

West Midlands Combined Authority

# Roadmap for Advanced Manufacture in Construction

Draft for Consideration by WMCA Housing and Land Board  
August 2020



# Introduction

WMCA committed to increasing the uptake of advanced construction technologies in WMCA's 2019/2020 Annual Plan, in response to the findings of the Land Commission and Farmer Review which highlighted the role that advanced construction technologies could play in accelerating housing delivery.

This definition has been adopted by the Board, to connect to the West Midlands' rich heritage of manufacturing and innovation, and to signify the standard to which the WMCA should aspire in the future, as part of a number of decisions including supporting the establishment of an AMC Expert Advisory Panel, and the approval of a series of principles to guide the development of an AMC Roadmap for the region.

This draft Roadmap for AMC has been prepared for consideration by the Housing and Land Board following a series of meetings of the Expert Advisory Panel, chaired by Mark Farmer – CEO of Cast Consultancy and MHCLG's champion of modern methods of construction in home building – and of the AMC Working Group, made up of representatives from councils across the WMCA region. Both groups have been supported and enabled by research commissioned to understand and map the current situation in relation to AMC in the region, including auditing the current AMC supply chain "eco-system" in relation, understanding the potential for AMC growth, and developing a picture of the knowledge, skills and training needs for AMC.

The Roadmap distils the information that has been collated and created during this process into a draft, high-level, document for the Board's consideration ahead intended publication in late 2020. It is intended to set the frame for future action in the region, balancing ambition for growth and change with some of the known barriers that still exist and that are set out in the document. In doing so, it seeks to set an appropriate long term, 10-year, vision across a number of strands of activity, and then develops a series of short and medium term steps that could enable that vision to be realised.

This Roadmap will be further developed to incorporate feedback, and as such the Board is asked to consider and comment on this report ahead of final publication.

## CONTENTS

Introduction.....	1
Why change?.....	2
Advance manufacturing in construction.....	3
Delivering in the West Midlands.....	4
The scale of the opportunity .....	5
Building on the West Midlands' unique strengths.....	7
Addressing the barriers and challenges .....	8
Roadmap for advanced manufacture .....	9

## CASE STUDIES

West Midlands Combined Authority & Urban Splash .....	13
Woden Road, Wolverhampton.....	14
National Brownfield Institute.....	15

