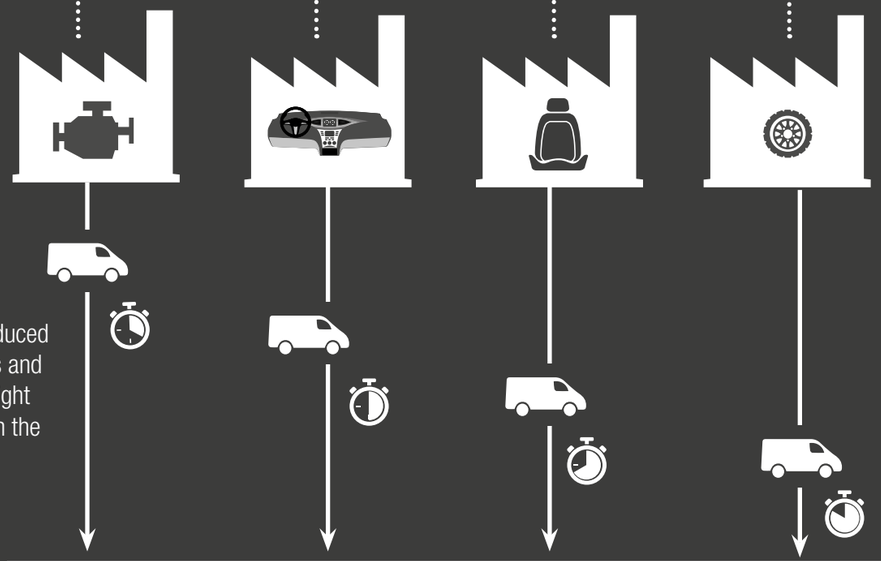
DESIGN	• Optimise any architectural design for off site manufacture. • All Employer's Requirements met or enhanced. • No compromise on specification performance or building regulations compliance.
MANUFACTURE	• Off-site manufacturing facility ensures consistent, factory-standard quality and safety. • Quality inspection at the production facility is streamlined and completed earlier in the process.
LOGISTICS	• Maximise the efficiency of every delivery, reducing vehicle movements by 40% - benefiting the environment and reducing impact on local communities. • 'Just-in-time' logistics strategy, building on decades of knowledge from the automotive sector.
SITE ASSEMBLY	• On-site installation process is significantly faster than traditional methods. Programme improvement of 25%, reducing funding costs and unlocking early income opportunities for developers. • Manufacturing approach significantly reduces the amount of trades required on site – a more efficient and safer method than traditional construction. • Improved safety - as HRS structures arrive to site with façades pre-installed, the need for work on the building edge is removed, creating a safer environment for workers and the surrounding community.
FINISHED PRODUCT	• Delivered to a consistently exceptional standard. • Unlocks opportunity to maximise value in additional areas ie. smarter design can optimise floor to wall ratios and net to gross areas, as well as creating lighter structures which can reduce foundation loadings and potentially realise additional floors within the same planning envelope.

‘JUST-IN-TIME’ CAR MANUFACTURING

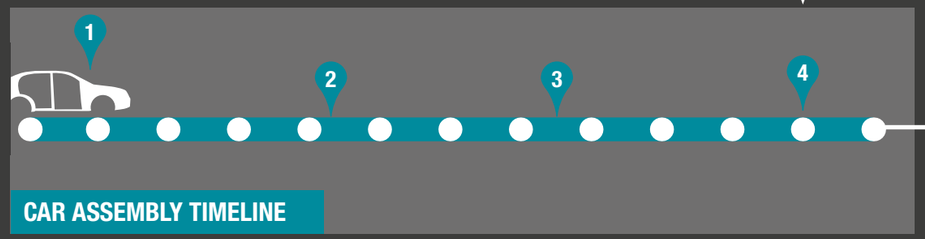
Customer chooses car specification and places an order

DIGITAL DESIGN

Assembly schedule produced and sent to product manufacturers



Components produced by manufacturers and delivered at the right time and place on the assembly line



