West Midlands Combined Authority

A Strategy for Advanced Manufacture in Construction

Draft for Consideration by the WMCA Housing & Land Board

October 2020

Cast

West Midlands Combined Authority

Introduction

An introduction will be included here after the Housing & Land Board has reviewed the final draft.

CONTENTS

CASE STUDIES

Why change?

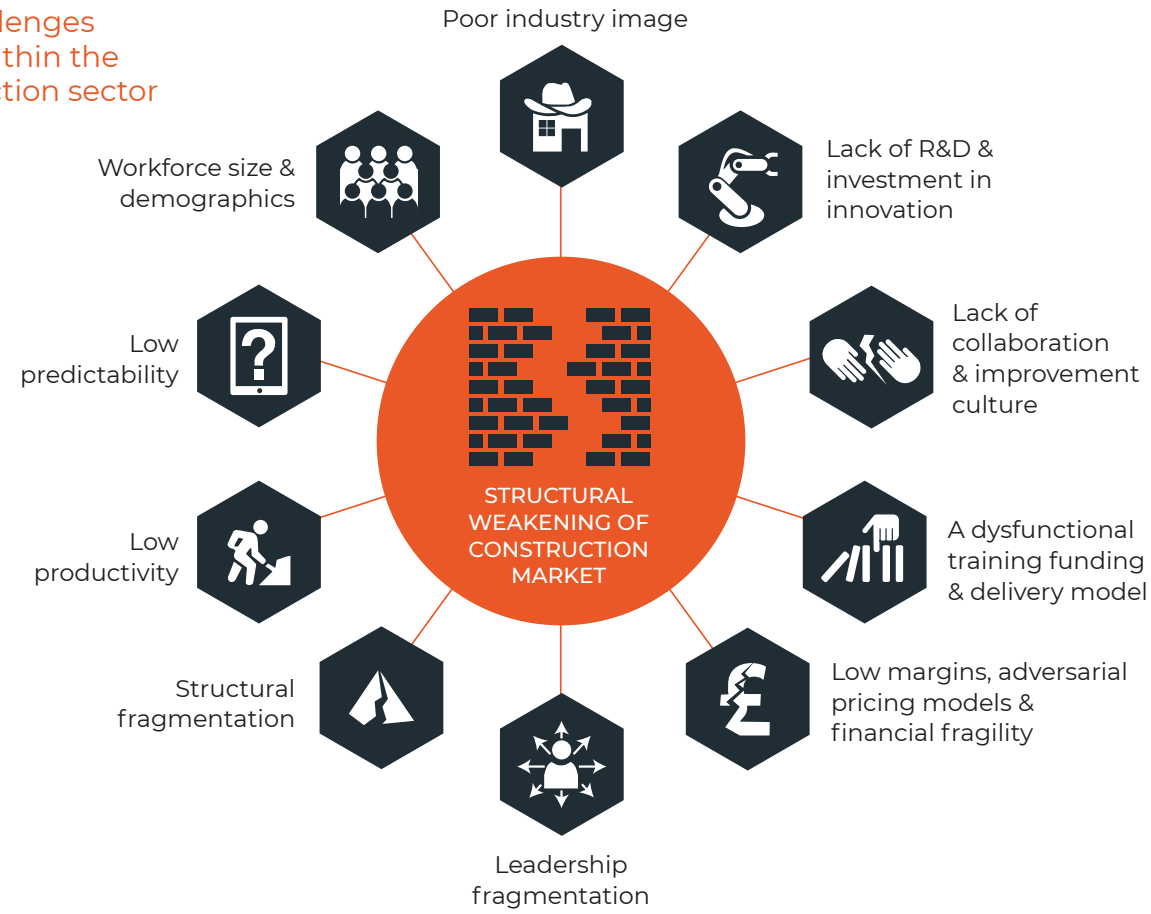
Challenges in the construction sector

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 workface 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. Manufactured components and homes that are created in clean and dry factory conditions also create much greater predictability for build programmes and avoid the worst of the seasonality issues that affect traditional construction, which is particularly beneficial for the delivery of new affordable homes.

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 better homes, 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.

Figure 1
National growth potential for MMC

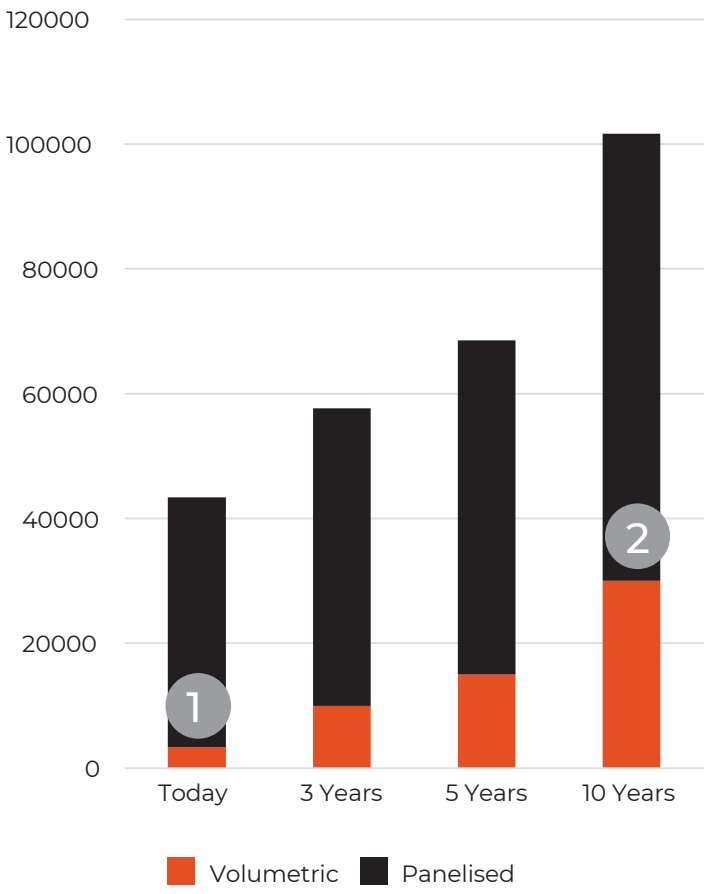
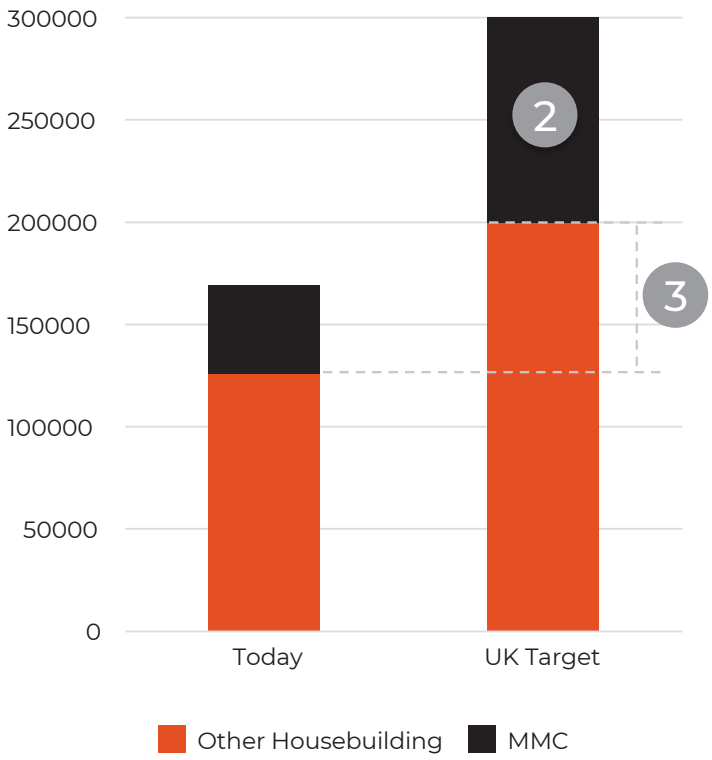


Figure 2
Building capacity for a growing housebuilding sector



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

Understanding the economic MMC opportunity in WMCA

In partnership with

HATCH REGENERIS

Much has been made about the novel nature of MMC and how it can be used as a key pillar to tackle the UK's housing crisis. There has however, been limited insight on the economic opportunity that MMC presents. This section explores the nature of this economic opportunity, reflecting both the current picture of MMC nationally and within the West Midlands Combined Authority (WMCA). Consideration is also given to the national growth potential of MMC and what this could mean for WMCA economically speaking if it were to seize the opportunity that emerges. In this chapter we use the broader MMC term to frame our research, in order to understand the long term potential of all aspects of the MMC definition framework.

Strategic significance

In order to understand the specific opportunity that MMC presents to WMCA, a consideration of the wider strategic significance of the sector is required. To this end, this section provides a wider framing of the national priorities of MMC and more broadly how MMC can deliver economic value.

The national challenge

The construction sector is a significant component of the UK economy

The construction sector in the UK represents around 6 per cent GDP and 10 per cent employment with an estimated £150 billion invested through public and private sectors[1].

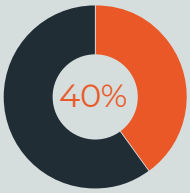
Construction productivity is lagging

In the past two decades, productivity growth in the construction sector stood at just 10 per cent, compared to 20 per cent across the economy as a whole and 65 per cent in the manufacturing sector[2].

Enhancing the pace of house building is essential

The Housing White Paper entitled *Fixing our broken housing market* published by the government in 2017 listed three main challenges facing the housing market:

- Over 40 per cent of local planning authorities do not have a plan that meets the projected growth in their area
- The pace of development is too slow
- The very structure of the housing market makes it harder to increase supply



The government has committed to resolving these challenges through the introduction of more efficient methods.

The built environment is significant generator of carbon emissions – 45% of total UK carbon emissions derive from the construction, operation and maintenance of the built environment[3]. There is a clear and urgent need to develop more advanced construction models that can deliver better performing homes more quickly than traditional models.

1 RICS: "Policy position statement: Modern Methods of Construction". https://www.rics.org/uk/news-insight/latest-news/press/press-releases/modern-methods-of-construction/

2 Infrastructure and Projects Authority: "Transforming Infrastructure Performance". https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664920/transforming_infrastructure_performance_web.pdf

3 The Royal Academy of Engineering: "Engineering a low carbon built environment". https://www.raeng.org.uk/publications/reports/ engineering-a-low-carbon-built-environment

The economic value of MMC

MMC accelerates the pace of housing delivery

A report by the National Audit Office found that using new methods of construction could reduce construction time by more than half, and enable up to four times as many homes to be built with the same on-site labour[4]. The potential for acceleration of housing delivery provides additional benefits related to the time preference of economic impacts (where future impacts are discounted at 3.5% a year – in line with Treasury Green Book guidance).

MMC can enhance the density of housing

The potential for high density housing constructed by MMC is rapidly being realised. In London, two towers which are to break the record for tallest modular building are approaching completion. The 44 and 38-storey residential towers at 101 George Street, Croydon will have been built in around 24 months and half the time of traditional methods[5]. Nearby, planning permission has also been granted for a further two towers which will again break the record for tallest modular building, including a 930-unit co-living tower[6].

MMC is a driver of productivity

Various studies have emphasised the productivity benefits that MMC can deliver[7]. The MMC process is typically more capital intensive than traditional house building, and the off-site nature of building can allow for a greater specialisation of roles – by adopting factory style manufacturing practices

MMC can generate significant carbon savings

Evidence from Arcadis suggests the higher environmental performance of MMC has the potential to reduce energy bills from average £800 per annum to circa £300-400 per annum. This is equivalent to reducing energy usage by 3,200 kWh per home per year by conservative estimates. These savings are able to be monetised and represent both significant economic value as well as notable savings to homeowners.

Alignment with economic priorities of WMCA

The value of MMC within the WMCA is both strategically and economically significant. At the same time the WMCA faces both productivity and housing challenges, in addition to the challenge of sustainable economic development of the region within the context of twenty-first century climate change.

Housing

The Strategic Economic Plan estimates that to accommodate a growing population of an additional 500,000 people, the West Midlands housing stock will need to increase by an additional net 215,000 homes by 2031. This target is equivalent to around 24% of the West Midlands total dwelling stock[8].

Please can we change the first sentence to the following: The Government backed Housing Deal securing in March 2018 supports the delivery of these 215,000 homes by 2031, with annual delivery required to rise to nearly 18,000 homes per year by that time. The West Midlands has a good track record of delivery, with more than 16,000 homes delivered in 2019, up 15% on the previous year, and AMC represents a significant potential enabler to achieve this higher annual output in ten years time[9]. The establishment of a long-term partnership with Homes England aims to support this housing deal through initiatives including the exploration of the potential for Modern Methods of Construction and other innovative opportunities within the West Midlands.

4 National Audit Office: "Using modern methods of construction to build homes more quickly and efficiently". https://www.nao.org.uk/wp-content/uploads/2005/11/mmc.pdf
5 Centre for London: "Made for London: Realising the Potential of Modern Methods of Construction". https://www.centreforlondon.org/wp-content/uploads/2018/09/Centre-for-London-Made-in-London.pdf
6 Planning Resource: "Croydon approves 49-storey 950-unit modular co-living scheme". https://www.planningresource.co.uk/article/1675633/croydon-approves-49-storey-950-unit-modular-co-living-scheme
7 Modern Methods of Construction – Introducing the MMC Definition Framework https://www.buildoffsite.com/content/uploads/2019/04/MMC-I-Pad-base_GOVUK-FINAL_SECURE-1.pdf
8 Subnational dwelling stock by tenure estimates, ONS, 2019. https://www.ons.gov.uk/peoplepopulationandcommunity/housing/datasets/subnationaldwellingstockbytenureestimates
9 West Midlands housing package. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/689710/W_Mids_overview.pdf

The West Midlands became the first region to re-define and introduce a localised definition of affordable housing that links the definition to the real-world incomes of people in the area, rather than local house prices.

The West Midlands built almost 17,000 properties in 2018/19 which represents a rise of 15% from the previous year and double the UK average increase[10].

Productivity

Construction is identified as a key sector strength within the West Midlands Local Industrial Strategy, with a specific focus on offsite modern manufacturing and land remediation[11]. Creative content, techniques and technologies is identified as a new market opportunity and includes the modular construction of high quality, low energy homes as a sector worth £2-3bn per year in the UK, with modular build growing by 25 per cent per year.

Major investments in the region such as HS2 and accelerated housebuilding are to be supported by the Construction Gateway skills programme which seeks to ensure that the demand for construction jobs within the region is met.

Local actions of the LIS include supporting new entrants to the market to support the increased delivery of housing such as through modular housing, and to work with the sector to enhance process innovation via modern methods of construction.

The WMCA Construction Action Plan Draft, published in May 2019, identifies construction as a significant part of the local economy and major employer of almost 200,000 people within the WMCA area[12]. Offsite construction already represents **over 15% of total construction sector output in the West Midlands**, with significant future growth expected, including the West Midlands ambition of delivering 25% of homes through advanced methods of construction (AMC) by the early 2020s and the majority of delivery by 2031.

While existing strong advanced manufacturing capabilities across the WMCA can assist in developing a world class offsite manufacturing capability, the Draft Plan highlights a lack of offsite training provision as one of the biggest potential challenges to exploiting the growth of offsite construction within the region.