ACKNOWLEDGEMENTS	16
------------------	----



# Why change?

## Challenges in the construction sector

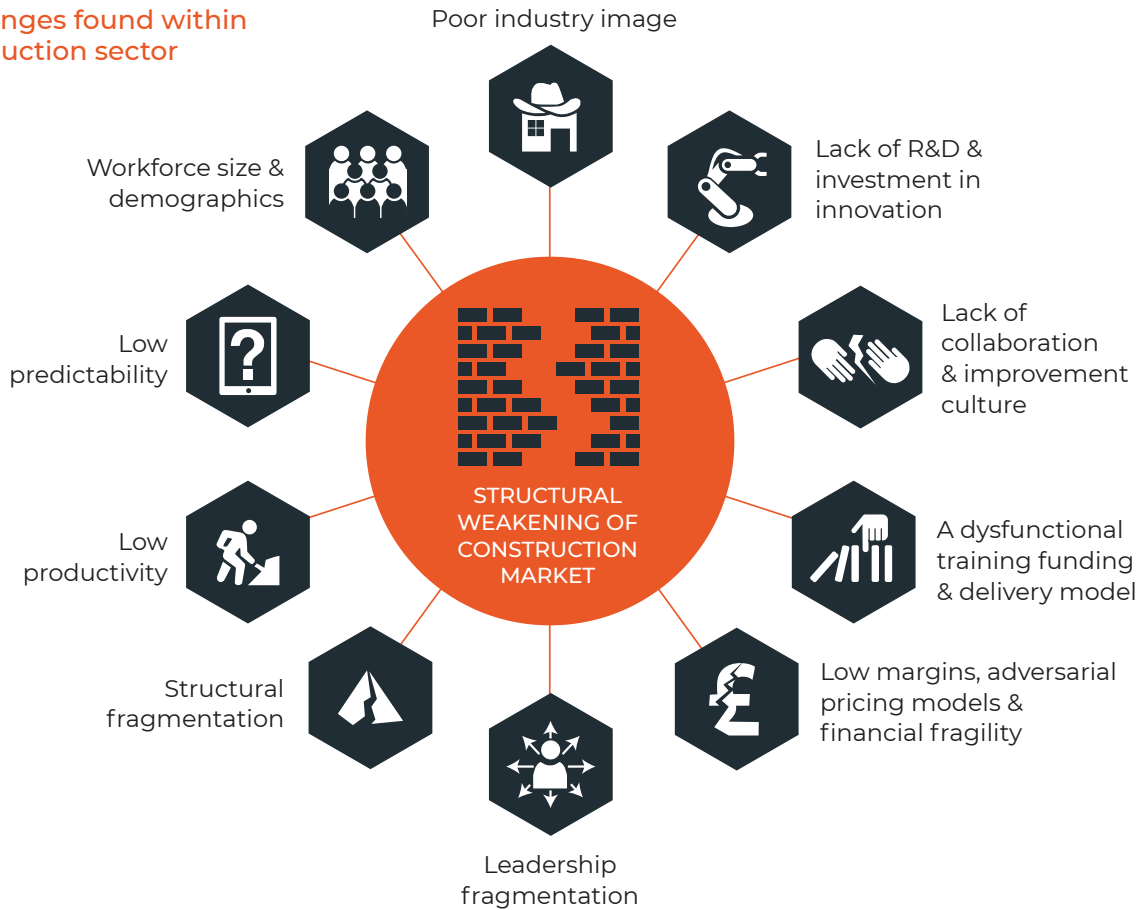
The UK construction and housebuilding sector faces severe structural challenges that act as a drag on productivity and innovation. The resulting impacts range from a sector wide culture of short-termism, to new homes not being seen as consumer products in the same way as other large purchases people make, to being a contributing factor to the UK-wide under supply of new homes relative to housing need.

These challenges impact on the ability of the WM to deliver 215,000 and change is required to achieve the quality, pace and performance in housebuilding that the region needs

“The Government is determined to build a stronger, fairer Britain where people who work hard are able to get on in life...we will diversify the housing market, opening it up to smaller builders and those who embrace innovative and efficient methods.”

– Fixing our Broken Housing Market (2017)

## The challenges found within the construction sector



# Advanced manufacture in construction

## What is AMC?

### Modern Methods of Construction (MMC)

A term defined by MHCLG to cover a broad range of pre-manufacturing techniques in construction. Pre-manufacturing encompasses work executed away from the final workforce including in remote factories, near site or on-site “pop-up” factories. These techniques are alternatives to traditional house building and aim to improve quality, programme efficiency, and reduce material waste in construction. It also includes on site labour productivity measures including digital tools and innovative materials and processes.

### Advanced Manufacture in Construction (AMC)

A term which covers a sub-set of the technologies described as MMC. AMC techniques are typified by the fundamental use of digital technology throughout the process, from design through to component manufacture and assembly, and the use of automation and high-performance materials where appropriate to drive quality, performance and mass-customisation through standardised processes. AMC techniques will also learn from, adopt and evolve manufacturing processes already established in other sectors.

## The potential benefits of AMC over the long term include:



Financial benefits with increased speed in construction



Tackling the skills shortage by changing workforce needs



Reducing cost and improving site efficiencies



Making offsite homes a viable alternative through mass production



Benefit the Zero Carbon agenda by reducing construction waste



Achieve a fast weathertight envelope



Improving health & safety with increased oversight



Future proofing skills and jobs using technology



Assisting a national, economic & industrial strategy



Making the sector attractive to a more diverse workforce





# Delivering in the West Midlands

While AMC has significant potential to drive a range of long term benefits to the construction sector by focussing on growing AMC use around the West Midlands, we see considerable wider benefits to the region. Specifically, AMC can supporting four of our existing policy goals for sustainable and inclusive manner growth:

## Accelerating housing delivery:

WMCA's housing trajectory aims to increase annual housing completions to nearly 18,000 homes per year by 2031. We have a good track record of delivery, with more than 16,000 homes delivered in 2019, up 15% on the previous year, but nonetheless need to maintain and expand upon this level of delivery to maintain the trajectory we need to achieve. In addition, fully 80% of the homes in our trajectory will be built on brownfield land, requiring potentially length remediation ahead of construction.

