



ECONOMICS



THE VALUE OF OFF-SITE CONSTRUCTION TO UK PRODUCTIVITY AND GROWTH

A WPI Economics report for Heathrow

Heathrow



WPI Economics would like to thank Heathrow for their support of this report. Thanks also go to the individuals and organisations that helped in our research. In particular we would like to thank those who took time to help us create the case studies found in this report.

Image on front page: Mechanical and Electrical Modules in place between steel towers for Mechanical and Electrical cores. Courtesy of Heathrow.

Disclaimer & Legal

This report has been produced by WPI Economics, an independent economics and policy consultancy. The views expressed in the report are based on independent research and represent solely the views of the authors. They are provided for informative purposes only.

Whilst we undertake every effort to ensure that the information within this document is accurate and up to date, neither WPI Economics nor the report's authors accept any liability for direct, implied, statutory, and/or consequential loss arising from the use of this document or its contents.

WPI Economics Limited. 28 Church Road, Stanmore, Middlesex, England, HA7 4XR. Registered Co. #10086986



WPI Economics is a specialist economics and public policy consultancy. We provide a range of public, private and charitable clients with research, modelling and advice to influence and deliver better outcomes through improved public policy design and delivery. We work with a range of organisations - from FTSE 100/250 companies to SMEs and charities and Central and Local Government.



AUTHOR - MATTHEW OAKLEY

Matthew founded WPI Economics in 2015. He is a respected economist and policy analyst, having spent well over a decade working in and around policy making in Westminster. He had previously been Chief Economist and Head of Financial Services Policy at Which?, and Head of Economics and Social Policy at the think tank Policy Exchange.

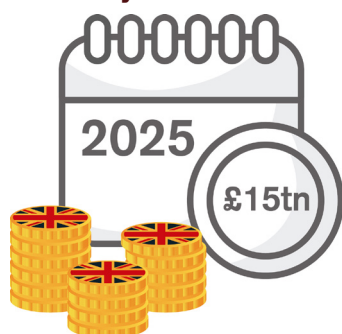
Matthew began his career as an Economic Advisor at the Treasury. He holds an MSc in Economics from University College London. He also led the Independent Review of Jobseeker's Allowance sanctions that reported to Parliament in 2014.

✉ matthew@wpieconomics.com  [@MJ_Oakley](https://twitter.com/MJ_Oakley)

Summary: modernising construction, boosting growth across the UK

The construction sector is vital to the UK economy and to the Government achieving its economic and social ambitions. But, to make the most of the opportunities available, the sector needs to modernise quickly. At the heart of this should be making the most of the skills and expertise that already exist in the sector right across the UK and, in turn, creating a major new export opportunity for our post-Brexit economy by undertaking a fundamental shift towards off-site construction methods.

Value of global construction market by 2025:



The approach comes with significant benefits, but recent research has shown that just 7% of UK construction is currently undertaken in this way.¹ By increasing this proportion to 25%, this report shows that productivity in the sector could increase by 3.6% by 2020. Perhaps most importantly, expertise and experience of off-site construction currently sits outside of the capital and, coupled with lower land and labour costs, this means that increased off-site construction will provide significant economic benefits to regions outside of the Capital. Modelling in this report shows that, by boosting employment and utilising skills and expertise outside of the Capital, the approach would provide a spur to growth outside of London worth some £15 billion up to 2020.

The long-term economic benefits to the whole of the UK are even larger. The global construction market is set to be worth £15 trillion by 2025. UK businesses can be at the forefront of this global market. Revolutionising UK construction through off-site methods would allow the sector to combine effectively with our already globally recognised architects and engineers to create what could become a major export market for an outward facing UK economy. With the UK now looking to forge a strong post-Brexit economy, it is now the time to seize the opportunity and modernise UK construction.

The benefits of off-site construction

Off-site construction methods come with a wide range of potentially large productivity, economic, social and environmental benefits. For example:

- **Faster and more reliable delivery:** new homes constructed off-site can be built 30% more quickly with 25% lower costs;
- **Reduced costs:** driven by efficiencies delivered through standardisation and simplification of processes and increased level and consistency of quality (off-site methods are associated with a 50% reduction in the project costs of dealing with “snagging” and reduced whole-life costs of assets due to improved quality of factors like air tightness and increased life span);
- **Improved workplace safety:** off-site methods reduce the need to work at height or underground and production line techniques provide a safer working environment; and
- **Reduced wastage and environmental impact:** off-site construction can produce the same assets with just half the waste.

Delivering change: business and Government in partnership

In part, this change can be delivered by bold action in the private sector. Heathrow's commitment to use logistics hubs as a major part of its expansion plans show how forward thinking projects can be a catalyst for this approach. The airport's plans will boost productivity, increase sustainability and spread the benefits of the airport's expansion across the UK by creating four logistics hubs to source products from local supply chains. It will then use the centres to either combine products into efficient shipments or pre-fabricate components or whole modules that will be used for the expansion project. By doing so, Heathrow's expansion can provide a

spur to modernisation of the construction sector.