The West Midlands Strategic Economic Plan highlights housing as a priority action which will be supported by a range of initiatives, most relevant which include the support of local off-site construction, supporting SME housebuilders and supporting the development of low carbon and zero carbon homes[13].

Climate emergency

The WMCA declared a climate emergency in June 2019[14] and the Combined Authority is working towards becoming carbon neutral by 2041, as outlined in the WM2041 green paper in January 2020[15].

Under 'we will create places and connections that help us to meet the climate challenge', all new build infrastructure is to be constructed thoughtfully and energy efficient, in order to achieve the ambitious 215,000 homes to be built by 2031. The emissions associated with construction and new homes could add £100-£300m to annual regional energy spending at current prices. With this in mind, ensuring new homes are zero carbon will provide both an economic and environmental boost to the region.

WMCA are developing a routemap for delivering zero carbon homes by 2025, with a focus on operational carbon in the short term and embodied carbon in the medium term.

10 West Midlands Combined Authority: "West Midlands becomes first region to re-define 'affordable housing'." https://www.wmca.org.uk/news/west-midlands-becomes-first-region-to-re-define-affordable-housing/
11 West Midlands Local Industrial Strategy. https://www.wmca.org.uk/media/3094/west-midlands-local-industrial-strategy-single-page.pdf
12 WMCA Construction Sector Action Plan Draft. https://www.blackcountrylep.co.uk/upload/files/Industrial%20Strategy/WMCA%20Construction%20Action%20Plan%20May%202019%20(002).pdf
13 West Midlands Combined Authority Strategic Economic Plan. https://www.wmca.org.uk/media/1382/full-sep-document.pdf
14 West Midlands Combined Authority: "Climate Public Engagement". https://beta.wmca.org.uk/the-mayor/climate-public-engagement/
15 West Midlands Combined Authority: "Zero carbon WM by 2041" https://www.wmca.org.uk/media/3639/wm2041-final.pdf?_ga=2.125254154.1070291611.1597070437-1251179460.1597070437

Approach

Determining the scale of the MMC opportunity

To understand the scale of the sector nationally a desk-based review of MMC literature and engagement with industry experts has been undertaken to determine the scale of MMC delivery at present as well as future growth scenarios. These have been applied to MHCLG house building data to establish levels of MMC delivery.

Through engaging with MMC manufacturers a determination of employees relative to housing output has been established, which has been applied to the national picture to gather a high level estimation of employment. Jobs figures have been applied to GVA per FTE data from the ONS to determine what the level of economic output currently is and could be if MMC growth reached the levels anticipated.

To establish what this could mean for WMCA, a series of notional statements have been tested. These include WMCA securing a certain proportion of the national MMC growth and what this could mean in economic terms.

Understanding WMCA's relative MMC proposition

To derive a relative understanding of the MMC proportion in WMCA relative to other locations a scan of other prominent MMC locations has been undertaken to determine the sector's:

- Scale
- Specialisation
- Distinctiveness

To do this, data has been drawn from an array of public and private datasets.

Here, ONS data of the broad construction sector is used to understand the scale of opportunity for AMC to grow and support the wider construction sector regionally. As the construction sector definition does not allow for a determination of MMC activity, this has been supplemented with an additional approach. Here, a manual interrogation of WMCA scraped web data from Glass.ai has been undertaken to get a better understanding of MMC beyond the stringent SIC Code definition of construction

To understand the relative scale and distinctiveness of WMCA as an MMC location, a series of wider comparator locations have been selected. These provide a valuable reference point to understand relative scale, concentration and distinctiveness of MMC activity. These locations are detailed spatially on Figure 3 below.

Figure 3

WMCA as an MMC location, a series of wider comparator locations have been selected.

Findings

MMC currently generates notable economic value nationally

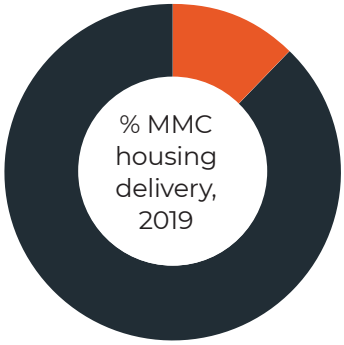
At the national level MMC at present is delivering a notable amount of units, but is currently making a small contribution to national house building efforts:

Using assumptions from wider industry reports and insights from sector experts, it is estimated that there are currently 27,000 homes built per year via MMC methods.

It is anticipated that currently only a small proportion of these homes are built using volumetric methods – an entirely new source of housing supply where the manufacturer is also the contractor and therefore is adding a new form of housing supply to the UK market.

Figure 4
MMC housing delivery, 2019

	% of Total UK Housing Delivery	Homes
Volumetric	2%	3,380
Panelised	14%	23,660
Total MMC		27,040

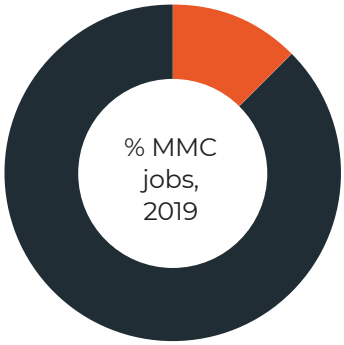


MMC house building sustains a significant amount of employment

It is estimated that the sector currently sustains in the order of 8,100 jobs nationally. Again, only a small proportion of these (1,010) are currently sustained by the volumetric market which is where the real driver and value add of the MMC sector lies.

Figure 5
MMC jobs, 2019

	Jobs
Volumetric	1,010
Panelised	7,100
Total MMC	8,110

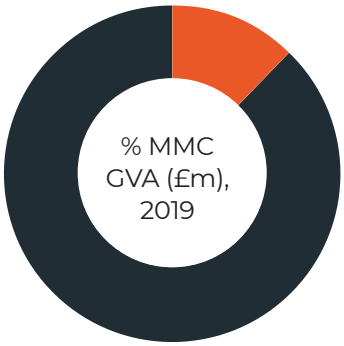


MMC house building jobs sustain a notable level of economic output

MMC jobs contribute in the order of £500m GVA per Annum to the UK Economy.

Figure 6
MMC GVA, 2019

	GVA (£ Millions)
Volumetric	£80
Panelised	£558
Total MMC	£638



In the coming years, MMC is set to grow considerably.

It is estimated that there is already notable latent capacity in the sector in the order of around 7,000 homes per annum. Furthermore, it is estimated that the sector is set to grow at 6% per year[16] .

The sector is currently dominated by panelised construction. However, it is also anticipated that volumetric construction has the potential to account for a significantly larger share in the future. Growth of the sector has been considered on the basis that:

- Latent volumetric capacity is realised in the next five years.
- The wider sector continues to grow at 6% pa thereafter.
- Growth of volumetric occurs at a faster rate to account for a larger share of MMC capacity.
- Overall capacity increases to 56,000 homes by year ten (which is broadly in line with *the Farmer Review* which estimates the potential to reach 50,000 homes through MMC methods).

Overall housebuilding is expected to increase above the current level of 169,000 home per annum – closer to the government's target of delivering 300,000 new homes by the mid-2020s. Expansion of MMC will diversify the supply of housing, encourage new market entrants and draw on supply chains that are complementary to existing housebuilding delivery approaches. It therefore has the potential to provide a key element in securing a significant expansion of housebuilding. On this basis, the growth of MMC is assumed to be additional to the current housebuilding sector and will not displace other forms of housing delivery.

The suggested growth of MMC still requires other forms of house building (including traditional methods) to increase by over 100,000 homes over this period.

The level of growth proposed for MMC is equivalent to 5-9 new factories (with a capacity of 1-2,000 homes per annum) coming online within the next decade (less than one per year).

Figure 7
Housing delivered via MMC

	3 Years	5 years	10 Years
Volumetric	10,000	15,000	24,158
Panelised	25,857	27,432	31,801
Total MMC	35,857	42,432	55,958

Were the sector to grow as set out above, it would sustain support a significant amount of national employment:

10,800 jobs in 3 years, 12,700 in 5 years and 16,800 in 10 years. This compares to an estimated 8,100 jobs today – and represent growth of 8,800 over this period (a doubling of employment across England).

Figure 8
Jobs directly supported through MMC

	3 Years	5 years	10 Years
Volumetric	3,000	4,500	7,200
Panelised	7,800	8,200	9,500
Total MMC	10,800	12,700	16,800

16 Frost and Sullivan project an annual growth rate of 6.3% from 2018-2025 https://ww2.frost.com/news/press-releases/global-modular-and-prefabricated-building-market-set-for-robust-cagr-of-6-3-from-2018-to-2025/

These jobs would deliver a considerable degree of economic output:
Over £1.3 billion, compared to £630 million today.

Figure 9
GVA generation directly supported through MMC (£m)

	3 Years	5 years	10 Years
Volumetric	£236	£354	£569
Panelised	£609	£647	£749
Total MMC	£845	£1,000	£1,319

What this could mean for WMCA

Whilst it is difficult to say exactly what this may mean for WMCA, it is possible to set out some indicative scenarios of what proportion of this national activity WMCA could reasonably secure. These notional levels of MMC activity are not a prediction of the level of growth WMCA will secure, but set out the scale impact that could materialise if WMCA is able to grasp the opportunity that lies ahead.

On this basis the notional opportunity for WMCA is for the area to secure additional capacity for 2,000 homes per annum, which represents circa 10% of the UK's additional volumetric production within the next ten years – equivalent to 2 factories with 1,000 homes per annum capacity or one larger facility.

If WMCA was able to secure this level of MMC growth, this could deliver:

2,000 homes
per annum

Support 600 jobs
(within the factory)

Deliver £47 million
GVA per annum

As identified above, our evidence suggests that growth in MMC, particularly that around volumetric is **highly additional and will not displace existing construction activity**. This has been brought to light through a series of sources. The engagement process with those involved in MMC has suggested that manufacturers are looking to different skills sets and different types of people to fulfil these roles, with an emphasis on digital and design skills. Moreover, this form of construction is a completely new form of housing supply to the UK market and as such would supplement traditional approaches which would cumulatively help the UK to realise its national house building targets.

This activity is also likely to generate a considerable degree of economic value through the **wider supply chain**. Here, a series of high level estimations of indirect impacts can be generated[17]. It is anticipated that MMC activity will indirectly **support 560 jobs** in the supply chain, generating in the order of **£44m in Gross Value Added**.

The delivery of 2,000 homes per annum would secure around 13% of WMCA's housing target for 2025 onwards. This could be considered a cautious estimate, and demand can be aggregated nationally in the future, as has been proposed in the recent *Build Homes, Build Jobs, Build Innovation* report by Mark Farmer and Mike De'ath, then the potential for MMC manufacture in WMCA may be even greater.

17 The multipliers are taken from the Hatch Regeneris Input-Output model (last updated in 2017). These impact capture the indirect impacts of employment and outputs (i.e. the spend in construction supply chains). Further impact would be associated with the induced impacts of employee expenditure in the local economy.

Construction sector at large

Understanding the wider construction sector across WMCA can provide valuable insights into the area's current construction credentials and an indication of how well placed the sector is to support future MMC activity that comes forward.

Whilst the construction sector is slightly less specialised and there is a lower concentration of businesses than is seen nationally, there is a critical mass of construction activity equivalent to 55,000 jobs across 10,295 businesses. This represents 4.3% of the total jobs and 9.7% of the total businesses across the West Midlands Combined Authority.

Within the construction sector there is a strong concentration of heavy infrastructure activities (Figure 10) which are relatively small sectors nationally, but large employers in the West Midlands. Notably:

The construction of railways is:

x 22

the level seen nationally

The construction of roads and motorways in WMCA is:

x 5

the level seen nationally

The construction of commercial buildings is also more specialised than the national profile:

x 2.7

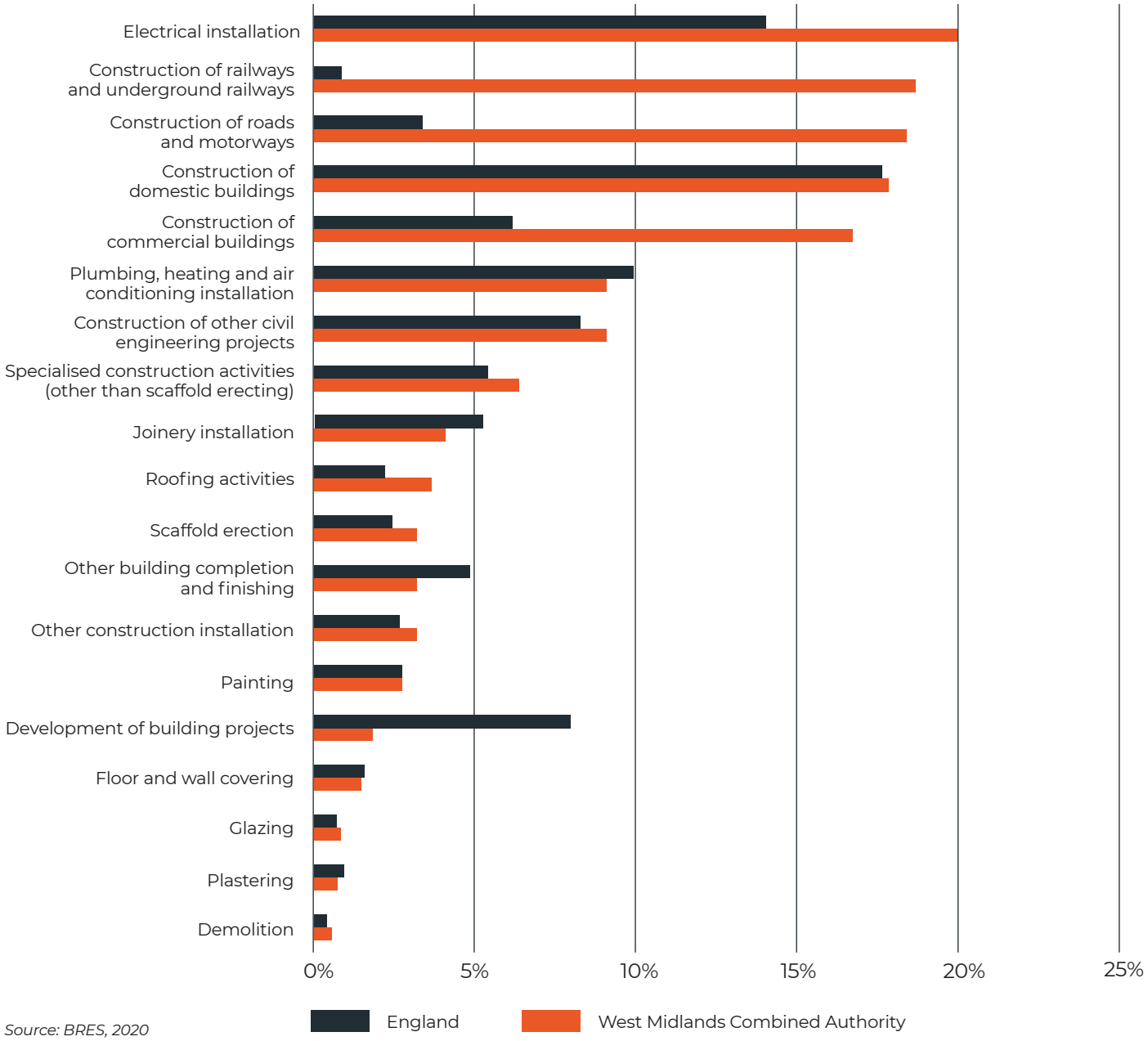
the national concentration

These sectors require highly specialised expertise and skills and reflect the tacit knowledge that exists within the construction sector locally. This provides a strong foundation for the growth of MMC activity going forward.