AMC offers a number of potential solutions – the increased speed of delivery on-site, compared to traditional methods, can offer a partial balance to the time taken on remediation for instance, and specialist MMC developers can offer additionality in new supply to augment the output of other methods of construction.

## Investing in regional and inclusive growth:

The WMCA approach to social value recognises the importance of local businesses within our communities in terms of job creation and wealth generation. We are committed to ensuring local businesses are provided with the skills to compete and offered the opportunity to work within our supply chain. We are also committed to promoting growth and development that ensures our communities develop new skills and gain meaningful employment.

AMC represents a significant growth opportunity for the UK and we are committed to securing the West Midland's share of that opportunity by utilising and growing our manufacturing base to supply our housing need. We also advocate collaboration between WMCA and other authorities around the country to support for our businesses to take advantage of the national growth trend, and not rely solely on demand from our region.

## Delivering a zero-carbon future:

In June 2019, WMCA declared a climate emergency, and has set a challenging 80-year carbon budget. As a region, we have committed to taking urgent action to cut harmful emissions, but the impacts of climate change are already being felt and will continue to impact upon the health and wellbeing of our residents and natural resources.

To ensure it contributes its part to the Paris Agreement, WMCA has agreed net zero carbon emissions by 2041. Advanced manufacture in construction, in controlled conditions, offers great potential to move towards carbon neutral homes. AMC processes minimise construction waste, achieve very high standards of in-use energy performance, and can minimise construction vehicle movements, with follow-on air quality benefits. By committing to AMC in new homes, WMCA and partners will be making a conscious and proactive step towards achieving its zero-carbon ambitions.

## Design that reflects the character, context, and aspirations of our communities:

The West Midlands is a diverse region with a distinctive set of places all sat within a landscape of high-quality natural environments, an extensive river and canal network and a unique geological heritage. It is also a region in renaissance – unprecedented levels of investment and development over the next decade will shape the way our residents live and work for years to come. The opportunity is one to seize; setting a new benchmark for what 'great places' mean now will enable our residents to prosper, our communities to thrive and our businesses to grow.

Great design can have a huge and positive impact on the quality of life and wellbeing, and we see advanced manufacture in construction as a key enabler in making that vision a reality. We want to harness the opportunity that manufacture brings to create a product-led mindset, championing high-quality, design flexibility and consumer choice.

# The scale of the opportunity

In developing this Roadmap, we have analysed the current output of the AMC sector across the UK, focussing in particular on MMC category one 3D volumetric solutions and on MMC category two 2D panellised solutions, which are currently the two solutions in focus with the WMCA, as both are now required on 200+ home sites funded by the SCF. The two figures opposite demonstrate the outcome of this analysis, and map that against the UK-wide housing need that has been stated by the Government.

Figure 1 shows that there were approximately 44,000 new homes delivered using volumetric and panelised solutions last year, with the vast majority of these utilising a panellised approach. Our analysis has identified that volumetric providers currently have significant capacity within their existing manufacturing base, which would allow for the production of 15,000 homes from current facilities. Using this, and drawing in other industry forecasts, we estimate that the number of homes developed using these two systems could more than double in the coming ten years, from 44,000 to more than 100,000 annually.

As shown in Figure 2, even at 100,000 new homes annually from these two types of AMC, there would still be significant scope for growth within traditional methods of delivery before AMC started to replace traditional construction, if the UK is to hit the 300,000 home per year target.

AMC, therefore, is clearly a sector with significant growth potential, and the opportunity to provide additional housing supply rather than necessarily competing with traditional construction methods.