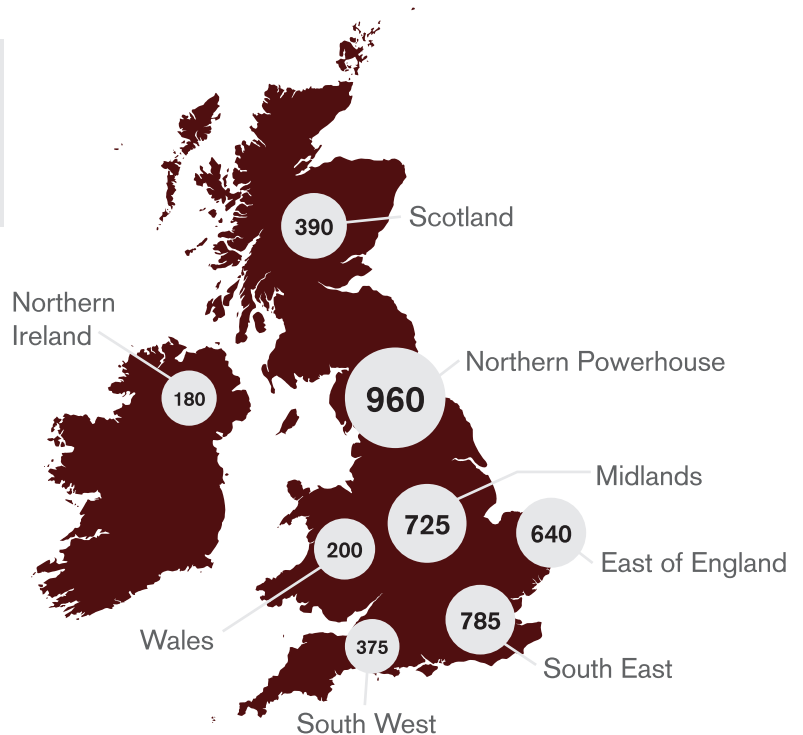
Central and local Government also have a role to play. The potential of off-site construction and the Government's Industrial Strategy Green Paper and Housing White Paper both committed to supporting the approach. However, more needs to be done more quickly. They must act in partnership with the private sector: leveraging their role in procuring significant infrastructure projects and supporting the growth of off-site by encouraging and incentivising the development of off-site clusters.

Taking this action will allow the sector to be at the heart of the Government's ten pillars of industrial strategy, it's ambitions for the UK as an outward looking trading nation, and its attempts to drive growth through upgrades to critical infrastructure, build enough affordable housing and deliver on the UK's sustainability goals.

Increasing the proportion of construction undertaken off-site to 25% would provide a significant economic boost to all regions outside of London.

Increased GVA in 2020 (£million)

Source: WPI Economics Modelling.
Figure shows central case of 20% increase in productivity from off-site construction



To achieve these goals, this report recommends that:

- The Government and construction sector should commit to a target of moving 25% of construction to off-site methods. As part of this, the Government should commit to a target of at least 30% off-site construction in major projects procured over the next five years.
- When developing its approach to reporting on the balanced scorecard policy, the Government should report on the number of tenderers proposing off-site construction methods and the proportion of these that were successful.
- Central and local government and industry bodies should work together to develop clusters built around off-site construction expertise. To encourage these, local areas should consider providing targeted incentives, such as a reduction in business rates to centres developing off-site construction expertise.
- The Government should explore whether national planning policy could be amended to give preference to applications that involve the use of off-site techniques.

Introduction

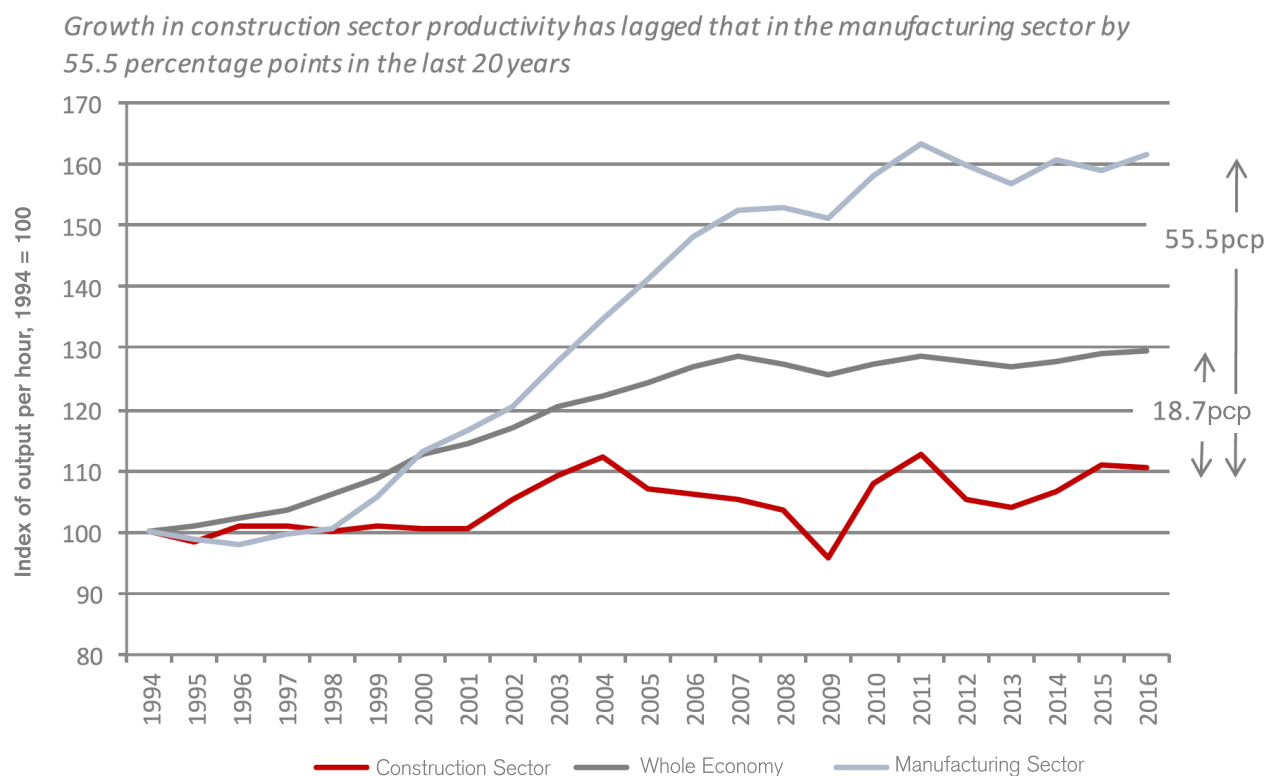
The construction sector is critical for the UK. It contributes over £100 billion to the economy and employs well over two million people. As such, it is directly providing jobs and incomes for families in all regions.² More broadly, it impacts on the living standards of everyone in the UK through the built environment surrounding us all and supports economic activity in all other sectors by providing the buildings and constructed assets through which economic activity takes place.³