Supporting sector

The sector is made up of a strong presence of sub sectoral activities that will support any core MMC activity that takes place. These are summarised in the accompanying chart to the right and include a prominent commercial building sector as well as supporting activities such as electrical installation, plumbing, heat and air-conditioning and roofing. All of these activities are highly likely to supplement any MMC activity that comes forward and provide an important foundation and supply chain for the sector to grow.

Figure 10
Construction sector profile (2018)



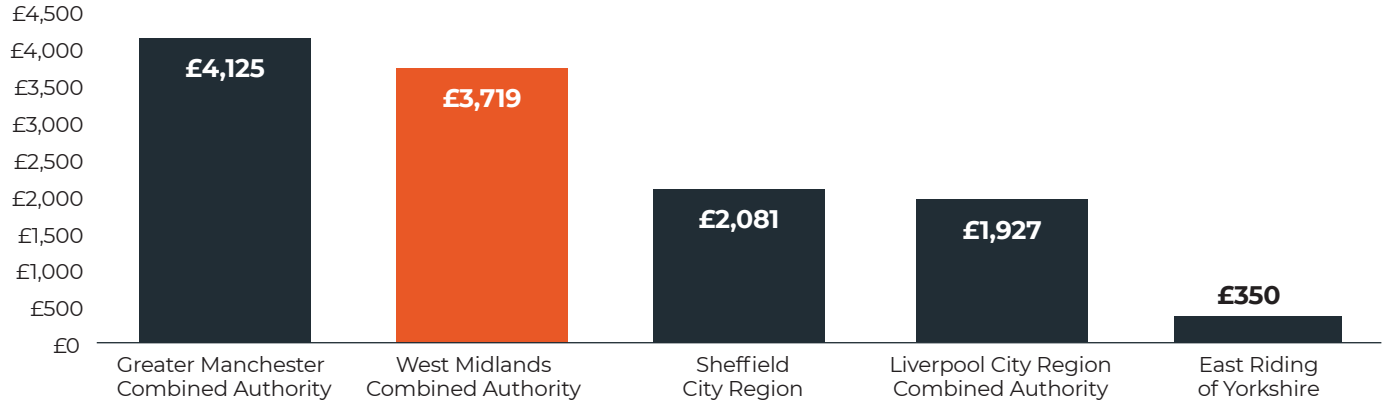
Source: BRES, 2020

Construction productivity

The West Midlands' Construction Sector is relatively large in gross terms

GVA of £3,700m indicates that in terms of scale the wider construction sector is significantly larger than the Sheffield and Liverpool City Regions but is lower than the GMCA.

Figure 11
Construction sector total GVA (Millions)

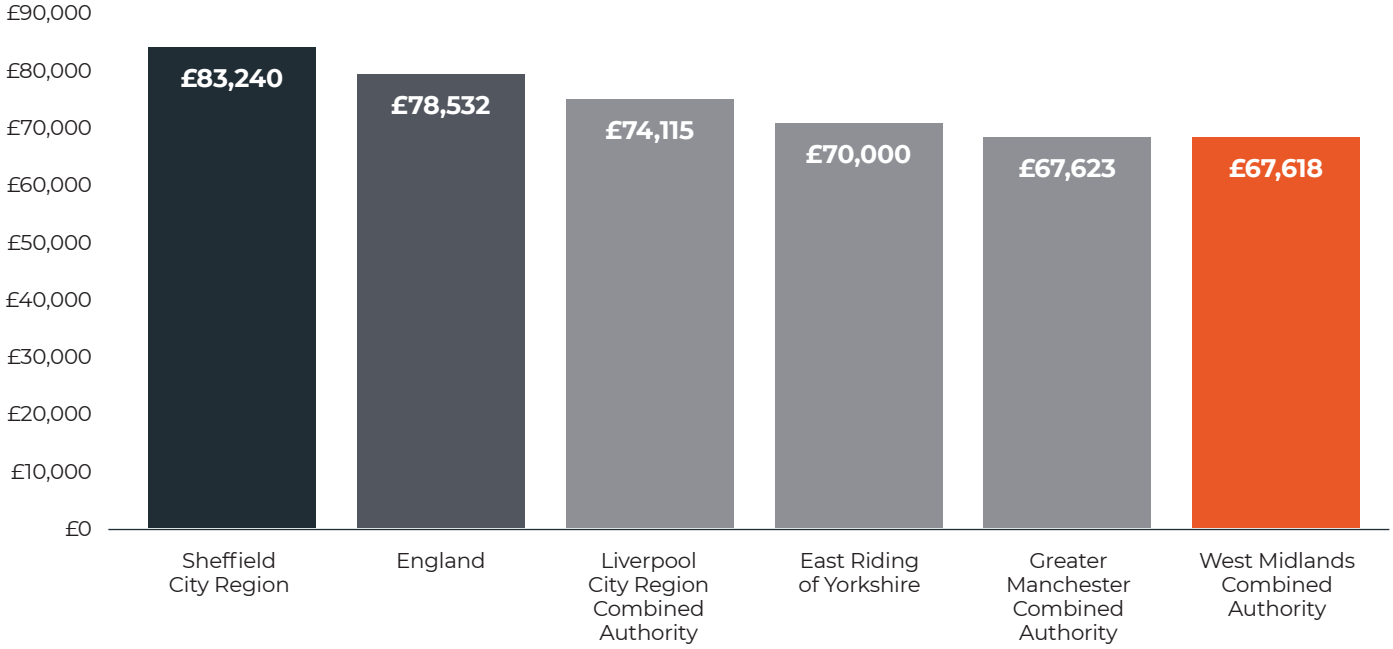


Source: ONS, 2019

In relative terms the West Midlands Combined Authority has low productivity across the construction sector

GVA per FTE of £68,000 is significantly lower than the comparator locations and national average. This reflects the lower levels of specialism in the WMCA construction sector than comparator locations, and its relatively larger employment in supply chain sub-sectors that are less productive in nature. To this end, MMC provides a means by which to improve productivity in the construction sector locally and meet the WMCA strategic ambitions to secure greater productivity in the area.

Figure 12
Construction sector GVA per FTE



Source: ONS, 2019

MMC related activities

Clearly, a large degree of MMC related activity will not be picked up or specifically identified through a traditional SIC Approach. To get around this issue data has been used from Glass.ai, which uses bespoke web crawling techniques to pinpoint companies that are engaged in relevant cyber and digital activities, by assessing company characteristics from their online presence.

Whilst this process provides a much deeper layer of analysis and goes beyond the limitations of SIC codes, it may still overlook companies that do not have an active website but are legitimate trading entities. As such, this has been used here to get an understanding of the relative strength of different MMC locations and to determine levels of specialisation in *MMC related activities*.

The data suggests that WMCA has a very strong specialisation of MMC related businesses with three times the level seen nationally. This is the most specialised location across all the comparators reviewed as part of this research.

A review of the companies that sit behind this data indicate that there is a diverse range of businesses operating in MMC related activities. These activities represent a strong foundation for the growth of MMC within the West Midlands and are summarised below.

Concentration of MMC related businesses (LQ)
West Midlands Combined Authority 2.9
Sheffield City Region 2.6
Liverpool Combined Authority 2.3
London 2.1
GMCA 1.7

Activities focused in supply chains

- Renewables & sustainability
- Energy
- Building materials
- Architecture & planning
- Transportation
- Mechanical and industrial engineering

Understanding the current AMC supply chain

In partnership with

ARCADIS Design & Consultancy for natural and built assets

Engaging with and understanding the West Midlands' AMC businesses

In order to understand the starting point for AMC in the West Midlands, we have undertaken a comprehensive mapping and engagement project, researching the market as it stands. Our research followed six streams:

1. Volumetric and panelised AMC manufacturers
2. Principal contracting businesses:
3. Types of businesses that could be involved in supplying the emerging AMC market and how many are in WMCA
4. Enabling assets: physical infrastructure, political and regulatory assets within the region
5. What is happening and future potential in innovation and R&D
6. Map how the housebuilding sector in WMCA compares to northern and national comparators

Methodology for discovery / analysis

Our research followed six streams:

1. **Volumetric and panelised AMC manufacturers:**

   The geographic boundary of research was outlined as the WMCA region. The Arcadis National AMC manufacturers database was filtered to identify manufacturers within the region. This short-list was validated through internet research and further validated through phone conversations/engagement calls with industry experts and manufacturers.

2. **Principal contracting businesses:**

   Definitions of "Principal Contractor" and the geographic boundary of research were developed. Internet searches were conducted to identify principal contracting organisations within the region. This information was validated through engagement calls with key principal contracting organisations and AMC manufacturers.

3. **Types of businesses that could be involved in supplying the emerging AMC market and how many are in WMCA:**

   Arcadis' AMC Residential value chain was used to identify ten types of business supplying AMC manufacturers (see below). Internet research and engagement calls were then used to develop a high-level supply chain analysis of the AMC ecosystem within West Midlands which was further validated through phone conversations.

4. **Enabling assets: physical infrastructure, political and regulatory assets within the region:**

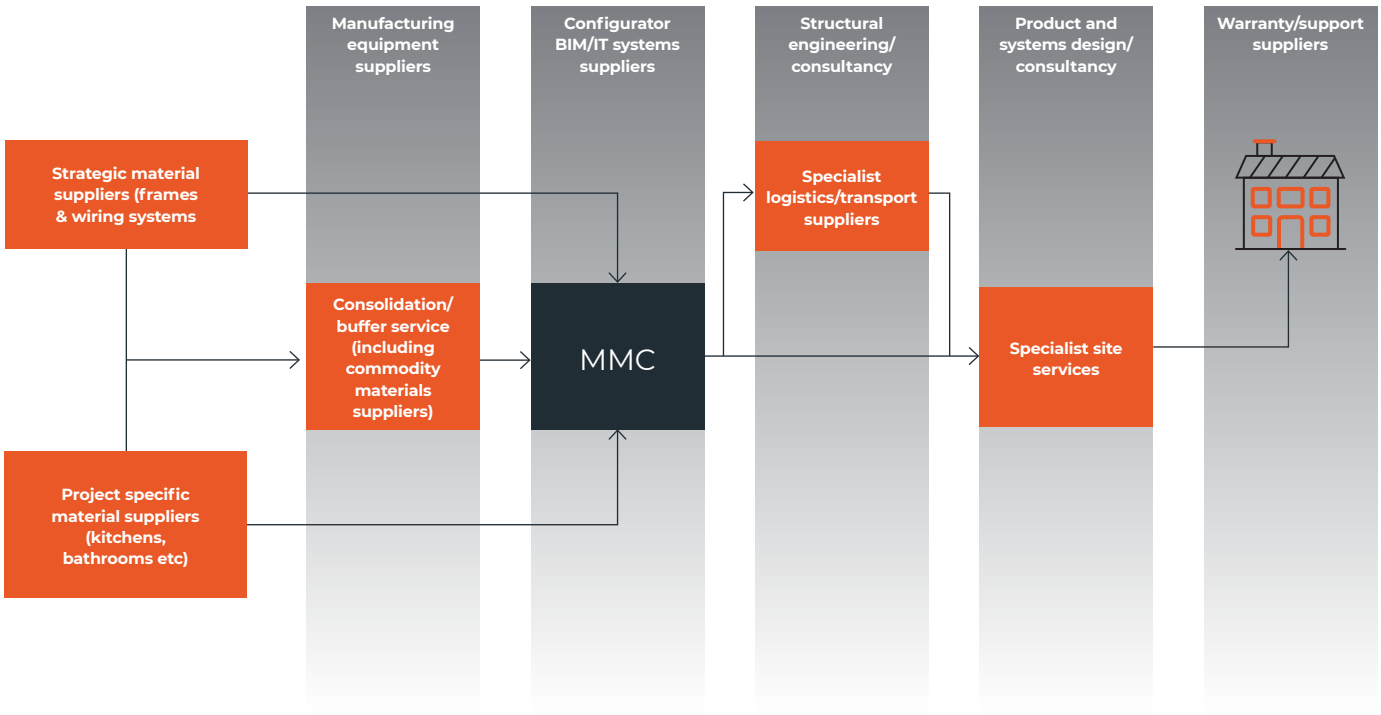
   Internet desk research into the region's physical infrastructure assets was focussed on the logistics network surrounding WMCA (key roads and motorways, rail and intermodal freight terminals and airports), accompanied by the WMCA Transport strategy. Political and regulatory enablers within region were identified through engagement calls with AMC manufacturers, house developers, supplying organisations and research institutes.

5. **What is already happening and future potential in innovation and R&D:**

   Research into the Innovation and R&D within the region was conducted through a combination of internet research and engagement calls.

6. **Mapping the housebuilding sector in WMCA and comparison with northern and national comparators.**

Figure 17
Types of businesses supplying AMC manufacturers



AMC Eco-System Findings

Volumetric and panelised manufacturers

Nine Tier 1 AMC residential manufacturers are located within the West Midlands:

- Totally Modular
- Local Homes
- Innovare Systems
- Dynamic Build UK
- Elements Europe
- Frameclad
- Modpods International
- Hadley Group
- Space4

These are comprised of four volumetric manufacturers and five panelised manufacturers. WMCA has a strong AMC manufacturing capability due to the high concentration of manufacturing within the region and there is potential to service the requirement for affordable housing in the region from its local supply base.

Figure 18
Location of AMC manufacturers within WMCA

V Volumetric (Cat 1) P Panelised (Cat 2)

There is an opportunity for WMCA to attract additional AMC manufacturing capability to the region. ilke homes represents an example of not only an AMC manufacturer but a fully integrated housing developer currently outside the region with a desire to have multi-region manufacturing capability; they have recently opened an office within Birmingham.

It was expressed through our engagement sessions that a higher degree of collaboration and engagement with WMCA would be beneficial in enabling growth in the sector regionally, as multiple AMC manufacturers within the region are looking to scale their operations.

All AMC manufacturers engaged through the interview process have declared strategies encouraging local sourcing within their supply chain.

Other enablers and insights emerging from engagement calls with AMC manufacturers include:

- Three factors identified when analysing the AMC landscape within a region:
  - Housing demand – evident in WMCA
  - Land availability – no group currently in place to represent landowners
  - Offsite manufacturing capability – evident in WMCA
- Aggregation of regional pipeline for affordable housing
- Consistency and certainty of demand would encourage manufacturers to further invest in scaling operations or additional shifts
- Changes in the planning system towards a preference for volumetric construction would aid growth of the industry

Manufacturers engaged through this process also felt that the Government could act as an enabler in the following ways:

- Clear and concise standards and regulations, which might include housing standards and building regulations, all of which were considered important criteria for creating standardisation of demand
- Zero carbon economy, insulation requirements and other stricter building regulations could signal the end of achieving energy efficiencies from traditional methods
- Enable manufacturers to build to standards with a clear criteria or target to adhere to
- Planning pre-approval for standard house types or portfolios would also be an aid to growth
- Early engagement in the development cycle with local authorities, housing associations and other providers is important as are long-term relationships and open dialogue
- Government assistance and financial help for R&D and manufacturing
- Earlier engagement in the procurement process for the public sector

Contractors

Principal contractors are defined as 'Contractors appointed by the client to have control of the construction phase of the project; to plan, manage, monitor and coordinate health and safety during this phase'.