By way of comparison, our work has estimated that the WM AMC sector has capacity to deliver around 4,500 new homes using AMC today – roughly 10% of the UK-wide output – and that presently it is delivering around 2,000 to 2,500 homes per year from that capacity. Approximately 12,000 homes per year have been delivered, on average, over the past seven years in the region and so this level of output is equivalent to approximately one in six of every new homes in the region, although of course much of the AMC output could have been exported out of the region.

WMCA's housing trajectory shows that the current 12,000 home per year average needs to increase to nearly 18,000 homes per year by 2031, and so were the sector in the region to double its output, to 5,000 homes per year, it could do so and not replace traditional construction on the assumption that the 18,000 home target is met and traditional construction remains stable.



### National growth potential for MMC

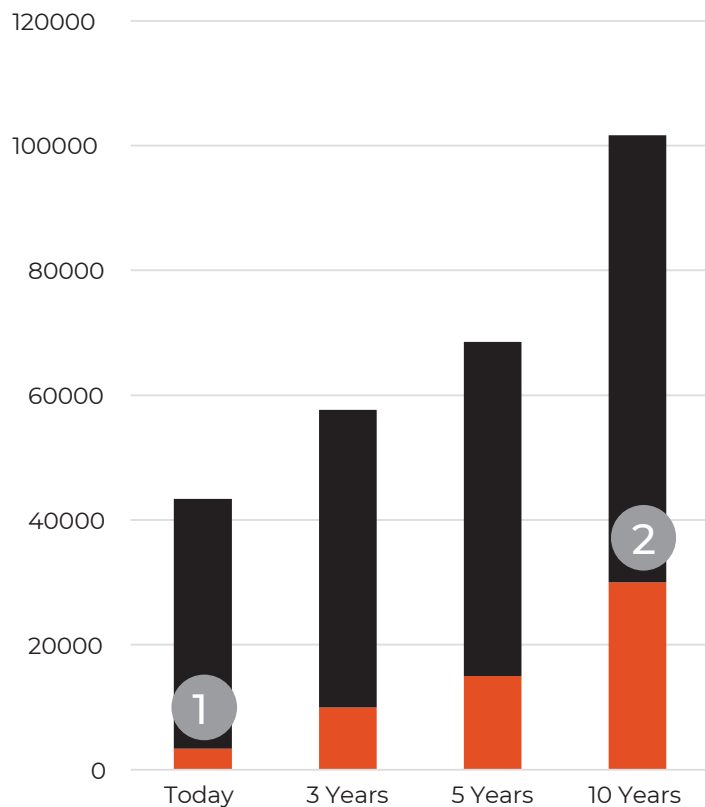


Figure 1 ■ Volumetric ■ Panelised

### Building capacity for a growing housebuilding sector

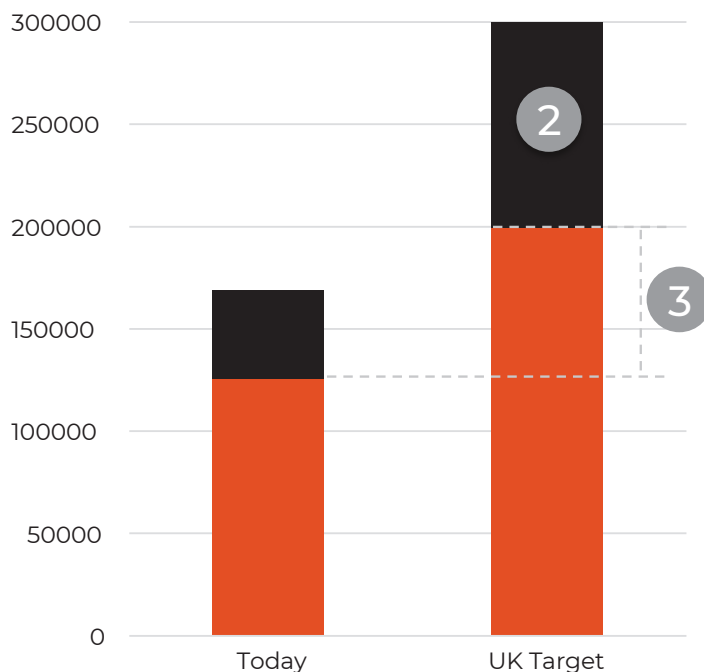


Figure 2 ■ Other Housebuilding ■ MMC

1

3,300 volumetric & 40,000 panelised homes in 2019

2

30,000 volumetric homes & 71,000 panelised homes by 2029

3

Further 70,000 homes opportunity before MMC replaces traditional construction output