Within this context, it is no surprise that the sector is at the heart of ensuring that the UK Government meets its growth and social objectives. At home, whether through building affordable housing or developing critical infrastructure the construction industry will play an instrumental role. And with a global market estimated to be worth \$15trillion by 2025, and the UK seen as having a competitive advantage in construction, there is a huge economic opportunity for an outward looking UK to be at the forefront of this global market.⁴

The Challenge

That is not to say that success is assured. The UK's productivity puzzle is a well-rehearsed concern and construction has been a sector that has performed particularly poorly.⁵ Over the last 20 years, whole economy productivity in the UK has risen by over 30% and productivity in the manufacturing sector has grown by over 60%. In contrast, productivity in the construction sector has increase by a little over 10%.⁶

Despite recent success stories, including the 2012 Olympics and the construction of Terminals 2 and 5 at Heathrow, the sector also has a mixed reputation for delivery. A 2016 survey showed that just 68% of projects finished within budget and only 41% came in on time or better.⁷



Source: ONS Notes: Seasonally adjusted

The need to take action to improve the performance of the construction sector has been a recurring theme in the national policy debate for many years. For example, in 2013, the Coalition Government and construction industry put forward a joint desire to:

- Lower the initial construction and whole life costs of buildings by 33%;
- Reduce the time from inception to completion for new build and refurbished assets by 50%;
- Reduce greenhouse emissions in the built environment by 50%; and
- Improve export performance by 50%.⁸

These are ambitious targets, and achieving them would mean ensuring that the UK construction sector places itself at the forefront of technology, innovation and standards. As such, it could play a vital role in delivering the 10 pillars for industrial strategy identified by the current Government: helping close the significant productivity deficit that the UK has compared to its key global competitors; opening up new markets for UK businesses to export to and grow into; boosting skills; facilitating investment in research and innovation; and helping spread growth across the UK.

“Productivity in the UK lags our G7 competitors by 17%”

“The gap in productivity has increased by 5 percentage points in the last 15 years.”

Source: ONS

Getting to this point will require the sector to address the challenges identified in numerous reports over the last two decades. These include skills shortages, a lack of collaboration and the fact that, unlike other sectors, adoption of technological opportunities and processes such as “lean” has been slow.⁹

The role of off-site construction

A key example of this slow up-take of innovative approaches, and the focus of this report, is off-site construction. The term is a catch-all phrase used to describe a range of construction activities that involve bringing together construction processes, components, elements or modules in a factory before installation into their final location.

The approach is not new, having been used since Roman times and, perhaps most famously, in the construction of Crystal Palace in London and prefabricated houses built across the UK following the Second World War. However, the level of sophistication and technology now used in the process means that it is viewed as a “Modern Method of Construction”, with a wide range of potentially large productivity, economic, social and environmental benefits. Numerous reports over the last 20 years have highlighted these benefits and advocated for more projects to adopt the approach.¹⁰ However, recent research has shown that just 7% of UK construction is undertaken in this way.¹¹

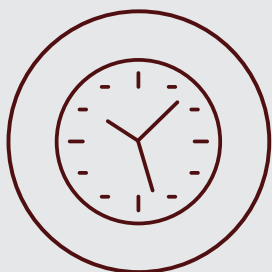
This report uses new quantitative and qualitative analysis to demonstrate the potential value of off-site construction to the UK economy and living standards. It highlights barriers to adoption and puts forward recommendations for how the sector can be supported to take off-site construction to the next level by increasing adoption and further improving the approach.

Why use off-site construction methods?