Eight prominent principle contractors operate within the Residential AMC sector in WMCA:

- Seddon
- Henry Riley
- F1 Modular
- Bowmer & Kirkland
- Keepmoat
- Farrans
- Grahams

Keepmoat has identified AMC as a major part of their strategy to deliver affordable homes and zero carbon housing, with plans to develop 400 modular homes with their volumetric module supplier ilke Homes. They also have a strategy to increase their timber frame AMC offering (currently 10% of their revenue) and provide a turnkey solution which includes land development.

ilke Homes has recently opened an office within WMCA and have a vision to operate within the region as a fully integrated housing developer with an aim to acquire land, get consent and supply finished modules enabling them to bring homes to the market more quickly. With a strategy to operate as a principal contractor within residential AMC projects and to collaborate with housing associations and local contractors, this highlights an example of the strategy of many AMC manufacturers to adopt vertical integration and add principal contracting to their offering pushing towards turnkey solutions.

All contractors engaged in this research shared an ambition to improve their AMC capability and scale their offering by increasing the number of houses developed using AMC. They believe that manufacturing capability in and around the region is key to their supply chain and an enabler to fulfilling their demand for their affordable housing requirements.

Enablers identified in engagement calls with contractors include:

- Traditional principal contractors accommodating AMC requires large-scale changes to existing operations
- The majority of housing projects have been principally designed for traditional construction and must be redesigned for AMC; WMCA can counter this by encouraging AMC concepts early on in planning and development cycle
- Currently AMC costs are considerably higher than traditional build; to justify using AMC methods they need to access additional grants that Housing Associations have access to.
- Public sector could help force the private sector and wider construction industry to look ahead with policies e.g. a percentage of new developments should be built using AMC methods
- Homes England are key to funding and research, understanding that there is land to unlock in the coming years, introducing restrictions on types of homes on the land unlocked is a key player in increasing volumes
- Help-to-buy stimulates demand
- Forward visibility of housing plans and projects is key
- Open conversation with key stakeholders and early engagement in local plans
- Warranty providers and their ability to offer insurance to customers is critical

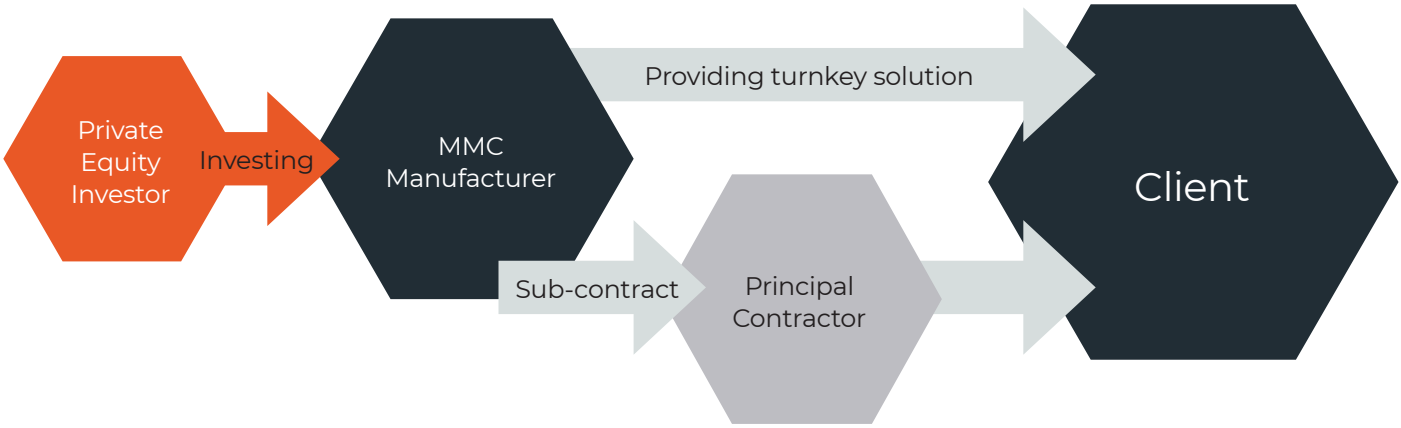
Further observations include:

- Private equity investment into AMC

The figure below outlines a common theme within the AMC ecosystem which has been identified through research and the engagement calls with AMC manufacturers. There is a wealth of evidence of Private equity-based investors entering the AMC residential development landscape and investing in AMC manufacturers. This is providing the capital for the manufacturers to invest and develop their facilities and their production capability to deal with the forecasted growth in demand for affordable homes. Examples include Impact Capital investment in Lesko Modular, TDR Capital investment in ilke Homes and Goldman Sachs investment in TopHat.

Private equity investment could potentially extend further down the AMC supply chain with the acquisition of strategic component suppliers to further support and secure the pipeline and resource for affordable housing.

Figure 20
Private equity investment and manufacturers providing turnkey solutions



AMC manufacturers providing turnkey solutions

There is also evidence that AMC manufacturers are moving upstream by providing turnkey solutions directly to the clients and in doing so bypassing principal contractors. Examples from our engagement sessions of manufacturers adopting the strategy of vertical integration, upscaling their principal contracting and housing delivery capabilities to provide turnkey solutions include:

- Innovare systems
- Hadley Group
- Accord Group
- ilke Homes
- Totally Modular
- Dynamic Build UK
- Elements Europe

In this model, onsite work is still subcontracted to local organisations for activities such as groundwork and site installation, but this is under the management of the manufacturer. There are also instances where the manufacturer has acquired these service providers to expand their offering.

This model provides an opportunity for local contractors and SMEs to become specialist partners to AMC manufacturers within region supporting the growth within their offering and the sector as a whole.

- AMC manufacturers are keen to take on principal contracting roles and sub-contract on project basis to complete on-site installations
- Where manufacturers work through a principal contractor, they typically require a concrete slab, site access and scaffolding (for panelised products) and then installation is conducted by their own employed teams or installation sub-contractors
- The benefit to end client is estimated at 15% saving due to bypassing principal contracting charges and using AMC manufacturer's turnkey proposition
- Providing turnkey solutions also allows AMC manufacturers to control end to end quality and build process
- AMC manufacturers and principal contractors with AMC capability also looking into land development
  - Keepmoat is expanding their turnkey offering with a strategy of working with landowners to acquire and secure new sites across brownfield and greenfield locations. Acquiring both small and large-scale land developments
  - As the AMC landscape evolves and acknowledging some of the challenges entering the market, ilke Homes have set up their own land and development team as part of their strategy to move towards a full turnkey solution
- Opportunity remains for local developers as AMC is not cannibalizing Construction market
  - A further opportunity to provide a wider range of jobs in the region as AMC adds an additional requirement to the job market rather than cannibalizing existing labour within the construction sector
  - AMC projects can be deemed less attractive to traditional principal contractors as the existing highly fragmented sub-contracting model in traditional construction presents opportunity for margin to be made across large number of sub-contracting organisations. Same opportunity is reduced within AMC due to reduced number of sub-contracting organisations required on projects

Supply chain

The region has a strong supply base which can be developed to support AMC activity and other future opportunities both within the region and nationally.

The supply chain within the region is predominantly equipped to service the traditional construction sector. This includes a large base of consolidators and buffer services for commodity supplies (building materials and key components), however there are some strategic materials suppliers identified within research which support the AMC ecosystem. These strategic materials include steel frame structures and timber frames suppliers that play a key part in the AMC value chain.

Engagement sessions with Tier 1 AMC manufacturers have revealed that they interact with, and procure products from, organisations within the traditional construction supply chain; due to this being a reliable source of supply that has been established and built to service the wider construction sector. A key takeaway from the engagement sessions identified the fact that Tier 1 manufacturers were often procuring from national organisations with regional distribution centres and capabilities ensuring:

- Reduced risk due to reliability and continuity of supply
- Ability to handle large peaks and variations in demand brought by the intermittent nature of demand within project-based environments

The heatmap opposite identifies the current supply organisations within WMCA aligned with the ten types.

Figure 21
Heatmap of supply chain organisations

Strategic material suppliers (frames and wiring systems)

Steel frame – walls / ceilings / floors	Hadley Group	Kingspan (steel frames)	Frameclad	Superior Sections	Drywall Steel Sections	Met Structures	Albion Sections	Midland Erection	Midland Structures	Ash and Lacy
Wiring system and electrical components	Adren electrical services	West Midlands Electrics	CEL Electrical	Contact Electrical	RS Electrical Supplies					
Timber Frames & Structures	(SG) – Pasquill	(SG) – Roofspace Solutions	(WB) – Timber Innovations	Taylor Lane	(WB) – Timber Engineering	Lowfield Timber Frames	Skyline Timber Systems			

Project specific material suppliers (kitchens, bathrooms, etc.)

Kitchens	Symphony	Ideal Standard												
Bathroom – vanity units	Core Modular	Symphony	Ideal Standard	Kondor Pods	Walker Modular	Offsite solutions								
Doors and windows	Central RPL	DW Windows	West Midlands Double Glazing	Reliant Windows	Finesse Windows	Stedek Windows & Doors	Carera Windows Ltd	Diamond Windows Droitwich	Wombourne Windows	Hayley windows				
Brick slip / cladding	Eurocell	Rhino Steel Cladding	Ash and Lacy	Bushbury Cladding	Phoenix Steel	Johnsons Timber Supplies	Just Walls UK	Ketley Brick company	Brictec	Slips on Site Ltd	The Brickslip Brothers	SPV Group	NV Roofing	SB Roofing & Cladding
Plumbing, piping & water management systems	City Plumbing	BSS Group plc	Bes Ltd											
Walls / Panels / Insulation – SIPs	Kingspan	CCF	Falcon Panel Products	(SG) Glosford Sips	(WB) – Timber Innovations	Birmingham Asphalt	Superior Insulated Panels Ltd	Encon Insulation						
Roofing	(SG) – Pasquill	(SG) – Roofspace Solutions	Scotts Timber Engineering	(WB) – Smart Roof	Rinus Roofing	SIG Roofing								
Consolidation / buffer service (including commodity mat's suppliers)	(SG) – Jewson	(SG) Grahams	(SG) CTD Tiles	Wickes	Buildbase	Travis Perkins	Eurocell	Buildbase						
Specialist logistics / transport suppliers	WS Trans-portation	Midlands Portable Puildings	Marshals of Evesham	Modular Movements										

Specialist site services (Installers – subcontractors)

Manufacturing equipment Services	Mantech Manu-facturing	Eriks	Raybould Machining Tools	Mazak										
Structural engineering / consultancy	Arcadis	OES Consulting	BK Consultants	David Smith Associates	Harborne Building Consultancy	KWL Consulting	Simplify Structural Engineering	Brookbanks Consulting	Patrick Parsons	Adept Consulting	Integrated Designs & Associates	OES Consulting	PJ Barnett Associates	Glencross & Hudson
product and system design consultancy	Modularize	Arcadis	Eurobond	BSRIA	Mott Macdonald	Bryden Wood								
Configurator / BIM / IT systems suppliers	UK Con-struction online	Autodesk	Tekla	BIMobject	CoBuilder	Solibri								
Warranty / support suppliers	NHBC	Bopas												

WMCA
WMCA + 50 miles
National

Further observations on the supply chain include:

Large number of prospective AMC supply chain participants in WMCA

Eighty-six businesses identified within WMCA currently supply the construction sector and could contribute to the AMC supply chain.

These range from local SMEs to national organisations with regional distribution operations.

17
Strategic Material suppliers identified

8
consolidation and buffer services for commodity suppliers

41
project specific material suppliers

14
structural engineering/ consultancy providers

Business within WMCA currently supplying the AMC ecosystem

Saint Gobain, with their off-site solution division, presents an example of an organisation which could play a key role in the region's AMC supply chain with a multitude of off-site services within their offering. Two of their offsite manufacturing brands Pasquill and Roofspace Solutions have facilities within the region that deliver strategic components (roofing, whole timber house kits, steel frame solutions) to the AMC manufacturing sector. British Gypsum is also part of the group and work closely in partnership with Hadley Group to develop drywall construction solutions.

Saint Gobain has adopted a strategy of vertical integration and a product-based approach to their offsite services. While manufacturing 4,500 homes annually from their timber frame assembly, they also work with National Tier 1 AMC manufacturers as a supply chain partner providing products and components. This includes receiving housing designs or bills of materials from their partners and producing housing components and other components needed for offsite manufacture.

Opportunity to encourage growth of supply base to supply AMC industry around the region.

There is an opportunity for some of the current supply chain to diversify their offering and support the growing AMC capability and manufacturing operations within the region.

Engagement calls have confirmed that AMC manufacturers are promoting a strategy of local sourcing which would help promote the supply chain within WMCA and create an opportunity for the supply chain to develop further and support the requirements of more manufacturers, such as those situated around the M62 corridor.

One of the key focuses for local sourcing is within specialist site services which are subcontracted to local organisations and include groundwork, landscapers, site installations, external finishing, on site fit out and decoration which tend to be sourced within the region.

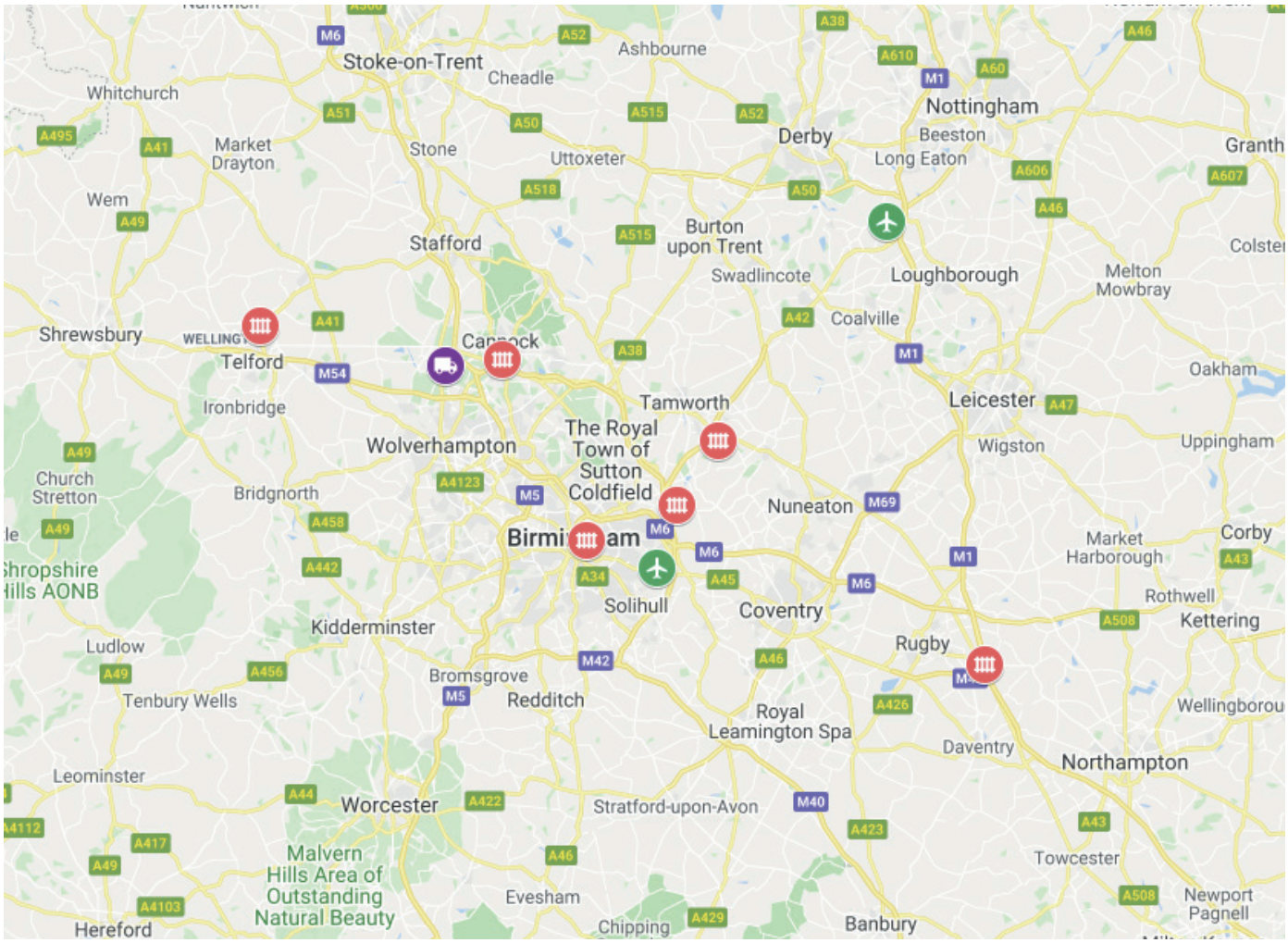
Enabling assets

Physical (road/infrastructure/land)

WMCA is uniquely positioned at the centre of a strong transport network. This physical infrastructure supports the opportunity for the region to promote itself as a pivotal hub for the AMC activity across the midlands and support the national AMC ecosystem. It also presents an opportunity to bid as a future site for a national construction logistics hub as Birch Coppice Business Park in Tamworth was considered previously.