# Building on the West Midlands' unique strengths

The WM is uniquely well placed to take a leading role in the introduction of pre-manufacture, and especially advanced manufacture, into the construction sector.

The strengths and opportunities set out opposite provide the region with an excellent foundation on which to build its roadmap for the next decade of AMC investment.

## WM economy and construction sector

- WM has a high value construction sector relative to comparator regions, employing 55,000 people across 10,300 businesses.
- There are signs of an advanced manufacture cluster forming in the region, particularly in the Black Country – there are already 58,000 jobs across 1,900 businesses and this has the potential to drive upstream activity for AMC.
- WM has a notable concentration of AMC-related activities – 44 companies in a range of sectors including renewables, sustainability, logistics and supply chain, represents a concentration of nearly three times the national average.

## AMC sector

- WM is one of the key hubs of AMC nationally, underpinned by strong advanced manufacture capability and transport infrastructure.
- Nine Tier 1 AMC residential manufacturers are located within the region, and are committed to capacity building within the local supply chain.
- There is already a strong supply chain which could be equipped to diversify its offering to support growing AMC capability and capacity.
- There is an opportunity to develop the AMC sector as a nationally leading “vanguard” to bring together manufacturing and construction and also to balance negative structural changes in other sectors such as automotive.

## Policy environment

- WMCA has signalled support for AMC through a commitment to deliver at least 20% AMC on any site funded by the strategic commissioning fund of 200 homes or more.
- Nationally significant partnership commitment to deliver 10,000 AMC homes with national developer/manufacturer Urban Splash.

## R&D, skills and qualifications

- WM is home to a uniquely relevant collection of R&D and HEFE institutions which are clear assets in support of AMC including the MTC and Wolverhampton, Coventry and Birmingham City Universities.
- The WMCA has a legacy of skills in manufacturing and innovation, with key actors in a position to drive the agenda forward, including WMCA Skills Board/West Midlands Skills Advisory Panel.
- Dudley College is the national exemplar in AMC skills delivery and is already exporting programmes nationally, and other UK-leading training partnerships include those between MOBIE and the HEFE sector.
- There is a strong policy focus on investment in STEM skills and boosting productivity. The opportunity is for the growth of new technologies acting as a catalyst for digital skills in construction which can become a specialism for the WM economy.







# Addressing the barriers and challenges

While there are a unique combination of strengths and opportunities, these need to be balanced against a series of barriers and challenges which will need to be addressed in order to maximise the impact of investment and growth in the AMC sector.

A number of these are UK-wide challenges which WMCA and partners will not be able to address alone, but nonetheless they are included here as they will inform the pace and focus of the 10 year roadmap.

## WM economy and construction sector

- There has been recent decline in the region's construction sector, from nearly 60,000 jobs in 2015 to 55,000 today.
- The WM construction economy is less productive than comparator regions and the national average, with output per full time employee of £67.6k in WM compared to £78.5k nationally.

## AMC sector

- UK-wide, the AMC sector is still relatively young, and is made up of a number of emerging manufacturers with varying levels of capacity and experience.
- AMC can present challenges in relation to funding, insurance and warranty. UK-wide efforts including an MHCLG working group are addressing these, and there have been recent positive changes as a result including NHBC's new "NHBC Accepts" route for AMC products, but nonetheless these challenges need to be recognised.
- UK-wide, there has been a relatively large investment into productive capacity, a large proportion of which is currently unutilised. Similarly, the WM AMC sector is currently estimated to be operating at c50% of capacity.
- Sustainable growth of the sector will require intelligent commissioning practice, smarter procurement models and likely will require demand growth to run slightly ahead of manufacturing growth in the medium term.
- The WM AMC sector is made up of manufacturers of a range of sizes, and a key challenge is to ensure the growth of SME manufacturers as part of a varied production economy.