The obvious first question is why move construction off site, when it can be undertaken on site? Existing research and practical examples demonstrate some significant advantages over more traditional on-site construction methods. These include:



More reliable delivery: on-site methods are impacted significantly by the weather, site conditions and access conditions. With off-site methods, each of these are controlled within a factory environment, providing greater certainty and allowing improved delivery. A clear example here is Portakabin Group, who delivered nearly 100% performance in delivering off-site projects on budget and on time over a 12-year period. The industry average over the same period was 40% for timeliness and 30.7% for budget accuracy.¹²



Greater efficiency: these same factors also lead to off-site construction being associated with speedier project completion. This is also facilitated by the fact that activities can take place concurrently and be scheduled for “just in time” delivery, when needed on site.¹³ The NAO previously demonstrated that off-site construction methods could reduce onsite build time for housing by over 50% and more recent work at the BRE innovation site has shown that a house can be built in just one day.^{14,15} Industry case studies suggest that overall this means that homes constructed off-site can be built 30% more quickly with 25% lower costs.¹⁶



Improved and more consistent quality: these benefits typically arise from the fact that the factory environment facilitates the use of tighter controls and more consistent and standardised processes. As well as the obvious benefits of improved quality, this drastically reduces the need (and associated cost) of re-design and re-work.¹⁷ It is estimated that off-site methods are associated with a 50% reduction in the project costs of dealing with “snagging”.



Improved safety and workforce satisfaction: An average of 2.2million working days were lost to work-related injuries and ill health in the construction sector each year between 2013/14 and 2015/16. At its most extreme this led to 43 fatal injuries, representing nearly a third of all fatal workplace injuries in the UK.¹⁸

The overall costs of workplace injury and work-related illness in the construction sector is around £1.2 billion a year.¹⁹

Off-site construction has the potential to significantly reduce the risk of accidents and ill health. The HSE list a range of potential advantages, including that it provides a controlled, clean and warm environment, uses production line techniques and standards, reduces the need to work at height or below ground and reduces exposure to UV.²⁰



Reduced environmental impact: by reducing traffic flows to and from the construction site, there are significant benefits in terms of congestion and, by implication pollution in the local area. Recent research based on case-studies has suggested that projects using off-site construction can deliver a reduction of between 20% and 60% in metric tons of CO₂ associated with project transport.²¹

Substantial benefits in terms of waste are also possible. Traditional methods are associated with 10%-20% raw material wastage, however with more advanced techniques, for example the use of CAD / CAM, off-site construction can produce the same assets with just half the waste.²²

The energy use associated with the completed assets can also be lower. This is a result of the fact that off-site construction is generally associated with higher and more consistent build quality, for example, leading to improved air-tightness. Estimates suggest these savings could be as high as 25% over the asset life.²³



Increased support from local residents: the vast majority of the UK population support the development of critical infrastructure²⁴ and housing. Nearly nine in ten people want to see higher levels of investment to improve infrastructure and nearly three quarters of people think that there is a shortage of housing that they would be able to afford.²⁵

However, the challenges with gaining support from both residents near construction sites and planners are apparent in the UK's long history of slow development. Concerns about the construction process itself are often important in explaining this. For example, responding to qualitative research for a recent report one local authority Director of Planning argued that "...they [local residents] don't actually object to the new houses... It's the lorries, the diggers and all that sort of stuff." In the same report, a London Councillor suggested that: "...people are sick and tired of living on the construction site, because it never ends. There is always something going on: trucks going up and down..."²⁶

Off-site construction can significantly ease the concerns of local residents. By reducing time, headcount and the range of activities that need to be completed on-site, compared to traditional on-site methods, it leads to projects that are completed on site, compared to traditional methods, it leads to projects that are completed more quickly with less noise, less local air pollution and less traffic disruption.

The current use of off-site construction

Off-site construction methods are already used successfully in a wide range of countries in a number of settings, but most notably in house building and infrastructure development.

For example, recent research suggested that over half of the new homes planned by 17 of the UK's largest Housing Associations would be constructed using off-site methods.²⁷ And it is not just small properties that can be built in this way. For example, Build to Rent developer Essential Living has adopted a pre-manufactured approach to delivering its 23 and 12 storey residential blocks in Creekside Wharf, Greenwich²⁸. In Singapore, two 40-floor residential towers are currently under construction, with the intention of using off-site methods for 65% of the towers' superstructure.²⁹

As well as the obvious benefits to the supply of affordable housing, the approach provides an opportunity to develop centres of expertise and to spread the benefits of growth across the UK. This is clearly demonstrated by Legal & General's investment in a modular housing factory in Leeds.³⁰ These potential benefits are also demonstrated in the case studies below.

Case study: Ocean Academy

The Ocean Academy is a school for 340 pupils which opened in September 2015. The building was constructed using modular design with 90% of the building being manufactured off-site. The total time taken from design to completion of the project was 62 weeks, with the majority of manufacturing occurring over a 10-week period at McAvoy's off-site location. This was partially enabled by the fact that off-site methods meant that building sections could be manufactured at the factory in Northern Ireland while site preparation and civil works were being carried out concurrently, saving significant time compared to normal construction methods.



Picture: Ocean Academy, courtesy of McAvoy Group

The modular nature of construction meant that there was an emphasis on using standard grids and room layouts to maximise compatibility between items, and specialist areas such as a large hall, a dance studio, and libraries were added. Large sections of the building were manufactured and then shipped, resulting in faster on-site construction and the need for fewer deliveries to site, increasing productivity. Furthermore, the fact that construction was done in a factory setting meant it was highly predictable as it was not affected by items such as adverse weather, allowing for construction to happen quicker, and with a higher level of productivity than if conventional means had been employed.