CAR ASSEMBLY TIMELINE

Car shipped to customer/ car dealership

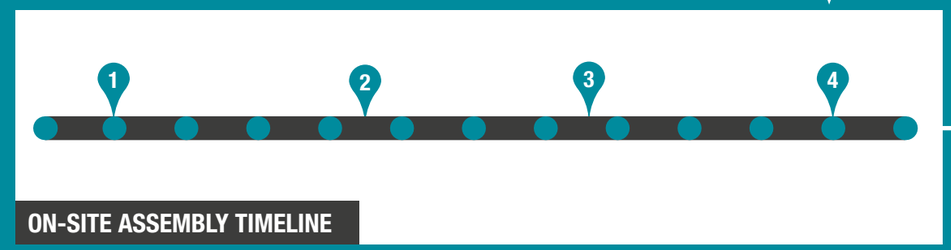
‘JUST-IN-TIME’ HOUSE BUILDING

Mace works with our client and professional team to optimise their design

BIM

Supply chain manufacture platforms/sub-assemblies to order

Mace's UK wide supply chain deliver them to the site or local assembly centres at exactly the right time



ON-SITE ASSEMBLY TIMELINE

Assembled homes

FROM CONSTRUCTION TO PRODUCTION - THE IMPORTANCE OF STANDARDISATION

Some of the most significant benefits from MMC come from standardisation of components across projects and buildings.

If we can realise a manufactured construction industry, more akin to automotive, where common, standardised elements are used repeatedly across many different products, we will be able to drive cost efficiencies over time.

A factory-manufactured product with standard components, but with an ability to maintain architectural design ambition, and exacting standards in quality should be the goal.

If we are to truly transform the industry, we believe we need to change from a 'construction' to a 'production' approach. The Government's new Construction Sector Deal sets out the ambition for all Government departments to procure projects with a 'presumption for off-site' - meaning they will expect the majority of construction activity to take place off site. The direction is clear: organisations that operate within the built environment sector need to move towards a new delivery approach.

Mace has been developing its approach to prefabrication and off-site assembly for over 20 years. We have developed a wealth of innovation and knowledge – from utilising utility and bathroom pods within residential buildings, to pre-wired and plumbed utility cupboards, to modular methods of data centre construction, and most recently our High Rise Solutions.

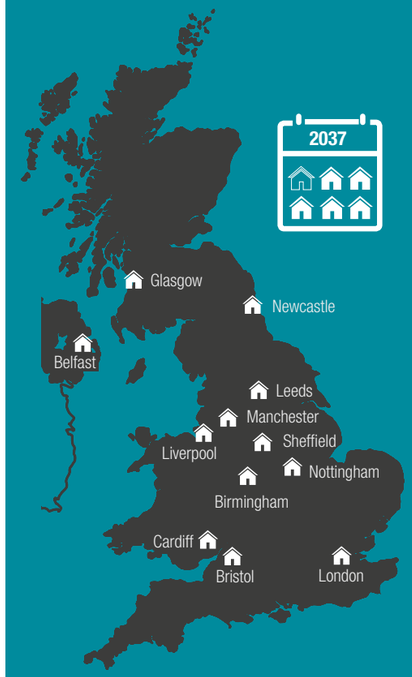
Moving from 'construction to production' will allows us to deliver faster, with more predictability, in a safer way, at less cost and at a better quality. We are committed to being a company that delivers specific building typologies that are 85% manufactured off-site, factory safe, and factory quality. This is a step change that will revolutionise how we deliver buildings and infrastructure and it will allow us to take advantage of new markets, both in the UK and increasingly overseas.

It will allow us to boost productivity, create better relationships with our supply chain, and most importantly, improve further still our record on health and safety. In short, this is the model of the future and we are excited to be pushing forward with the roll-out of our production model, delivering a step-change for the construction sector.

The UK's National Audit Office, amongst others, recognised that currently factory solutions cost about the same as a traditional approach.

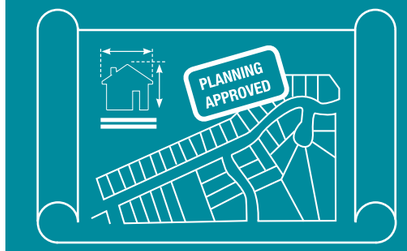
In addition to the opportunities already outlined, the most significant benefits will come when building components are standardised across projects and sectors where possible. This will give a significant pipeline of work for each component, which will lead to the supply chain gearing up to meet the demand and economies of scale being delivered. Which in turn will make factory solutions have cost benefits as well as those outlined above.