- Physical location and surrounding infrastructure are key assets of the WMCA:
  - The network of key roads surrounding the region including the M6, M42, M40, M5 and M1 motorways provide a strong road network to allow efficient logistic operations. These roads connect the region to another corridor of AMC activity in the north across the M62 and provide a link to London, both locations within 3-4 hours' drive of Birmingham.
  - This strong road network is supported by five intermodal freight terminals and two airports within a 30-mile radius around WMCA further displaying the regions connectivity.
  - Alongside this strong logistics infrastructure, there are plans to develop the West Midlands Strategic Rail Freight interchange; a large development close to the M6/A5 intersection with more than seven million sq. ft of rail-served and rail-linked warehouses to support the regions logistics industry growth and help offer a more sustainable, efficient and reliable approach to logistics through rail freight.

Figure 22
Key infrastructure assets around WMCA



Regulatory and political organisations

Across the WMCA and its constituent bodies there is a strong political ambition and range of policies to encourage growth, with key ambitions of investing in the local community and fulfilling the housing demand within the region.

- The AMC ecosystem could be a great way to fulfill the demand for housing (specifically affordable housing) and the opportunity to encourage and support local SMEs and other organisations to support this ecosystem.

WMCA are encouraging growth within the AMC sector through a range of initiatives:

- WMCA plans to insist on the use of offsite construction on projects within the region. The speed of offsite delivery outweighs the potentially higher current cost of undertaking AMC methods compared to traditional construction. Some of these costs could be offset by funding mechanisms; grants and investments which WMCA are willing to offer to developers committed to AMC.
- The strategic partnership with Urban Splash to build 10,000 new homes using AMC which aims to deliver circa 5% of the WMCAs target of 215,000 homes by 2031 demonstrates the region's progressive stance. Having delivered projects within the region at Fort Dunlop, Rotunda and currently working on site at the Port Loop, the collaboration between a local authorities and the private sector highlights an avenue which can be taken to enable AMC to service the demand for houses.
- Furthermore in the past year WMCA and Lovell have agreed a further strategic partnership, for 4,000 homes over the coming eight years, and this will also promote the use of AMC.
- The Advanced Manufacture in Construction (AMC) Expert Advisory Group which has been formed by the WMCA also identifies their commitment to the progression of the AMC agenda and its ability to help economic growth within the region; also providing a shorter term recovery strategy to offset the impacts of the coronavirus pandemic. This provides WMCA with an opportunity to capitalise on the current manufacturing and innovation capability within the region by establishing a platform to promote collaboration and utilise the expertise and innovation within the region to help develop and build AMC capability and best practice.

Other institutions playing a key role in WMCA:

- Innovate UK plays a pivotal role in the sector regarding funding, facilitating collaboration and accelerating innovation. This enables organisations to carry out research, invest in pilot schemes and initiatives to improve their capability around AMC manufacturing.
- Examples of manufacturers who have had assistance from Innovate UK in relation to funding projects include:
  - Hadley Group to help build a prototype of a modular home and access to the R&D tax credit system provided by Innovate UK
  - Totally Modular & TDS for a modular collaborative project.

Benefits not considered under other categories

In dialogue with AMC manufacturers it appears that there is a mismatch between their expectations/requirements for investing in a new site with what local authorities are able to offer. Other enablers identified by stakeholders within the engagement calls to help support the growth of AMC operations and the supply of affordable homes within WMCA would include:

- Consistency and predictability of demand
- Regional demand aggregation
- Assurity of pipeline when considering investment within the region
- Collaboration between housing associations, councils and AMC ecosystem
- Early engagement in development cycle
- Governance and regulation regarding modular housing and lifetime cost
- Long term relationships with clients with open and honest dialogue.
- Encourage investment in digital capability in building design as it enables transparency of end to end process (material, product, and resource requirements)
- Housing authorities will need to implement a quota within developments making AMC mandatory to change behaviour. As cost tends to be key driver to shape behaviour currently and adoption of new modules and innovation.

Innovation and R&D

WMCA is well established as a hub of innovation and research. The key institutions contributing to the West Midlands reputation globally include the heavy presence of manufacturers and research capability within the automotive sector and a multitude of academic institutions which engage in research within the manufacturing and built environment sectors.

Academic Research Institutions

Aston University
Birmingham City University
University of Birmingham
University of Warwick
Coventry University
University of Wolverhampton
Dudley College

West Midlands R&D Assets

Aston University Logistics Expertise
Birmingham Centre for Rail Research & Education
Centre of Excellence in Digital Systems
Energy Systems Catapult
High Temperature Research Centre
Manufacturing Technology Centre (MTC)
MIRA Technology Institute
MIRA Technology Park
National Automotive Innovation Centre (WMG)
National Transport Design Centre (NTDC)
Quinton Rail Technology Centre
Smart City Mobility Centre
TIC-IT (Horiba-MIRA)
UK Central
UK Mobility Data Institute (WMG)
UK Battery Industrialisation Centre (UKBIC)
Very Light Innovation Centre
Warwick Manufacturing Group (WMG)

Innovation and R&D Facilities

Coventry University Technology Park
University of Warwick Science Park
Warwick Innovation Centre
Wolverhampton Science Park
Innovation Birmingham Campus

With the strong research and innovation footprint within the WMCA, there is an opportunity for the AMC sector to utilise this capability; aligning current and future research to the needs of the sector and facilitating these institutions in conducting manufacturing and built environment research.

The region's wealth of academic institutions is a key facilitator. WMCA could draw on the academic institutions and their current research and projects to facilitate an AMC-focused coalition to assist the sector within the region and nationally:

University of Wolverhampton

AMC based research and projects with Tier 1 AMC manufacturers within the WMCA

- (Hadley Group) Researching into Ontology – Heating, lighting and cooling in housing.
- (LoCaL Homes) Research into long term benefits to homeowners around energy efficiency and incorporating it into their housing design process and also the CHARM project into plastic free housing, which is considered to be a leading R&D project Europe-wide.

Birmingham City University, School of Engineering and The Built Environment –

Currently undertaking research to improve the housing crisis by facilitating offsite construction & Design for Manufacture (DfMA). Aim to construct six DfMA houses with further 200+ new homes in the pipeline and assist choosing design options for 400 houses per annum.

University of Birmingham, Civil Engineering Research (Structural Engineering)

Current research includes studies in structured materials, structural insulated panels and structural component design, novel design methods using cold formed steel structures and off-site construction methods facilitated by new construction materials.

University of Warwick

Innovative manufacturing & future materials research into the decarbonisations of products, processes and operations on the house including battery technology research which could play a role in the environmental and sustainability aspects of affordable housing. Warwick Manufacturing Group (WMG) research includes sustainable materials and processes, materials engineering, and life cycle analysis and knowledge transfer partnerships with Tier 1 AMC manufacturers.

University of Coventry, Centre for Manufacturing and Materials Engineering

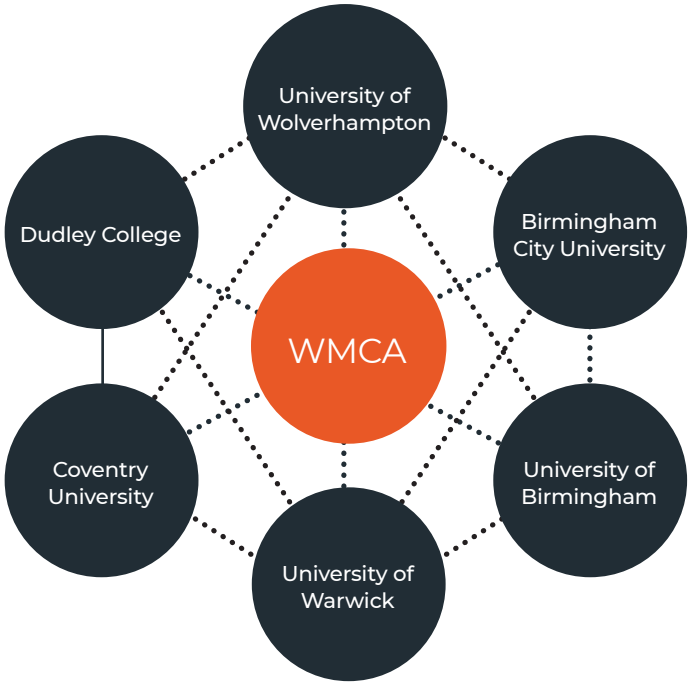
Offsite Wrap-around Large Scale retrofit (OWLS) is a project which aims to develop a rapid, highly replicable and innovative approach to external insulation of walls and roofs by applying modern methods of construction to retrofit. This research aims to benefit social housing projects through improvements to comfort, environmental improvements with the reduction of CO_2 and reduction in energy costs.

Dudley College

Dudley Advance II, a purpose-built facility geared towards providing apprenticeships, training and education for offsite manufacturing and digital skills including developing techniques such as BIM. Involved with multiple Tier 1 AMC manufacturers within the region and the Sustainable Housing Action Partnership (SHAP) assisting to push a smart, sustainable national housing infrastructure for 2050.

Figure 23

The academic institutions within the region which WMCA could utilise to assist their AMC initiatives and strategy



There is an opportunity to combine automotive manufacturing expertise and best practice with the AMC manufacturing landscape within the WMCA by:

- Marrying WMCA's strong foundation of automotive manufacturing knowledge to the research currently being undertaken across multiple academic and research bodies within the built environment and manufacturing sector. This presents an opportunity for West Midlands to align these expertise and research to help propel the AMC manufacturing sector within the region and nationally.
- Marrying the capability found in WMCA between the private institutions (manufacturers) and academic research would benefit organisations and the workforce within the sector as it would develop the manufacturing process, expertise, product knowledge and develop that skill set within the region.

The Manufacturing Technology Centre (MTC) also plays a key role in the research and innovation capability within the region. There is an opportunity to expand the MTC's collaboration with the Advanced Manufacturing Research Centre (AMRC) on initiatives and innovation relating to the AMC sector; enabling these institutions to utilize the synergies from their research, combining operational excellence from the automotive sector with manufacturing and materials-based research relative to the AMC ecosystem.

- Opportunity for West Midlands Innovation network with its focus on automotive and manufacturing process to collaborate with AMRC to utilise their expertise in AMC manufacturing and materials to benefit capability, skill sets and create synergies.
- Facilitate the connection between industry and academia within the region. Individual connections have been made between manufacturers and academic institutions in the shape of knowledge transfers and training schemes, but development of innovation and research which will introduce applicable innovation and improve manufacturing operations within the sector needs further encouragement.
- Use the strong research and expertise of the MTC, academic institutions and the private sector to understand *the art of the possible* in regard to building sustainable homes and help manufacturers to make incremental changes to their operations using an agile approach.

Case Study

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.

Understanding the skills and training environment for AMC

In partnership with

HARLOW CONSULTING

Skills profile in the West Midlands Combined Authority

The WMCA Regional Skills Plan identifies a number of challenges as well as positive trends for the region from a labour market perspective:

- A low employment rate (70% of 16-64 year olds being employed)
- High levels of unemployment
- High numbers of residents with no qualifications
- A high number of residents in low paid jobs
- A quarter of vacancies described as 'hard to fill'

+ A growing number of jobs
+ Improvements in school attainment
+ Large and growing population of young people

Major new homes development (in the order of 12,000 new homes each years) presents just one of various opportunities to address the identified challenges.

Furthermore, sectors aligned with AMC such as advanced manufacturing, construction (building technologies) and digital creative have been highlighted by the WMCA as 'transformational'. Housing is one of the key priorities set out in the *Strategic Economic Plan*, with construction (building technologies) the key sector to deliver the Authority's £500m investment in this area.

The skills profile of AMC

Roles and functions involved in AMC

It should be noted that this section focuses on the core functions involved in the manufacturing and construction-related elements of AMC. This excludes other cross-sector roles and functions such as sales and marketing.

Offsite versus onsite

Firstly, there is a need to differentiate between offsite manufacture and onsite assembly and the functions that they each perform. From a skills perspective, this is important because 'construction' is tightly defined, based on the construction sectors 'in-scope' to the CITB Levy.[18] These sub-sectors range from traditional trades (e.g. bricklaying, carpentry, painting and decorating), to groundworks, drilling, scaffolding, to road building. Activities performed 'offsite' in a manufacturing facility are outwith this definition of construction.

The interface between the onsite and offsite elements of AMC therefore sets a unique challenge in terms of skills integration. This is particularly true where 'traditional' companies, such as Tier 1 employers are adopting AMC techniques involving offsite manufacture.