The use of a factory environment also permitted health and safety and sustainability processes to be more codified and reliable. This was partially due to the fact that factory environments can be safer than live external sites, in turn meaning a lower rate of accidents, but also because the competency of supply chain members and their commitment to health and safety was regularly tested. Whilst not impossible to achieve with conventional methods, the use of off-site construction embedded in the process from design to construction achieved more reliable outcomes such as on time project completion and a building that produces lower CO₂ emission levels during its operational phase than the levels predicted during its design phase.

Case study: the use of off-site construction in large-scale infrastructure projects

Off-site construction has been used on large infrastructure projects before, including components of Crossrail being manufactured in the West Midlands. Another example is the use of off-site construction methods to assist with the construction of Terminal 2 and Terminal 5 at Heathrow. In both cases, to expedite construction and join local supply chains with the national project, components were constructed off-site before being shipped semi-finished or pre-fabricated to the construction site.

For Terminal 5 this included Mechanical and Electrical (M&E) modules that were assembled in areas including the West Midlands, Kent, and Renfrew in Scotland, before being transported by road to Heathrow. Other components included floor slabs for car parks from Scotland, drywall construction from West Sussex, and joinery and fit-out of toilets from Northern Ireland. These were not just small elements of the overall construction; they included the structural steelwork for Terminal 2, which was constructed in Lancashire and Yorkshire and also the roof cassettes used in Terminal 5.

In the case of both Terminals, this off-site assembly was facilitated through the Colnbrook Logistics Centre which acted to coordinate and consolidate materials, as well as for coordinating efficient delivery of bulk materials. Whilst it is difficult to aggregate the overall savings in terms of time, or the collective safety benefits, they clearly exist. For example, it is estimated that the offsite construction of 14 prefabricated risers for Terminal 5 saved approximately four months per riser compared to conventional construction. Overall, the use of offsite construction made it substantially easier to build both Terminal 2 and Terminal 5 at a quicker pace and with less disruption than traditional methods would allow, and that it also resulted in the work for these projects being spread across the country.



Picture: precast concrete beams for multi-storey car park ramp. Source: Heathrow.

The future of off-site construction

These examples show how off-site construction has already been used successfully in the construction sector. The challenge for the UK construction industry going forward is to both increase take up and innovate to improve the approach.

Increasing take-up

The use of off-site construction methods has been increasing steadily in countries including Japan, Malaysia, the USA, Australia and the UK. However, overall adoption is, on the whole, relatively low. To tackle this issue, policy makers in many countries are considering how to increase adoption. Examples of initiatives include:

- In the USA, the Government has taken steps to regulate to introduce standards and codes to support the development of the approach;³¹
- In Malaysia, the UK and USA dedicated centres have been established to share best practice, encourage cooperation and coordinate research and training;
- In Singapore the Building Control Authority mandates the use of prefabricated, prefinished volumetric construction (PPVC) on some sites and has established fund to incentivise adoption of the techniques and workforce / capability development.³²

However, a range of barriers to future up-take still remain. These include:

- **Pipeline:** A lack of existing and committed future demand means that the investment costs of developing off-site construction centres can be too uncertain.
- **Skills:** the approach requires the construction sector to collaborate and build a wide range of new capabilities and skills. For example in design for manufacture and assembly, production engineering and project integration.³³ Combined with an existing skills deficit in the construction workforce, this presents a real challenge.

This means that, if adoption is to take off, a step change in approach is needed and government can do much more to support this.

Future innovation

But ensuring that off-site plays its role in the renaissance of UK construction is not just about take-up or about what the Government can do. To make the most of future opportunities, the sector will need to continue to improve, enhance and adapt the approach. The private sector has a key role to play here and examples of good practice are already being seen. For example, Heathrow's plans to use logistics hubs for its expansion provide a vital opportunity to introduce a step change in off-site construction and productivity. Other examples can be seen in plans for the delivery of HS2.

Case study: the use of logistics hubs in the expansion of Heathrow

Heathrow's expansion requires leveraging a £16bn supply chain and off-site construction will be integral to delivering this. Heathrow plans to create four logistics hubs to source products from local supply chains, and then use the centres to either combine them into efficient shipments, or to pre-fabricate whole modules of the buildings or component that will be used for the expansion project. As an example, Heathrow are currently investigating whether pre-cast concrete might be used to speed up runway construction, and are examining where it has been used previously in airports such as Chicago and Atlanta.

The result of approaching the whole project like this is that some 60% of the procurement spend will be outside of London, spreading the benefits of local investment regionally and nationally. This is reflected in the job creation figures, which are forecast as around 108,000 in total outside of London and the South East.

Making off-site construction central to the expansion enables a number of different benefits. First, by making it an integral part of the strategy, affordability and efficiency are boosted, and a concerted effort is made to ensure that the whole project has regional and national benefits that go beyond London. Costs are also likely to be reduced by streamlining transport of components, and health and safety and productivity gains can be more effectively realised due to the larger scale of off-site construction used. Last, by using these methods, delivery can occur to the tight timeline, without creating more disruption than necessary.