One in **six** of the homes that these city areas need by 2037 are yet to be built



We need to build over...

10,500



new homes across our cities every month of every year, for the next 20 years to meet demand

BUILDING MORE CITY HOMES – THE ECONOMIC PRIZE

While there are clearly many factors that affect the supply and demand for housing, one thing is unequivocally true – building more quality homes will bring economic benefits to our cities.

The homes that urban areas need

Our economic analysis looks at the future housing needs of cities and the commuting zones around them. The cities included in the analysis are: Belfast, Birmingham, Bristol, Cardiff, Glasgow, Leeds, Liverpool, London, Manchester, Newcastle, Nottingham and Sheffield.

Taken together, these cities and their commuting zones cover over 33,000 square kilometres and have a combined population of nearly 31 million – which is expected to rise by over 3 million in the next 20 years. The headline numbers in terms of housing are as follows:

- One in six of the homes that city areas will need in the next 20 years are yet to be built.
- The current stock of homes in these city areas currently stands at 13m, with the stock of homes needed by 2037 estimated to be 15.4m.
- That means we need to build over 10,500 new homes across our cities every month of every year, for the next 20 years to meet demand.

The economic and productivity benefits

If housing stock in these city areas grows at its current rate, the number of homes they require over the next 20 years will not get built. In other words, there is an economic opportunity if housing stock can be built more quickly:

- Eradicating the shortfall in the necessary supply of new homes to our cities will add £53bn to their combined economic output over the next twenty years.

Being able to increase the supply of new homes will require either the construction industry to increase its capacity or increase its productivity performance (or both). While some capacity increases will undoubtedly be realised, supplying the required number of homes will only materialise if significant productivity gains are realised from modern methods of construction:

- The construction industry would need to increase its productivity by 30% if it is to build the homes that cities need.

To put this another way, the construction sector needs to become as productive as the manufacturing sector to ensure an adequate supply of homes in our cities by 2037.

If MMC were to deliver productivity improvements of 2% a year, the shortfall in the supply of homes our cities need would be eradicated by 2030.

More action is needed if the homes that the UK's cities need are to be built. The policy recommendations set out here would help create momentum behind innovative techniques in construction, which would then drive productivity gains both in the construction industry and in the wider economy. The recommendations are geared towards homebuilding, but there would be wider benefits into other areas using MMC:

1. Overhaul the planning system to boost new construction techniques. The planning system could help urban environments exploit MMC to build the homes that cities need:

- **Accelerated planning applications for MMC projects.** For example, London has introduced a policy to fast-track developments through the planning process if affordable housing is part of the development.[xviii] A similar approach could be adopted for developments that are focused MMC. For example, offering accelerated planning applications for projects that can demonstrate greater, faster, better and greener developments than traditional approaches.
- **Reform green belt restrictions.** The Centre for Cities think tank has recently called for green belt land that is within 1km of train and tube stations and 45 minutes away from Zone 1 in London to be de-restricted so that new homes can be built on them.[xix]

2. Earmark unused or underused urban spaces for pop-up consolidation centres. Temporary "consolidation centres" can help to manage the logistics for a construction project when space is at a premium.[xvii] The centre takes deliveries of materials from supply chains, then distributes them to close-by construction sites. This approach reduces congestion and carbon emissions and allows for a more efficient management of building materials.

Some new working practices will increasingly rely on supply chains the length and breadth of the country, meaning that the logistical challenges could be overcome if options for consolidation centres were sought out. Local government would have a key role in achieving this, by assessing where consolidation centres could be put up within their boundaries. A further step could be central government requiring local government in England to identify suitable locations for consolidation centres in Local Plans.

3. Turbo-charge the Construction Sector Deal. The UK construction industry is eight times the size of the automotive sector. Yet of the £4.7bn Government investment in R&D over the next 4 years, only £170m is dedicated to construction. By contrast, the Automotive Sector Deal has £725m of investment in Industrial Strategy Challenge Fund programmes. To put this another way, Government has a £600bn infrastructure pipeline, but is investing less than 0.03% of that value in R&D. The balance needs to be redressed.[xxv]

The Government should also look at further ways that MMC can be encouraged through their procurement practices.