## Capital cost, procurement and process

- Given the young nature of the sector and lack of scale economies, AMC products can be more expensive in terms of initial capital expenditure on a like-for-like basis compared to traditional house building.
- The full value of AMC-led development requires a different procurement approach from the start, for clients and commissioners to adopt a design for manufacture approach from the outset and to engage manufacturers early to maximise the benefit of manufacturing efficiencies.
- The challenge for the WM in maximising the use and value of AMC is to develop approaches to development process and procurement that better enable AMC. These will include balanced scorecard procurement models that prioritise the total cost of ownership on an equal basis to up front capital cost.

## AMC skills and jobs development

- There is a need to balance UK-wide growth of AMC with benefits to the WM regional economy. There needs to be a joined up approach to demand and supply planning to ensure WM plans are integrated into the national picture as far as possible to avoid 'cannibalising' markets.
- Relevant training provision for AMC is limited UK-wide. Only 82 qualifications have potential relevance and two qualifications in Innovative/MMC were withdrawn due to lack of take up.



# Roadmap for advanced manufacture

## LONG TERM VISION (10 year objectives)

## SHORT TERM ACTIONS (practical steps for years 1-3)



### ACCELERATED HOUSING DELIVERY

AMC drives scale and pace in housing delivery across the WM. Integrated AMC-specific developers create additional supply models, while AMC plus brownfield remediation unlocks land that would otherwise be unviable to deliver. "Traditional" construction delivery models can incorporate hybrid on-site AMC approaches to improve speed, quality, productivity, and worker safety.

- Implement 20% minimum AMC categories 1 & 2 on large sites.
- Explore measures of pre-manufactured value (PMV) as recommended by the Construction Leadership Council, as the basis for providing additional funding for projects that can demonstrate an uplift in PMV, across all seven categories of MMC.
- Develop appraisal/funding methodology to enable additional funding where AMC proportion is increased.
- Explore use of Value Tool as being developed by Construction Innovation Hub (CIH).
- Identify and aggregate land assets that might enable 100% AMC housing delivery to create scale and momentum.
- Engage and support AMC-led integrated developers which might create true additionality in supply and diversify the housing market.



### QUALITY AND CHOICE IN NEW HOMES

Advanced manufacture combines standardised processes with both standardised and customisable products to improve consumer choice. Digitally enabled development creates a golden thread for quality and components from conception through assembly to in-use performance monitoring. Advanced materials and design enable WM to achieve carbon zero objectives in new home delivery.

Bring together architects, planning professionals and manufacturers to develop a programme of design-quality led AMC product development. Focus areas could include:

- Enabling a standard specification for AMC from public sector clients and drive use of Construction Quality Planning (CQP) as defined by Construction Innovation Hub (CIH).
- Design code approaches to planning that enable consumer choices around a standardised "chassis" that might link to an accelerated 'type approval' process linked to pattern books.
- Develop a strategy connecting AMC to the proposed planning reforms.



### ADVANCED MANUFACTURE GROWTH

The regional manufacturing sector is the leading location for AMC manufacturing in a now-significant UK-wide industry. Existing manufacturers, including SMEs, play a significant role as part of this sector, alongside new entrants who have been deliberately attracted to the WM. All AMC categories are represented, to enable agility and flexibility in delivery models.

- Play an enabling role across the wider public sector in the WM region to create a transparent and aggregated future pipeline of AMC development land, and use this to support the managed growth of the existing manufacturing sector.
- Secure Government investment and identify land for an expansion of manufacturing capacity in the region ensuring that this is complementary to existing capacity and focuses on consolidation and additionality.
- Begin to explore options for aggregated models of delivery that could be enabled by interoperability between AMC systems (see below).