The planned logistics hubs will also continue to exist after expansion, providing a vital focus for regional skills and growth strategies by either serving other projects, or helping local supply chains export their products to other areas of the UK, or abroad. This case study represents an example of how off-site construction might be made more central to large infrastructure projects in the future, and the benefits that such an approach could bring.



Picture: Heathrow's approach to expansion will build on the success of Terminal 2 and 5. Source: Heathrow.

Estimating the benefits of increased use of off-site construction

The examples above show that, as the approach becomes more and more sophisticated, the benefits of the UK increasing the use of off-site construction are wide ranging. There are many routes through which they could occur:

- Improved working practices, skills and efficiency could help boost productivity in the construction sector and wider economy;
- By facilitating quicker project completion and easing local resident's concerns on construction, it would mean a speedier and more cost-effective upgrading of the UK's critical infrastructure;
- Off-site construction centres can form a lasting body of construction expertise, providing a long-lasting economic boost to the area in which they are located;
- These centres can also provide a focus for skills and investment policy – facilitating the growth of a high-skilled economy from which agglomeration effects can be felt;
- By creating a lasting economic centre – small businesses can be supported to contribute to the supply chain, driving growth in this important demographic of businesses; and
- Importantly, these benefits are not just felt by those in the area surrounding the construction activity. By moving construction off-site, economic activity is more effectively spread around the country, meaning that it can play a strong role in ensuring that regions all across the UK benefit from economic growth, increased skills and productivity and higher living standards.

To better understand some of these potential effects, WPI Economics undertook modelling based on the expected impact of increasing off-site construction. These figures are not definitive, the precise impacts will depend on the nature of the growth in off-site construction, the parts of the construction sector that embrace it and wider factors like technological change. However, they provide a range of scenarios to help the reader understand the potential scale and nature of benefits that might be felt.

The model created for this research is based varying two key assumptions:

1. The extent to which off-site construction leads to increased per-job productivity compared to standard on-site construction methods. We have modelling the following cases:

Low (10% more productive) / Mid (20% more productive) / High (30% more productive)

Our central case is the “mid” value. Given the increases in speed, safety and quality highlighted above, we believe this to be a conservative estimate.

2. The increase in proportion of work in the construction sector that is undertaken off-site. We have modelled the following cases against the baseline of current 7% coverage:

Short-term (25% coverage) / Aspiration (50% coverage)

Our central case is chosen to be the low coverage figure. Whilst some industry experts believe that it will be possible to undertake up to 70% of all construction activity off-site, we believe the 25% figure is deliverable over 5-10 years, whilst the 50% coverage should represent a longer-term aspiration for the sector.

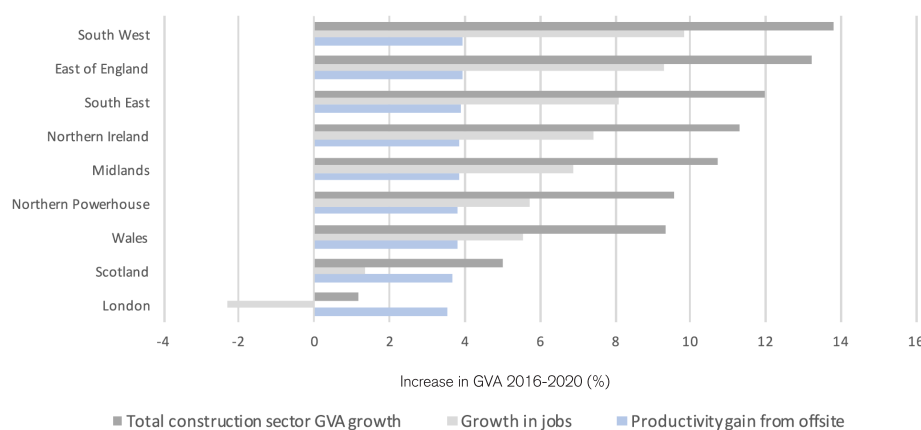
It has also been assumed that, compared to the existing UKCES baseline of jobs growth, a move to off-site construction results in more significant growth in of construction jobs over the next ten years (in line with the proportionate increase in off-site coverage) outside of London.

Results from our central, but conservative, case suggest that, if the construction industry were able to increase the use of off-site construction so that 25% of all work is undertaken off-site, it would be associated with an increase in GVA per job of 3.6%.

Combined with growth in construction sector jobs modelled by the UKCES, this suggests construction sector GVA increasing in all regions of the UK.³⁴ However, given the existing (and likely future) distribution of expertise in off-site construction, our model suggests that employment growth will be concentrated outside of London. This provides a large boost to those regional economies, with GVA in regions outside of London increasing by £4.3 billion by 2020 as a result of the shift to off-site methods. This is driven by:

1. Off-site construction methods improving productivity across the sector;
2. Off-site construction methods leading to a redistribution of construction jobs growth outside of the Capital.

A shift to off-site construction methods will increase productivity all across the UK and boost jobs growth in regions outside of London.