4. Create a 'Golden Thread' of modern working practices in construction throughout the education system. Whatever the stage of a person's education or career, it is possible for them to learn more about emerging working practices in construction. As such, the concepts of MMC and skills training related to MMC should be embedded in the education system at all levels. Some examples of this are:

- **As part of the school system.** Mace has previously suggested the idea of promoting the construction industry's use of technology in primary and secondary schools to promote construction as an innovative sector.

  The creation of construction clubs could teach children the basics of how buildings are designed and built, and could even include mini construction projects that utilise emerging technologies such as 3D printing.[xx] This would try to replicate the success of Code Club, which teaches school children digital skills.[xxi]
- **As part of Further and Higher Education courses.** Sweeping changes are being made to the post-16 education system. New apprenticeships are being designed and 'T levels' are being introduced.

  The course content of these qualifications – and of degree qualifications – have to reflect the evolution of MMC, which are rapidly changing. At the least, the government should review the course content of construction-related Apprenticeship Standards and T levels at regular intervals.
- **As part of continuous professional development.** The pace of adoption of innovation is hindered by culturally ingrained working practices. It is critical that those that have been working in the industry for a number of years – having learnt their expertise in a different era of construction – keep up-to-date with the latest developments. The recently launched Construction Skills Fund does not appear to cater for this type of upskilling, but consideration should be given to how the fund could be used for it.[xxii]

5. De-risk innovation by expanding state-backed finance schemes. For example, the Home Building Fund is a £3bn pot of money that provides loan funding to support things like development costs and site preparation. This type of fund could be used to support projects using relatively untried and untested techniques. For instance, with relatively untried and untested construction techniques, insurance issues can arise.[xxiv] A state-backed financing scheme could be used to support whole project insurance for major urban developments that act as proof of concepts for future projects.

This would be a similar concept of the products offered by UK Export Finance, which helps protect exporters from risks in trading abroad.

6. Capture data to showcase innovation and unlock productivity. In traditional construction there is a lot of data and information that helps inform people about the cost of projects. New innovations do not have this information. In theory, as more of the benefits of new working practices are recorded – such as higher quality, time-certainty, lower costs – the more likely they will be adopted and used.[xxiii]

The question is: How should data on the benefits of innovations be recorded and published? One approach could be for construction firms to partner with universities to analyse the benefits of construction projects that are utilising new working practices.

7. Enable the construction industry to export innovation. The UK is not alone in having a productivity problem in construction. If the UK gets innovation in construction right then it can export skills and knowledge across the globe, supporting international trade prospects in a post-Brexit world. However, exporting performance in construction has not been positive; as the Construction 2025 strategy stated, the UK:

"…has not yet specialised in construction exports despite its capability in construction technology and services and relatively higher proportion of construction-related patents comparing to its competitors".

The global trend of urbanisation is a huge opportunity to change this poor exporting performance. The Department for International Trade should develop a strategy with the Infrastructure and Projects Authority to understand emerging construction techniques in the UK, with the objective of selling expertise in these techniques around the world. This strategy should include showcasing the UK's innovation in construction, such as the Commonwealth Games in Birmingham in 2022.