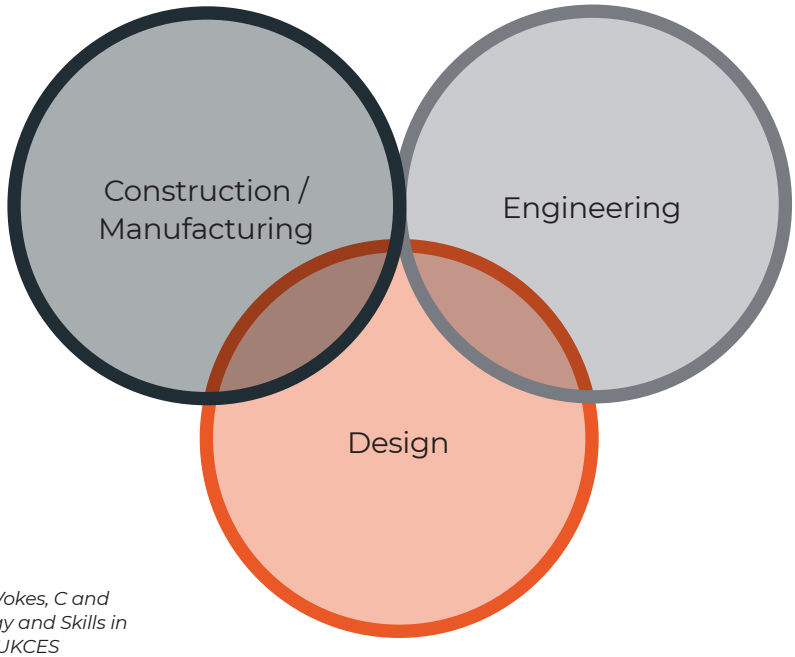
The interface is where the build process becomes more closely assimilated with manufacturing, requiring integration between different disciplines (Figure 13).

As a consequence, AMC requires close collaboration and a mutual understanding between all parties involved in manufacture and assembly. Contractors undertaking placement and assembly need to work to tighter tolerances, work more productively and efficiency, have an appreciation of the manufacturing process and understand the difference between traditional and AMC builds. To achieve this, it is widely acknowledged that all parties need to be involved from the design stage.

"Knowledge of the different disciplines is key. The challenge comes in the interdisciplinary nature of the profession."

Feedback from stakeholder interview.

Figure 13
Integration between different AMC disciplines



Source: Reproduced from: Vokes, C and Brennan J (2013) 'Technology and Skills in the Construction Industry', UKCES

18 Based on the Industrial Training (Construction Board) Order 1964 (Amendment) Order 29912 ("Scope Order")

Functions and job roles involved in AMC

Due to the cross-fertilisation between AMC and traditional skills – i.e. the need for a mixture of innovative production techniques in the offsite manufacturing environment, as well as traditional skills required in onsite groundwork, assembly and finishing – there is a need to consider the functions performed by the different parties as well as the job roles. This is particularly the case where Tier 1 contractors have diversified into manufacturing. For clarity, and as an exemplar, Table 1 illustrates the core functions involved in AMC, and the associated job roles.

Table 1
Functions and job roles involved in AMC

Function	Description	Job role	
Digital design	Success of projects hinges on the right design	• 3D Visualiser • CAD Modeller • Architectural Technician • BIM Technician	• Pre-construction Designer • Electrical Engineer • Architect • Design Engineer • Structural Engineer
Estimating/ commercial	Seen as a 'black art' Getting it wrong can undermine benefits of using offsite	• Contracts Manager • Commercial Manager • Estimator • Quantity Surveyor	
Offsite manufacturing	Moving towards multi-skilled operatives however training is largely in silos Collaborative nature of offsite working requires cultural shift for traditional trades	• Wood Machinist • Multi-Skills Operative • Steel Fixer • Welding Fabricator • Trades (joiner/kitchen fitter)	• Factor Supervisor • Project Manager • Factory Manager • Plant Manager
Site management and integration	Sequencing and scheduling crucial for efficient on-site assembly Requires generic skillset in construction plus knowledge of materials and products	• Site Manager • Project Manager • Construction Manager	
Logistics	Critical function – requires key skills in supply chain management Training does not explicitly address interface between offsite and onsite	• Banksman/Signaller • Dispatch • Logistics/Plant Manager • Dispatch Manager • Transport Manager	
Onsite placement and assembly	Lack of precision can compromise the entire build To realise benefits of offsite, understanding is required of the offsite process and materials used	• Assembly Technician • Erectors (steel, precast concrete) • Operatives (groundworks, roofing) • Banksman/Signaller • Crane Operator • Forklift Driver	• Trades (plumber, painting, joiner) • Chargehand • Site Supervisor • Project Manager • Site Manager • Site Inspector

At the lower levels, job roles are unlikely to change, but those at the higher levels are predicted to evolve[19].

Academics consulted for this research suggest that, to realise an increase in AMC and to optimise production, the opportunities lies with manufacturers. As one academic stated: manufacturers already know how to produce, so to introduce a new business model might not be that difficult for them.

19 Vokes, C and Brennan J (2013) 'Technology and Skills in the Construction Industry', UKCES

Skills, knowledge and behaviours

UK-wide research with sector employers conducted in 2017 identified the common AMC-specific skills and knowledge needs of those working in the six core functions described on page 5. These needs relate predominantly to higher-level knowledge requirements concerned with realising the productivity benefits of AMC, as well as a wide range of soft skills and attributes (Table 2)[20].

Table 2
Common skills and knowledge needs

Knowledge needs	'Softer' skills needs
• Design codes and standards • Low carbon agenda • Materials suitability • Relevant products and systems • Lean methodologies • Offsite manufacturing processes • Current and emerging technologies (e.g. 3D printing) • Site specifics • Safe lifting and handling • Order or sequencing • Assembly processes and tolerances • Quality assurance processes and tests • Waste management	• Effective and ongoing communication • Problem-solving • Team-working • Attention to detail • Accuracy • Process improvement • Commercial awareness • Customer service • Business case for offsite • Negotiation • Adaptability • Resilience • Organisation

Those working in production roles need well-developed soft-skills equally as much as those working at higher levels. A key differentiator between construction and manufacturing, however, is that the latter relies on a relatively low-skilled or 'de-skilled' worker, heightening the need for those employed in production roles to possess appropriate behaviours and attitudinal characteristics.

"The skills of the person working on the building are the same as working on site, such as tiling. The mindset and work ethic is different to being on a construction site. That's what's most important."

Feedback from stakeholder interview.

Stakeholders consulted for this research identified the following as key skills needs for the future:

- Digital (specifically Virtual Reality and Augmented Reality)
- Robotics
- Analytics

20 Brennan, J and Vokes, C (2017) 'Faster, Smarter, More Efficient: Building Skills for Offsite Construction', CITB

Supply of AMC qualifications and training

Higher Education and academia

The Register of English Higher Education Providers[21] lists 21 providers of higher education programmes in the West Midlands Combined Authority area (Table 6). Some of these providers – such as colleges – offer 'franchised' provision on behalf of a university, sometimes acting as an additional campus. These providers deliver the programmes, which are then awarded and accredited by the respective university.

Three Universities and one Further Education College within the WMCA offer higher education provision related to advanced manufacturing in construction.

Birmingham City University

The University offers 27 courses related to construction and the built environment ranging from Architectural Technology, to Architecture, Building Services Engineering, Building Surveying and Design Management.

Of particular note is 'BA (Hons) Design for Future Living' created in partnership with MOBIE, which aims to develop innovative design thinking which 'prepares a new model of creative, skilled and disruptive designer with knowledge of home, digital technologies and creative design'. The programme aims to offer pathways into employment in a range of areas including design, delivery (e.g. prefabrication, offsite manufacturing) and development.[22]

The course is in its final stages of approval and is accepting its first cohort of applications for a course start date of September 2020.

Aside from the Design for Future Living programme, AMC is incorporated into the content of Masters level courses including Quantity Surveying, Construction Project Management, Planning and Civil Engineering. There is specific coverage in the MSc in Construction Project Management by way of a module entitled 'Integrated project delivery' which covers aspects such as lean concepts and advanced methods of construction.

At the School of Engineering and the Built Environment Dr Franco Cheung is leading a project which aims to *"create a knowledge-based engineering system that allows forecasting and easy planning of DfMA houses"*. The team is working with a major housing association – whg – which is looking to increase its housing stock from 250 new homes a year to 400 new homes a year through the adoption of DfMA[23].
Dr Cheung estimates that an investment of £2m would allow them to scale up the model; they are also currently developing a distribution model of factories that can be replicated in a local area (to reduce logistics).

21 The Register lists all the higher education providers officially recognised by the Office for Students (OfS): https://www.officeforstudents.org.uk/advice-and-guidance/the-register
22 Birmingham City University, Design For Future Living – BA (Hons): https://www.bcu.ac.uk/courses/design-for-future-living-ba-hons-2020-21
23 Birmingham City University, 'Improving the housing crisis by facilitating offsite construction': https://www.bcu.ac.uk/built-environment/research/transforming-building-life-cycle/research-projects/transforming-house-construction-using-design-for-manufacture-and-assembly

Coventry University

Coventry University is home to two research centres focused on the built environment:

- **Built and Natural Environment**
  With an emphasis on design, research areas include the dynamic performance of buildings; occupant and owner response; whole-life decision making; monitoring buildings.[24]

- **Future Transport and Cities**
  Which brings together expertise in art and design; human factors; engineering; manufacturing; computer systems and business studies.[25]

Also of relevance is the centre for 'Manufacturing and Materials Engineering Research'[26] which integrates with the Institute for Advanced Manufacturing and Engineering (the University's collaboration with Unipart Manufacturing). Areas of expertise comprise – amongst other things – supply chain management, process control and materials for advanced technologies. Although the courses offered[27] at the Institute do not include coverage of advanced manufacturing in construction they do cover generic skills areas of relevance, such as engineering material and manufacturing technology a part-assembly manufacturing project, design and computer aided manufacturing and design principles for manufacturing; lean and agile operations, CAD, automation and robotics.

The Centre is currently working on a couple of areas they consider relevant to AMC:

- Fibre composites (a replacement for asbestos)
- 3D printing

Wolverhampton University

The School of Architecture & the Built Environment offers HNCs, HNDs and undergraduate degrees in various disciplines from architecture and civil engineering to construction management, building surveying and quantity surveying. The school also hosts a BIM studio (formerly the Virtual Design Enterprise Centre (ViDEC)) delivering CAD and technology training to industry.[28] Modules on AMC have been introduced in Quantity Surveying and Construction Management undergraduate programmes.

The University offers its most AMC-specific provision at postgraduate level, for example:

- MSc Offsite Housing Construction
- MSc Building Information Modelling for Integrated Construction
- Postgraduate Certificate Building Information Modelling
- MSc Construction Project Management
- Postgraduate Certificate Construction Project Management

The MSc Offsite Housing Construction, developed in partnership with MOBIE and launched in January 2020, currently has a cohort of three leaners, one of whom is based abroad. The distance learning approach to delivery means the programme has a truly international market.

Dudley College of Technology

Although the College currently has limited HE provision – a Construction HNC – it is looking to expand its offer. The College enjoys a partnership with the Sheffield-based Advanced Manufacturing Research Centre (AMRC) and the Manufacturing Technology Centre (MTC), based in Coventry and is currently working on the development of a Higher Education Centre with Wolverhampton University. The Centre is intending to focus on three areas: Advanced Manufacturing; Medical Engineering, and; Modern Methods of Construction.

24 https://www.coventry.ac.uk/research/areas-of-research/built-and-natural-environment/
25 https://www.coventry.ac.uk/research/areas-of-research/institute-for-future-transport-and-cities/welcome-to-the-institute-for-future-transport-and-cities/
26 https://www.coventry.ac.uk/research/areas-of-research/manufacturing-materials-engineering/manufacturing-materials-engineering-research/
27 Manufacturing Engineering MEng/BEng (Hons) and Production Engineering & Operations Management MSc
28 University of Wolverhampton, School of Architecture and the Built Environment: https://www.wlv.ac.uk/schools-and-institutes/faculty-of-science-and-engineering/school-of-architecture-and-built-environment/undergraduate-courses/

The Manufacturing Technology Centre (MTC)

The MTC was established in 2010 as an independent research and technology organisation (RTO) to bridge the gap between industry and academia. Currently the Centre operates across nine markets, which includes Construction & Infrastructure. Since 2015, the MTC has been home to a training centre, offering the Advanced Level 4 Engineering Manufacturing Technician Apprenticeship and a degree apprenticeship (Management of Manufacturing MBA) with Aston University. The centre also offers short courses is areas such as additive manufacture, laser processing, project management and transferable skills such as recruitment management, finance and leadership.

The MTC is a key partner in the Construction Innovation Hub[29] which has recently developed a series of upskilling programmes pitched at Masters level such as an online course in DfMA and Quality Management for Construction. The Hub worked with BRE in developing the content and has an audience of approximately 2,000 companies of all sizes (although mainly large).

Although not originally funded for delivering training, the Hub is considering looking at skills gaps in the industry: mapping what's available and what's needed. This work would potentially focus on three areas: offsite and onsite assistive technology; design; management.

Further Education learning aims

This section focuses on the supply of post-16 qualifications and training available, the analysis has been divided into nationally regulated qualifications offered by Further Education institutions (e.g. Colleges and private providers) and non-regulated training, such as short courses and online modules.

There is a distinct lack of AMC-specific training provision in terms of regulated qualifications.

Ofqual's register contains 83 qualifications with potential relevance to AMC,[30] identified by mapping qualification titles (using existing knowledge of their broad content) to the six main AMC functions, and associated job roles (Table 7).

The mapping focused on level 3+ qualifications because we know from manufacturers that they tend to recruit low-skilled workers for factory floor operations and train them up in-house. Furthermore, existing construction-related qualifications at levels 1 and 2 focus mainly on trade and craft roles (e.g. bricklaying, carpentry and joinery). These qualifications are therefore not directly relevant to AMC-specific roles although, depending on the type of assembly, some of these trades will be used on site for interior fit out and finishing. The long-list of qualifications is available in the appendix.

The BTEC Level 3 Diplomas in Construction and the Built Environment offer a potential route into, and coverage of, AMC. Mandatory units include: sustainable construction, construction technology and design and building technology. Optional units allow the learner to follow a particular route such as surveying, planning, or civil engineering.

- Due to the unitised structure of many level 3+ qualifications, there is limited flexibility for providers to modify content and delivery. Without changes to the content and structure of the units, there is little opportunity to add or increase knowledge or skills development around AMC into these qualifications. Any changes would need to be made by the respective awarding organisation
- Lower level (e.g. level 1 and 2) offer most flexibility for introducing content for AMC because – according to providers – the content is more loosely specified. However, qualifications at this level do not appear to be in demand from AMC employers – specifically manufacturers – because these companies require low-skilled workers who they can train up in-house
- Two AMC-related Level 2 learning aims have been withdrawn,
  - Level 2 NVQ Certificate in Innovative/ Modern Methods of Construction - Cold Formed Steel Frame (Assembly) (QCF)
  - Level 2 NVQ Diploma in Innovative/ Modern Methods of Construction (QCF)

These awards do not appear to have been replaced, confirming the lack of demand for lower level provision for AMC.

29 The CIH is a partnership between MTC, BRE and the Centre for Digital Built Britain (CDBB).
30 This is from a total of 976 'currently offered' qualifications for the Sector Subject Area of 'building and construction'.