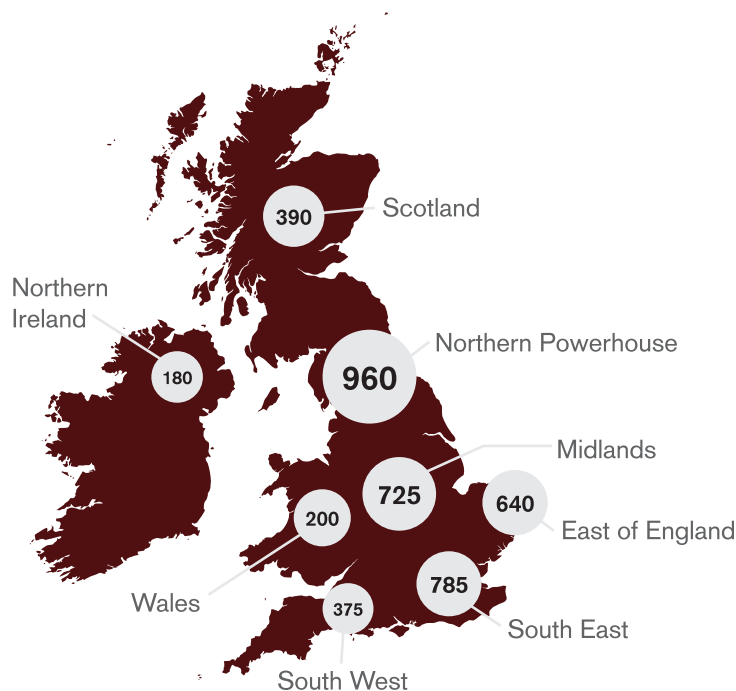
Source: WPI Economics modelling using ONS & UKCES data. Notes: mid productivity, short-term take up case is shown.

Looking in isolation at the impact of the increased use of off-site construction, we see that, in our central case, GVA in the Northern Powerhouse and Midlands would increase by £960million and £725 million, a year respectively over the next four years alone. If more ambitious targets for increasing off-site construction could be met – these figures could rise significantly.

Increasing the proportion of construction undertaken off-site to 25% would provide a significant economic boost to all regions outside of London.

Increased GVA in 2020 (£million)

Source: WPI Economics Modelling.
Figure shows central case of 20% increase in productivity from off-site construction



How to encourage off-site construction

This report has identified the clear benefits of off-site construction. It is also apparent that the Government and industry bodies are keen to take action to improve both the take-up of the approach and the level of innovation in the sector. The question is what can be done to deliver this.

Four proposals to place off-site construction at the heart of the Government's industrial strategy are outlined below.

Government procurement

The Government has recently committed to rolling out its “balanced scorecard” approach to procurement across all major construction, infrastructure and capital investment projects worth over £10million. The approach has a clear role in facilitating the growth in off-site construction as (amongst other aspects) it allows those buying goods and services to include consideration of factors such as: environmental sustainability; resource efficiency (including wastage); and health and safety.

Each of these are areas where off-site construction can demonstrate tangible benefits compared to traditional methods suggesting that, where the approach is taken seriously, tenders employing off-site construction should have a material advantage. The “balanced scorecard” approach also allows for more direct requirements to bidders to adopt specific methods of delivery, meaning that procurement processes for some projects could make the requirement for a given proportion of the project to be delivered off-site. This is a positive step from government, but to ensure that it has the impact it should:



Recommendation: the Government and construction sector should commit to a target of moving 25% of construction to off-site methods. As part of this, the Government should commit to a target of at least 30% off-site construction in major projects procured over the next five years.



Recommendation: when developing its approach to reporting on the balanced scorecard policy, the Government should report on the number of tenderers proposing off-site construction methods and the proportion of these that were successful.

Planning and regulation

The Government has also already committed to promoting the use of off-site construction in house building. However, the recent housing white paper lacks firm proposals to deliver on this commitment. To ensure that it has traction:



Recommendation: The Government should explore whether national planning policy could be amended to give preference to applications that involve the use of off-site techniques.

Local growth and devolution

Developing expert centres for off-site construction would have clear benefits for the areas where they are located: providing a basis for skills and investment strategy, attracting a high-skilled workforce by providing clear career paths; and providing significant supply chain opportunities for SMEs. To make the most of the opportunities that this provides, lessons can be learnt from the Advanced Manufacturing Park in Rotherham.³⁵



Recommendation: central and local government and industry bodies should work together to develop clusters built around off-site construction expertise. To encourage these, local areas should

consider providing targeted incentives, such as a reduction in business rates to centres building off-site construction expertise.

Conclusion

This report has demonstrated the clear importance of UK construction in securing productivity, growth and international competitiveness for the UK economy. However, it has also shown that, to ensure the sector plays the role that it should, it will need to take steps to evolve and modernise. Off-site construction should be at the heart of that transformation. Increasing and improving the role that it plays would boost productivity, improve reliability and safety and drive growth in the construction sector and UK economy more broadly. Perhaps most importantly, off-site construction provides a vital opportunity to deliver growth across all of the UK regions and develop a foothold in a major global construction market.