## MEDIUM TERM ACTIONS (practical steps for years 4-10)

- Expand focus on AMC by encouraging other AMC categories through SCF funding – encouraging AMC as part of hybrid traditional/manufacturing-led development.
- Deliver aggregated public land pipelines (see below) as part of programmatic approach that creates certainty for sector and scale and pace in delivery.
- Identify opportunities for AMC and brownfield remediation to combine with new appraisal methodology to unlock unviable sites.

- Develop structured partnerships with AMC manufacturers around a common specification for new homes and transparency of future pipeline.
- Build on the initial steps (left) by:
  - creating incentives for manufacturers to improve on that standard in relation to e.g. quality, cost or carbon performance.
  - connecting these partnerships with the R&D theme below to explore for instance advanced material use and structured performance testing to enable co-ordinated product development.
- There is great scope for proposed planning reforms focussed on digitised planning process to benefit AMC-led development because they incorporate digital design from initiation and are therefore better placed to integrate their current approach with new digital planning processes. This workstream could also ensure adequate planner education and awareness of AMC.

Utilise the expanded AMC focus of WMCA funding (above) and the previously developed options to implement an aggregated approach to AMC delivery that might incorporate the following features:

- Co-location of SME manufacturers.
- A move to more of a platform-based approach to delivery which does not damage previous investments made by high quality offsite manufacturing businesses with a promotion of more inter-operability between providers, drawing on the work of MTC.
- A greater focus on component-led sub-assembly delivery as additionality to volumetric modular AMC, which would still be delivered by larger Cat 1 manufacturer/ developers.

## LONG TERM VISION (10 year objectives)

## SHORT TERM ACTIONS (practical steps for years 1-3)



### SUPPLY CHAIN ENGAGEMENT

The wider supply chain base in the WM grows in parallel with the manufacturing base. Component and material specialists form strategic partnerships with AMC manufacturers UK-wide. There is clarity of the end-to-end supply chain incorporating design through to operation and WM enjoys a specialism in supplying those services to digitally enabled AMC developments. There is increased 'virtual' integration of multiple businesses, including SMEs and products that are consolidated into sub-assemblies and building systems that can be used by SME developers and larger developers and contractors.

- Explore co-location for regional SME manufacturers and supply chain companies single new facility above.
- Develop a comprehensive map of local supply chain capacity linked to the standardised specification referenced above.
- Broker collaborative partnerships between supply chain companies and AMC manufacturers and potential for aggregation of ordering combined between manufacturers.
- Develop a collaborative forum between AMC manufacturers and potential commissioners of AMC homes in the public, private and housing association sectors to provide an opportunity to build knowledge, connections, trust and understanding.
- Engage the local AMC supply chain in the emerging programme of retrofit, as AMC solutions (across all categories) will be very well positioned to drive the speed and efficiency of activity in this area.



### KNOWLEDGE AND SKILLS DEVELOPMENT

The WM retains its stand-out strength in delivering industry-leading pathways to employment in AMC through partnerships between industry, further education and higher education. Partnerships across the region bridge the gap between construction and manufacturing, to develop new roles that operate at the interface between the sectors. End-to-end digital delivery knowledge and skills requirements are well understood and provided for.

- Develop a comprehensive AMC skills proposition, drawing on existing strengths, that offers a qualifications at all levels from level 2 to post-graduate.
- Map the end-to-end AMC delivery process, and the digital skills requirements at each stage, and develop action plans to address core teaching skills and curriculum coverage gaps, for instance through additional funding for tutor recruitment.



### R&D PARTNERSHIPS BETWEEN GOVERNMENT, INDUSTRY AND HIGHER EDUCATION

R&D partnerships make a significant contribution to national and regional AMC growth by tackling some of the biggest barriers to AMC growth. For instance R&D partnership to enable interoperability between AMC systems, developing a robust evidence base and showcasing "best in class" AMC development, and supporting AMC product development through testing, advanced materials development and by enabling consumer feedback to influence design. This should align to national initiatives to improve the data and evidence base related to innovative construction and should build confidence in the finance and insurance underwriting markets. New entrants and SMEs are actively encouraged into the regional AMC sector to drive innovation and introduce new approaches.