Further Education provision in the WMCA

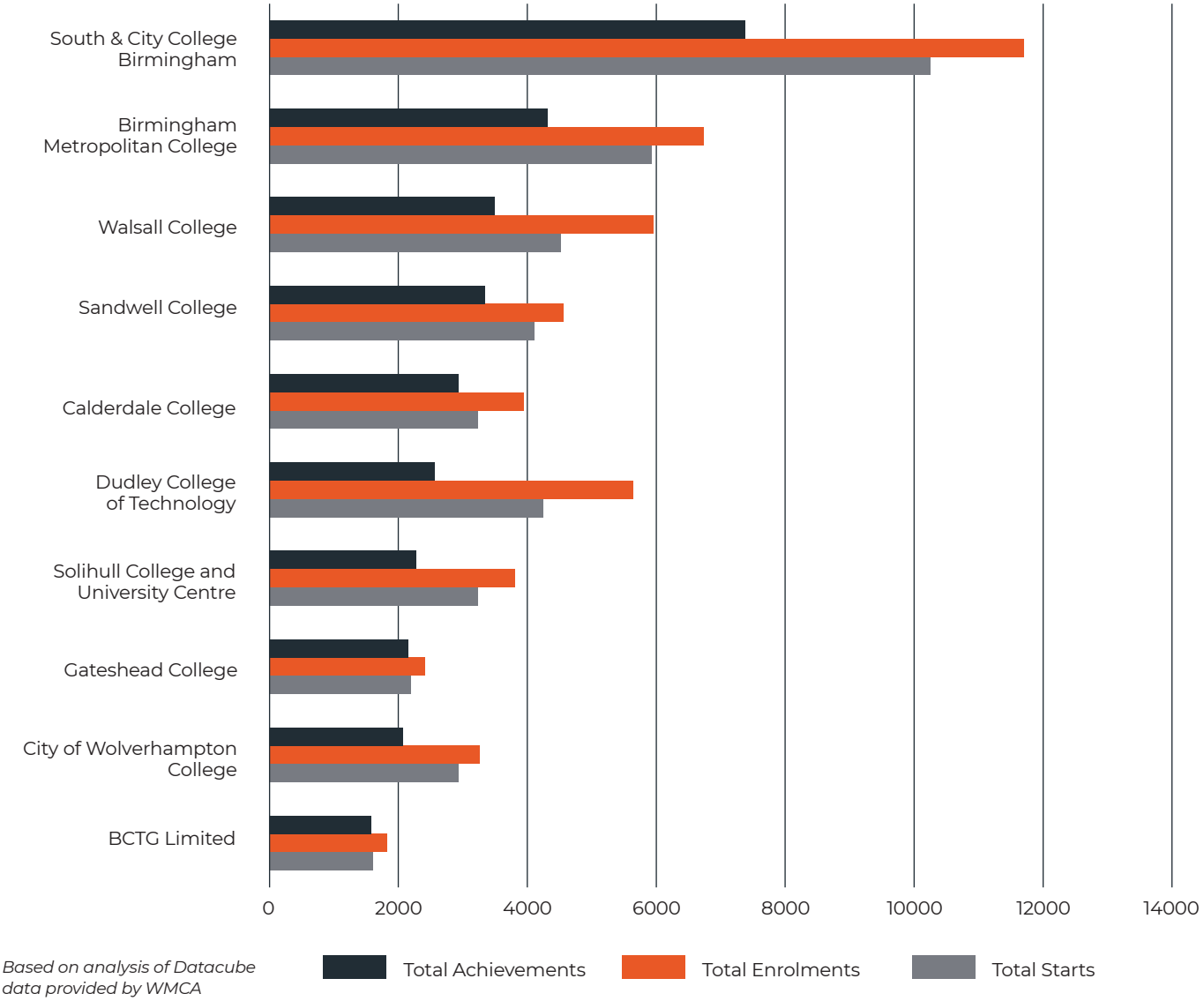
These findings are based on analysis of Datacube data.

Travel to learn distances for relevant qualifications tend to be short. Most learners remain within the WMCA.

South & City College Birmingham provides the highest number of construction-related learning aims to learners resident in the WMCA (Figure 2), ranging from level 1 and 2 trade and craft courses, level 3 BTEC Diplomas, HNC and HNDs in Construction and the Built Environment. Birmingham Metropolitan College's offer is focused on trade and craft courses at levels 1-3 only (Figure 2).

Nine out of the 10 providers are colleges with the only private provider – BCTG, based in Oldbury – specialising in the provision of apprenticeships and 19+adult skills, including pre-employment courses.

Figure 14
Top 10 providers of Learning Aim Sector Subject Area Tier 2 to learners in the WMCA, by total achievements 2016/17 to 2018/19



Based on analysis of Datacube data provided by WMCA

Dudley College of Technology

Although Dudley College is sixth on the list, it offers the most relevant provision needed for AMC at a number of specialist facilities:

- **Dudley Advance** offers full-time and part-time courses linked to traditional processes and emerging technologies in the engineering and manufacturing sectors.
- **Dudley Advance II** has been created in partnership with leading construction companies; it offers apprenticeships in new and traditional trades as well as professional upskilling in areas such as BIM.
- **Advance Technical Engineering and Construction Centre**, based in London, offers niche training in modern building technologies and construction trades.
- **Construction Apprenticeship Training (CAT) Centre** offers facilities for traditional construction trades as well as modern technical and digital-focused skills.

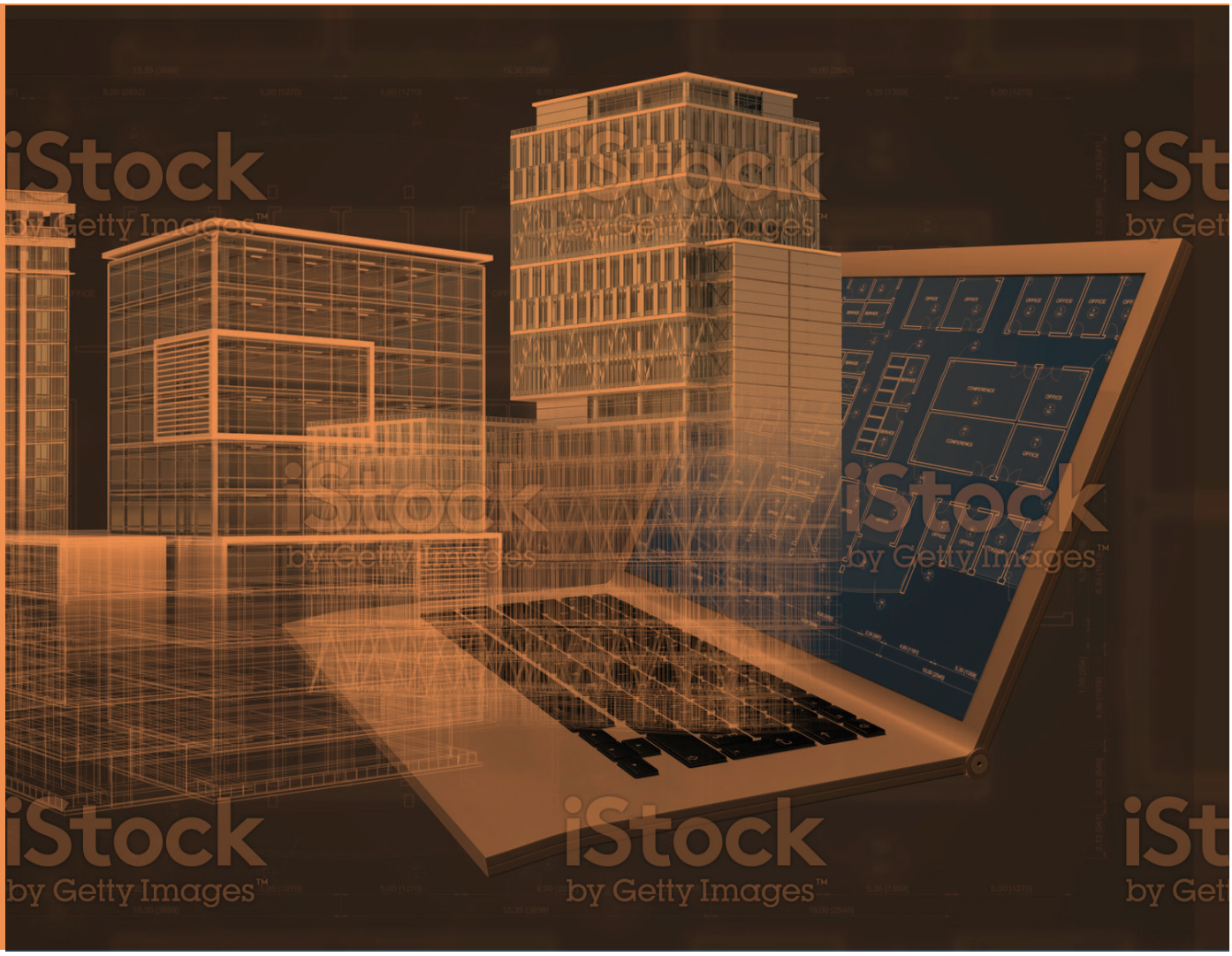
Overview of all SSA Tier 2 learning aims

Of the almost 600 learning aims in Sector Subject Area Tier 2 undertaken by learners resident in the WMCA, the most popular are level 1 and 2 aims – particularly non-regulated provision (Figure 15). The most popular aim – the Level 1 BTEC Certificate in Construction – had 1,072 achievements in the three years 2016/17 to 2018/19, with the QCF predecessor qualification having 825 in 2016/17 alone.[31]

Three of the top 20 most popular learning aims are qualification units:

- Level 2 Preparing for manufacturing operations (9 credits)
- Level 2 Conducting manufacturing operations (9 credits)
- Level 2 Promoting effective working relationships (5 credits)

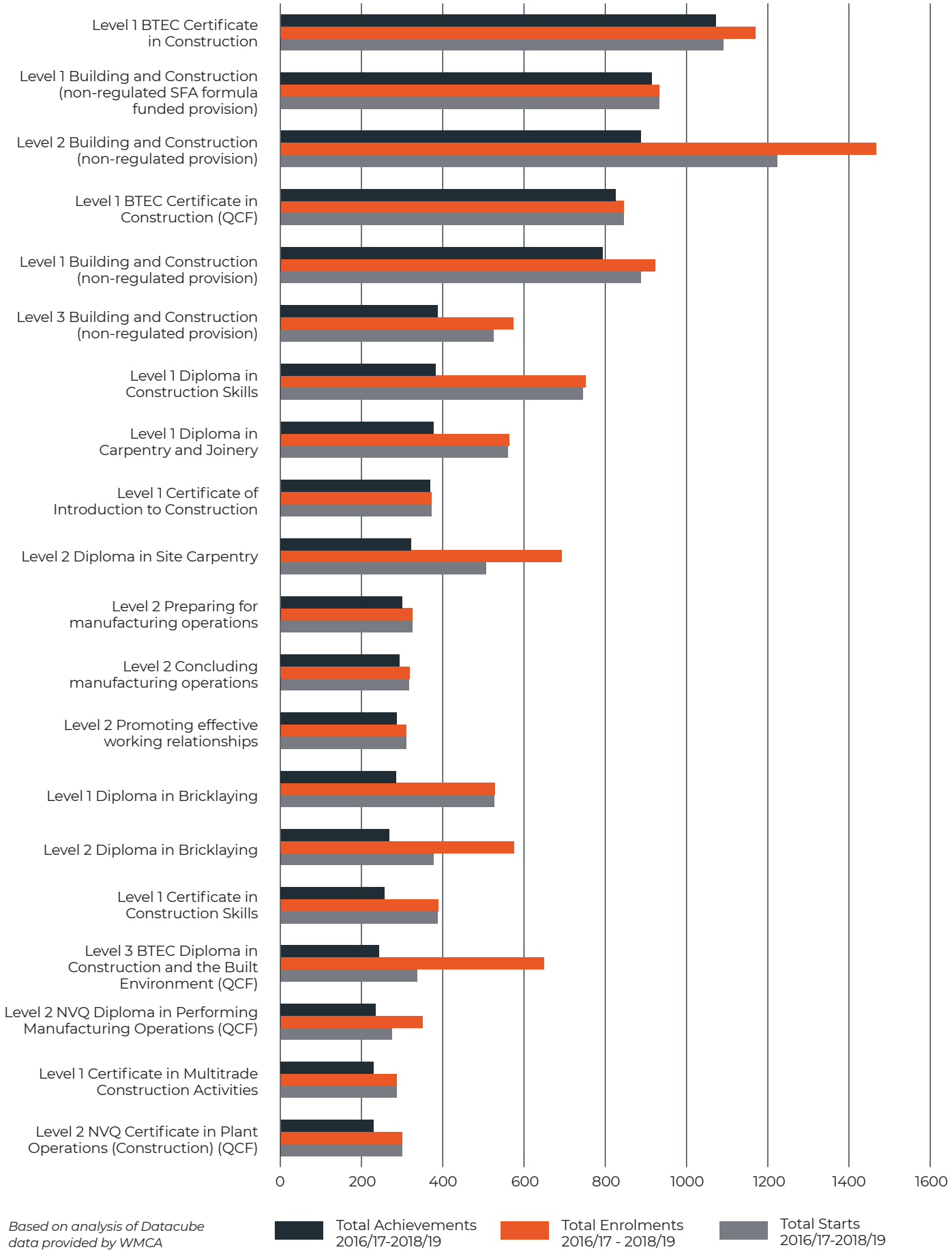
All of these units are components of the Level 2 NVQ Diploma in Performing Manufacturing Operations.



31 No starts, enrolments or achievements were recorded in 2017/18 or 2018/19.

Figure 15

Top 20 Learning Aim Sector Subject Area Tier 2 taken by learners in the WMCA (2016/17 to 2018/19)



Based on analysis of Datacube data provided by WMCA

Potentially AMC-relevant learning aims (Level 3+)

Of the 83 learning aims identified as being 'in-scope' to this study, 29 have been undertaken in the last three years by learners residing in the WMCA. Table 3 lists these aims, showing the number of achievements in the period 2016/17-2018/19; those with '0' achievements had learner starts or enrolments.