CONCLUSION: THE CHAIN REACTION OF MMC

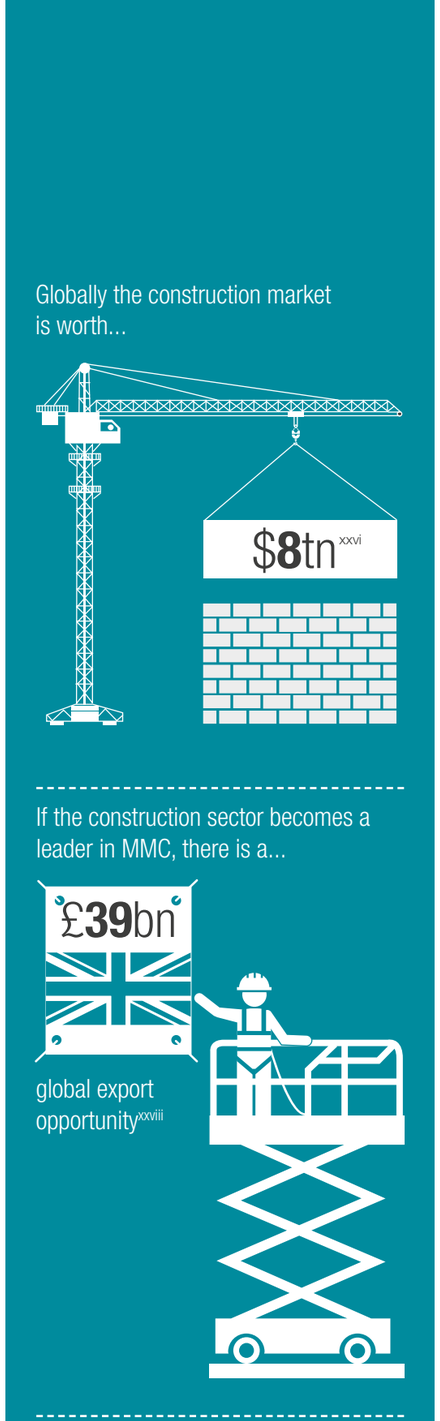
The future housing supply of our cities will be delivered by more than one type of MMC – city living will be revolutionised by a combination of volumetric, platforms (or sub-assemblies) and kit of parts.

While each of these approaches to MMC are different, they will have similar outcomes depending of the density and height of the homes being built. All of the approaches will deliver homes that are better designed and of higher quality. They will be built faster and at lower cost. They will be better for the environment and support home ownership.

But there is much, much more that MMC can achieve. More widespread use of innovative working practices can ignite a chain reaction that begins in the construction industry supply chain, spreads throughout communities, skills profiles and productivity performance and ends with the UK's MMC expertise being sold in every corner of the globe:

- **The supply chain.** The standardisation of construction components means that they can be manufactured anywhere in the country. This means that MMC can transform the geography of construction activity in the UK, and the productivity and profitability of those involved.
- **Communities.** The transformation of the construction supply chain will mean new jobs in new places around the country and regional growth. As has happened in the automotive industry, centres of excellence will develop and flourish, providing new opportunities for people to take advantage of.
- **Skills.** New working practices require people to learn new skills. The education system and the construction industry will have to adapt and evolve to provide these new skills.
- **Productivity.** New skills will build capacity and capability in the construction industry. The same inputs of labour and time will produce more outputs of built assets, creating the step change in productivity that has eluded the construction industry for decades.
- **Exports.** If the UK can become a leader in MMC, there is an enormous opportunity to get a greater share of the $8 trillion[xxvi] global construction market. Countries all over the world will want to buy the knowledge and expertise that the UK has to offer. Our analysis shows that if the UK can become leaders in MMC in the same way the UK automotive sector is world leading, annual construction exports (in services and goods) would increase by £39bn.[xxviii] This chain of events is entirely plausible.

Yet if there is one message that needs to be repeated time and time again, it is that MMC success is not guaranteed. To give success the best possible chance, the construction industry and government both need to be committed to change. If they are not, the MMC revolution will die before it has a chance of beginning.



APPENDIX I – METHODOLOGICAL APPROACH

- The economic analysis in this report uses the geography of a Functional Urban Area (FUA), which represents, "… the wider functional economic area surrounding the core city or greater city based on its commuting zone". These FUAs are defined by grouping local authority geography together.
- The official statistics on dwellings, households and populations have been used to derive a picture of the housing needs of FUAs. Future household and population projections are used to determine housing need. Essentially, the projections were used to answer the question: How many dwellings would need to be built to keep the household/dwelling ratio the same in 20 years' time?
- Using this ratio may underplay how many new dwellings are required over the next two decades. For instance, if there is a housing shortfall now then the number of dwellings needed would be higher. However, the analysis assumes that the population of a city currently has housing.
- To determine the difference between housing demand and housing supply over the next 20 years, current build rates were used. More specifically, the statistics on Net Additional Dwellings were averaged over the last three years to produce an annual build rate. These build rates were then projected forward. Of course, these build rates will have factors that increase them and decrease them in the absence of technology – we assumed these effects cancelled each other out.
- GVA per head statistics to illustrate how housing shortfalls in urban areas would affect economic output in those areas. Productivity statistics were taken from Mace literature on how their methods and techniques affect their productivity.

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