- Develop a forum or partnership vehicle through which cross-sector links and delivery can be enabled – potentially by maintaining the AMC advisory group
- Key focus areas in the short term could include:
  - Building the evidence base for AMC development, including by linking to Homes England existing work in that regard.
  - Supporting the development, testing and optimisation of the standardised AMC specification.
  - Enabling pre-competitive collaboration between manufacturers, and connecting to national efforts in that regard such as through the MTC at Coventry or the AMRC in Sheffield, both part of the High Value Manufacturing Catapult.
- Connecting the WMCA and partners to the AMC-related activities being undertaken across the UK, particularly in other combined authority regions, to maximise collaboration, value and growth in the AMC sector UK-wide.
- Explore and support opportunities to develop high-profile sites and other projects which will generate national interest and enable local manufacturers to demonstrate their systems to the widest possible audience.



## MEDIUM TERM ACTIONS (practical steps for years 4-10)

- Develop bespoke partnerships with supply chain companies where necessary to enable their expansion to meet the demands of a growing AMC market.
  - Broker collaborative partnerships between supply chain companies and AMC manufacturers to enable component design and development to support AMC product development.
  - Focus support and effort on models with the greatest potential for scalability, across the WM and beyond including the potential for IP technology transfer domestically and internationally.
- 
- Implement WM-wide approaches to apprentice and trainee sharing/placements between AMC manufacturers.
  - Target AMC training pathways on other WM-based sectors under-going structural .
  - Broker partnership working between CITB, local FE colleges, local universities and the MTC designed to break down the barriers between manufacturing and construction skills training.
- 
- Long term programme to be developed through the forum (left) and the outputs of early stages, but features could include:
    - Developing connections between AMC and the WM specialism in brownfield regeneration, to create true additionality in housing supply including links to the proposed National Brownfield Institute.
    - Connecting WM manufacturers to developments in advanced materials research, where this might drive improvements in cost, speed, performance and sustainability.



# West Midlands Combined Authority & Urban Splash: A memorandum of understanding

WMCA and Urban Splash have established a long-term partnership commitment, which is codified in a Memorandum of Understanding (MOU) and which supports the ambition for House by Urban Splash to deliver 10,000 homes by 2031 - 5% of the WMCA overall housing target, including on the *Port Loop* urban regeneration masterplan, pictured.

The MOU sets out *House by Urban Splash's* commitment to AMC as a default construction approach. *House by Urban Splash* has made significant investment into AMC since 2012, including establishing a factory in Alfreton, East Midlands. The MOU and the developments it will lead to are evidence that the vision of this Roadmap is already translating into real, practical delivery.





## Woden Road, Wolverhampton

This development at Woden Road in Wolverhampton is just one of many high-quality and highly-sustainable developments to have been manufactured and assembled by West Midlands based LoCaL Homes, part of the Accord Group.

Woden Road consists of 91 houses and 21 apartments, all of which were constructed using LoCaL's *Eco 200* system at its factory near Walsall before being assembled on site. The project achieved outstanding speed of delivery – with 86 of the homes built in 86 days – excellent environmental and energy performance, and fantastic value for money with all above ground works being completed for less than £1,000 per square metre.





## National Brownfield Institute

University of Wolverhampton (UoW) has invested £100 million in the new Springfield campus, to host its world-class school of Architecture and Built Environment and the planned National Brownfield Institute (NBI), which was recently awarded £14.8759m from the Government's Getting Building Fund.

The NBI will research soil and groundwater contamination and ways of regenerating contaminated land. NBI will also use knowledge from other research centres at UoW to help assess new construction methods and will enable AMC use in the region in a range of ways, including by coordinating research into new remediation technologies. It will advocate for AMC use as the additional speed of delivery will partly counteract the time required for brownfield remediation, a crucial factor as around 80% of the WM housing pipeline is on brownfield land.



# Acknowledgements