Table 3

AMC-relevant qualifications taken by learners resident in the WMCA (2016/17 - 2018/19)

Learning Aim Title	Level	Total starts 2016/17-2018/19	Total enrolments 2016/17-2018/19	Total achievements 2016/17-2018/19
BTEC 90-credit Diploma in Construction and the Built Environment (QCF)	Level 3	159	160	101
BTEC Certificate in Construction and the Built Environment (QCF)	Level 3	6	6	1
BTEC Diploma in Construction and the Built Environment (QCF)	Level 3	337	649	242
BTEC Extended Diploma in Construction and the Built Environment (QCF)	Level 3	261	344	136
BTEC Higher National Certificate in Construction and the Built Environment	Level 4 (original)	168	229	35
BTEC Higher National Diploma in Construction and the Built Environment	Level 4 (original)	27	40	12
BTEC HND Diploma in Construction and the Built Environment (QCF)	Level 4 (original)	32	45	12
BTEC National Diploma in Construction and the Built Environment	Level 3	16	16	2
BTEC National Extended Certificate in Construction and the Built Environment	Level 3	11	11	7
BTEC National Foundation Diploma in Construction and the Built Environment	Level 3	1	1	1
BTEC Subsidiary Diploma in Construction and the Built Environment (QCF)	Level 3	37	41	25
Diploma in Insulation and Building Treatments (QCF)	Level 3	7	7	7
Higher National Certificate in Construction	Level 4 (original)	29	29	0
Higher National Diploma in Construction	Level 5 (original)	5	5	0
NVQ Diploma in Accessing Operations and Rigging (Construction)	Level 3	3	3	0

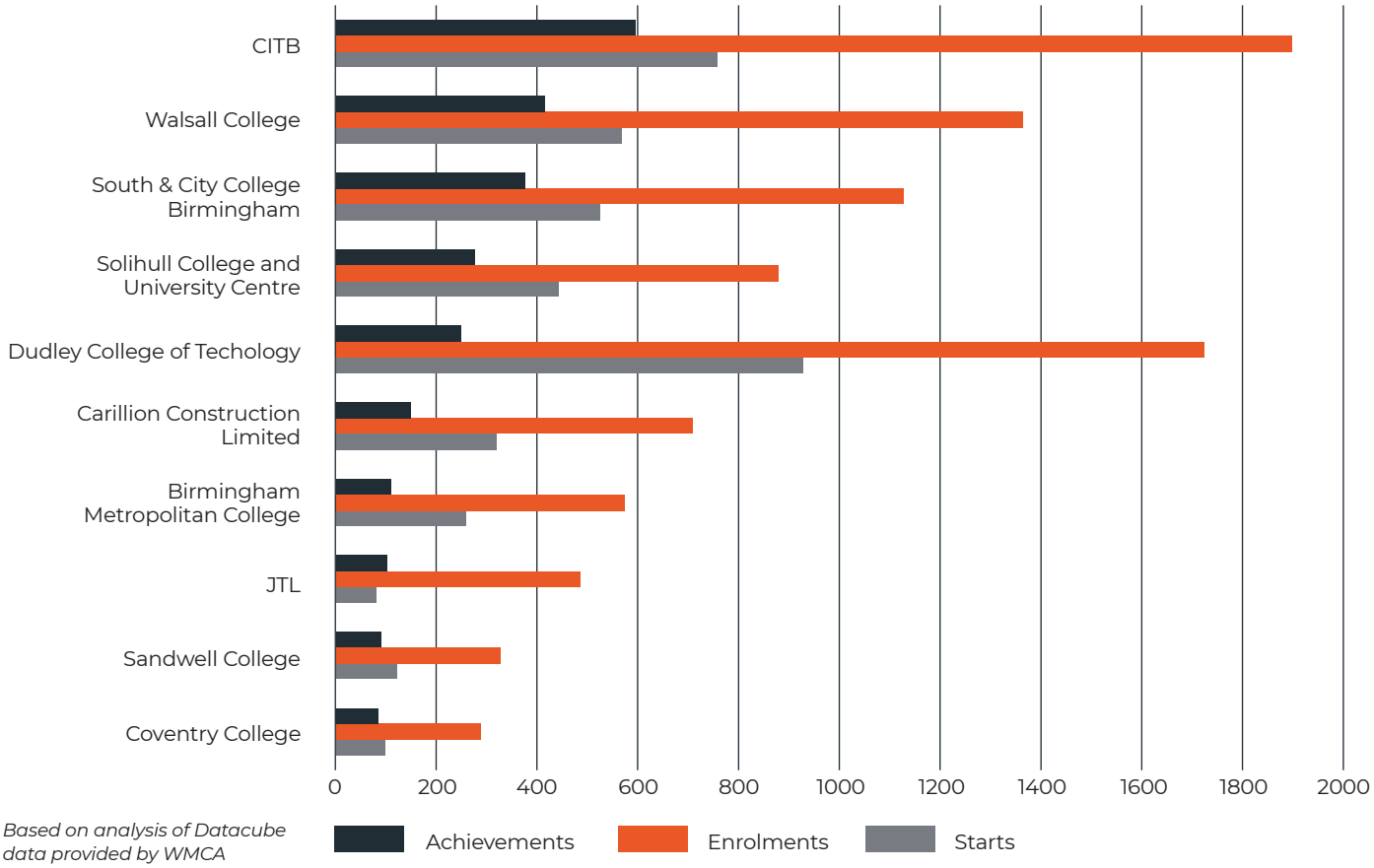
Learning Aim Title	Level	Total starts 2016/17-2018/19	Total enrolments 2016/17-2018/19	Total achievements 2016/17-2018/19
NVQ Diploma in Built Environment Design	Level 3	26	38	1
NVQ Diploma in Built Environment Design (QCF)	Level 3	5	5	0
NVQ Diploma in Cladding Occupations (Construction)	Level 3	10	13	10
NVQ Diploma in Construction Contracting Operations	Level 3	60	161	60
NVQ Diploma in Construction Contracting Operations (QCF)	Level 3	26	85	23
NVQ Diploma in Construction Management (Sustainability)	Level 4 (original)	26	40	6
NVQ Diploma in Construction Site Management (Construction)	Level 4 (original)	0	2	2
NVQ Diploma in Construction Site Management (Construction) (QCF)	Level 4 (original)	2	2	0
NVQ Diploma in Construction Site Supervision (Construction)	Level 4 (original)	30	52	5
NVQ Diploma in Construction Site Supervision (Construction) (QCF)	Level 4 (original)	5	5	1
NVQ Diploma in Occupational Work Supervision (Construction)	Level 3	231	285	172
NVQ Diploma in Occupational Work Supervision (Construction) (QCF)	Level 3	20	53	16
NVQ Diploma in Surveying, Property and Maintenance	Level 3	9	14	1
NVQ Diploma in Surveying, Property and Maintenance (QCF)	Level 3	2	3	1
Total		1551	2344	879

Apprenticeships

Profile of construction apprenticeship providers in the West Midlands

The largest provider of construction-related apprenticeships to learners resident in the WMCA is CITB at Levels 2 to 4+ (594 achievements between 2016/17 and 2018/19), followed by Walsall College (414 achievements) and South & City College Birmingham (375 achievements) (Figure 16).

Figure 16
Top 10 providers of apprenticeships to learners resident in the WMCA (2016/17 to 2018/19)



Based on analysis of Datacube data provided by WMCA

Anecdotally, we have been made aware that the main digital-focused programme of relevance to AMC is the Level 3 Digital Engineering Technician standard. It covers subjects such as virtualisation and simulation of design, construction and management of assets; digital measurement; integration of construction data and information.[32]

The only provider currently offering this Standard in the WMCA is Dudley College, with the fist cohort of apprentices in 2017/18 numbering 12 starts; this increased to 30 in 2018/19. When learning at the college, Apprentices stay at a residential block on campus. Eight of the current apprentices are employed by a large housebuilder.

Looking ahead to future developments, Wolverhampton University is working with MOBIE to develop a postgraduate apprenticeship – an MSc in Offsite Construction. We understand it was felt by the Trailblazer group that postgrad is the most appropriate level of demand as it allows for the accommodation of students from different backgrounds and disciplines. Mark Farmer will be the chair with involvement from MOBIE, Wolverhampton Uni, Urban Splash and others.

32 Digital Engineering Technician: https://www.instituteforapprenticeships.org/apprenticeship-standards/digital-engineering-technician/

T Levels

From September 2020, T Levels will be taught for the first time in England.

The programmes will be offered to young people as an alternative to A levels and incorporate a three-month industry placement. Released in waves, two of the first T Levels for delivery will be in Design, Surveying and Planning for Construction and Digital Production, Design and Development. Stakeholders consulted for this research reported that there is minimal content on AMC within the new construction T Level. A review of the outline content revealed there is only one learning outcome on AMC: 'Construction methods, including traditional and modern methods, e.g. on and off-site construction and robotics'.[33]

Table 4 shows which Colleges in the West Midlands will be offering the construction route.

Table 4
Construction T Level providers in the West Midlands

T Level Provider	2020/21	2021/22	2022/23
Dudley College of Technology	X	X	X
Herefordshire, Ludlow and North Shropshire College		X	X
North Warwickshire and South Leicestershire College			X
Sandwell College		X	X
South & City College Birmingham			X
Thomas Telford UTC (formerly West Midlands UTC)		X	X
Walsall College	X	X	X
Warwickshire College Group			X

Source: DfE, T Level Provider List Final 22 July 2020

33 DfE (2018) 'Construction: Design, Surveying and Planning, T Level outline content: final version for inclusion in ITT'

Informal provision

Informal training (e.g. online modules) relevant to AMC focuses on 'awareness-raising' and/or has a purpose of increasing knowledge and best practice. Examples of sources of online training are listed in Table 5.

The uptake of this type of training is not known, neither are the courses easy to find. For example, none of the training listed above was readily detectable via internet searches using key words such as 'modern methods of construction training', 'modern methods of construction learning', or 'modern methods of construction courses'.

Table 5
Examples of online training for AMC

Supply Chain Sustainability School	Self-assessments, toolbox talks and learning resources covering: • Sustainability • Lean construction • Management • BIM • Offsite
Offsite Ready/Construction Scotland Innovation Centre	Online learning materials and face-to-face events covering: • Offsite fundamentals • Digital design • Estimating/commercial • Logistics • Offsite manufacture • Onsite placement and assembly • Management and integration The website also includes a 'teaching support system' to aid the integration of Offsite Ready content into existing curricula.

Drivers and barriers for AMC skills and training

Drivers for AMC skills and training

Policy

- In the 2018 Construction Sector Deal the UK Government committed to "establish a technical education system that rivals the best in the world to stand alongside our higher education system" as well as investing in maths, digital and technical education to address a shortage of STEM skills. This included increasing apprenticeships to 25,000 a year by 2020 and to increase the number of approved apprenticeship standards as well as increasing diversity of the sector in terms of gender, ethnicity and disability. A key action is to:

> "Develop programmes to retrain the workforce with the skills to support the future industry needs to embed and maximise the use of digital technologies and modern methods of construction".[34]

- An increase in AMC growth in the WMCA would respond to this ambition of improving diversity in the sector. Due to manufacturers' requirement for low- or de-skilled workers in the production environment, they are more likely to recruit from a different labour pool than for traditional trades. This labour pool can include ex-offenders, school leavers and ex-military.

Environmental and sustainability

- There is a need for upskilling in the areas of specification and installation of environmental technologies. The Committee on Climate Change (CCC) has identified substantial skills gaps in housing design, construction and in the installation of new energy efficiency measures.[35] The development of AMC provides an opportunity to help address these skills gaps and more generally respond to the low carbon agenda through better quality, more efficient housing.

Technology

- Since the UK Government published its BIM strategy in 2011, Cabinet Office and the former BIS have been working to implement "a long term programme to embed the use of BIM across centrally procured public construction projects". The government Construction Strategy committed to using Level 2 BIM to deliver publicly funded project which was mandated in the same year.[36] In 2012, the UK Government went further, committing to develop capability in BIM-enabled design for manufacture and assembly (DFMA) and lean construction process.[37]
- The government reaffirmed its commitment to AMC by recommending that government "ensure skills programmes, apprenticeship schemes and the new T Level give learners the skills they need for both traditional techniques and MMC and encourages more young people into the sector". However, the new T levels in construction contain very little content on content on AMC.

Demographic change

- The Independent Review of Build out Rates found that, whilst "availability and price of labour was a significant concern for the major house builders", transferability of skills between certain on-site trades means that labour could be drawn from other construction sectors (and potentially other industries) to meet an increase in demand for trade skills.[38] Consultation with stakeholders for this research suggested that, in the context of offsite, the flow of labour would only be appropriate for the transfer of traditional skills into the offsite manufacture and assembly environment. They suggested that skills leant in the production environment could not easily be transferred into onsite roles.
- This may translate to a need for cross-skilling or up-skilling, potentially in the form of bite-sized training, possibly individual units.
- Stakeholders tend to agree that demands for professional and technical skills will increase, particularly in data use/analytics, VR/AR and robotics.
- This requirement may be exacerbated by a current shortfall in technician-level and management skills. For example, various stakeholders highlight an existing skills gap around the use of BIM.
- At the lower levels, job roles are unlikely to develop, particularly in the manufacturing environment. Therefore, the current low, or no demand for low level qualifications and training is unlikely to change.

34 HM Government (2018) 'Industrial Strategy, Construction Sector Deal'
35 Committee on Climate Change (2019) UK housing: Fit for the future?
36 HM Government (2018) 'Industrial Strategy, Construction Sector Deal'
37 HM Government (2012) 'Industrial strategy: government and industry in partnership, Building Information Modelling'
38 Rt Hon Sir Oliver Letwin MP (2018) 'Independent review of build out: final report, Ministry of Housing, Communities and Local Government

Barriers to AMC skills and training

- Stakeholders confirm that there is currently very little demand for AMC-specific competency-based training or qualifications, however, future demand is likely to be for digital skills, particularly in terms of data use.
- Despite potential demand for higher level design qualifications, specifically around BIM, regulated qualifications are not currently offered to, nor taken-up by, learners in the WMCA. Demand appears to be for short, upskilling courses and for higher level (level 6/7) provision.
- Short, bespoke courses can be more attractive to employers because they only require workers to be away from the workplace for a small about of time. Funded provision of small units may well be attractive to employers for upskilling; this could also be considered as a 'bolt-on' to existing construction/manufacturing-related courses to improve knowledge of and upskill those entering the labour market.
- There is a distinct lack of AMC-relevant provision available for the post-16 market at Level 3+. Of over 1,000 qualifications available nationally for delivery, only 83 are of potential relevance to AMC. However, there are positive developments in the apprenticeship market with the introduction of the Level 3 Digital Engineering Technician and the Level 2 Construction Assembly and Installation Operative and the proposed postgraduate level degree apprenticeship.
- Academics confirm there is an opportunity to embed AMC content into degree programmes; indeed there are examples of this happening in practice in construction management and quantity surveying courses. However, there is an apparent challenge in incorporating AMC into architecture programmes because of the rigidity of the RIBA validation criteria.
- Further Education providers face substantial challenges in attracting and retaining appropriately skilled tutors and assessors for higher level professions – e.g. Civil Engineering, Structural Design, Town Planning, Advanced Manufacturing – because FE is unable to compete with wages paid in industry. There are examples of providers paying industry professionals on a consultancy basis to support delivery.

Case Study

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.

image credit and copyright Urban Splash

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

a. WM has a high value construction sector relative to comparator regions, employing 55,000 people across 10,300 businesses.

b. 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.

c. 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

a. WM is one of the key hubs of AMC nationally, underpinned by strong advanced manufacture capability and transport infrastructure.

b. Nine Tier 1 AMC residential manufacturers are located within the region, and are committed to capacity building within the local supply chain.

c. There is already a strong supply chain which could be equipped to diversify its offering to support growing AMC capability and capacity.

d. There is an opportunity is 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

a. 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.

b. Nationally significant partnership commitment to deliver 10,000 AMC homes with national developer/manufacturer Urban Splash.

R&D, skills and qualifications

a. 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.

b. 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.

c. 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.

d. 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

a. There has been recent decline in the region's construction sector, from nearly 60,000 jobs in 2015 to 55,000 today.

b. 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

a. 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.

b. 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.

c. 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.

d. 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.

e. 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

a. 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.

b. 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.

c. 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

a. 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.

b. 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 inter-operability 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.

Case Study

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.

Case Study

Enabling local distinctiveness through AMC: Beechwood Village

Located in Essex, Beechwood Village is delivering 570 new, custom-build homes to people on a range of incomes, and is utilising AMC and an innovative approach to town planning.

The project is led by Swan Housing in partnership with Homes England and Basildon Borough Council who worked together to secure an outline planning permission that fixed some details, and enabled resident choice within a pre-agreed framework on others. As a result, residents can configure their own home, choosing features including the external treatment, number of rooms and floor layouts, exemplifying the potential for AMC to combine the benefits of manufacture and of consumer choice to deliver high quality and personalised homes.