Annex: headline results from modelling

All figures are in £ million increase in GVA between 2016 and 2020

25% off-site coverage	Total	Of which move to off-site	Total	Of which move to off-site	Total	Of which move to off-site
Northern Powerhouse	1,403	612	1,753	962	2,103	1,311
Midlands	1,220	458	1,487	724	1,754	991
East of England	1,443	386	1,696	638	1,948	891
London	-116	-1,024	241	-667	598	-310
South East	1,719	449	2,052	783	2,386	1,117
South West	868	231	1,013	376	1,158	521
Wales	247	139	310	202	373	266
Scotland	246	246	389	389	531	531
Northern Ireland	223	136	269	182	315	228
UK Total	7,254	1,632	9,210	3,589	11,167	5,545

All figures are in £ million increase in GVA between 2016 and 2020

50% off-site coverage	Low productivity case (10% increase)		Mid productivity case (20% increase)		High productivity case (30% increase)	
	Total	Of which move to off-site	Total	Of which move to off-site	Total	Of which move to off-site
Northern Powerhouse	2,195	1,403	3,043	2,251	3,891	3,099
Midlands	1,813	1,051	2,460	1,697	3,107	2,344
East of England	1,950	892	2,559	1,502	3,168	2,111
London	-1,231	-2,139	-444	-1,353	342	-566
South East	2,316	1,047	3,120	1,850	3,923	2,653
South West	1,169	532	1,521	883	1,872	1,235
Wales	424	316	578	470	733	625
Scotland	566	566	910	910	1,254	1,254
Northern Ireland	391	304	505	418	620	533
UK Total	9,593	3,972	14,251	8,630	18,909	13,288

Source: WPI Economics modelling using ONS & UKCES data.

- Note that providing a precise estimate is difficult. The most frequently cited estimate is from a 2013 UKCES report and is the figure used here. UKCES, (2013). Technology and skills in the construction industry. UKCES, London.
- HM Government, (2013)., Construction 2025. TSO.
- WEF, (2016), Shaping the Future of Construction A Breakthrough in Mindset and Technology. Prepared in collaboration with The Boston Consulting Group. Accessed online at http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Construction_full_report_.pdf, 05/04/16.
- HM Government, (2013)., Construction 2025. TSO.
- BEIS, (2017), Building our Industrial Strategy. TSO; Farmer, M., (2016). The Farmer Review of the UK Construction Labour Model. The Construction Leadership Council (CLC), London.
- ONS, Labour Productivity time series dataset.
- Glenigan, (2016)., UK Industry Performance Report: Based on the UK Construction Industry Key Performance Indicators. Available at: https://www.glenigan.com/sites/default/files/UK_Industry_Performance_Report_2016_LR.pdf?sid=77198 Accessed 06/04/17.
- HM Government, (2013)., Construction 2025. TSO.
- Farmer, M., (2016). The Farmer Review of the UK Construction Labour Model. The Construction Leadership Council (CLC), London; KPMG, (2016), Smart Construction: how off-site manufacturing can transform our industry. KPMG; HM Government, (2013)., Construction 2025. TSO.
- For example see DTI, (1998), Rethinking Construction: the report of the construction taskforce. HMSO, London; HM Government, (2013)., Construction 2025. TSO.
- Note that providing a precise estimate is difficult. The most frequently cited estimate is from a 2013 UKCES report and is the figure used here. UKCES, (2013). Technology and skills in the construction industry. UKCES, London.
- <http://www.yorkon.co.uk/news-and-views/project-delays-in-uk-construction-continue-to-worsen/>
- Hairstans, R., (2013), Building off-site: an introduction. A report sponsored by the UKCES. Available at

- http://www.buildoff-site.com/content/uploads/2015/06/Building_Off-site_An_Introduction.pdf Accessed 06/04/17.
14. NAO, (2005)., Using modern methods of construction to homes more quickly and efficiently. NAO, London.
 15. <https://ipark.bre.co.uk/parks/england/buildings/Userhuus>
 16. DCLG, (2017). Fixing our broken housing market. HMSO, London.
 17. KPMG, (2016), Smart Construction: how off-site manufacturing can transform our industry. KPMG.
 18. Note that death and injury in the workplace have been falling in the construction sector. In 2000/01 there were 113 fatal injuries, while in 2015/16 that number had fallen to 43. HSE, (2016), Statistics on fatal injuries in the workplace in Great Britain 2016: full-year details and technical notes. Available at: <http://www.hse.gov.uk/statistics/pdf/fatalinjuries.pdf> Accessed 10/04/17.
 19. WPI Economics analysis using HSE Construction Sector data available at: <http://www.hse.gov.uk/statistics/industry/construction/index.htm> Accessed 10/04/17.
 20. Taylor, S., (2009), Off-site construction in the UK construction industry: a brief overview. HSE.
 21. Krug, D., (2013), Off-site construction: sustainability characteristics. Buildoff-site. Available at http://www.buildoff-site.com/content/uploads/2015/03/BoS_off-siteconstruction_1307091.pdf Accessed 10/04/17.
 22. HM Government, (2013)., Construction 2025. TSO.
 23. Krug, D., (2013), Off-site construction: sustainability characteristics. Buildoff-site. Available at http://www.buildoff-site.com/content/uploads/2015/03/BoS_off-siteconstruction_1307091.pdf Accessed 10/04/17.
 24. Copper, (2015). Independent survey of attitudes to infrastructure in Great Britain. Available at <http://www.copperconsultancy.com/attitudes-to-infrastructure-roundtables-what-does-industry-think/> accessed 07/02/16.
 25. Populus Poll for Wolfson Economics Prize, May 2014, online sample of 6,166 adults from Great Britain, weighted to be representative of all UK adults. Quoted in Worth, S., (2015), Get Britain Building: A new approach to localism. Westminster Policy Institute, London
 26. Sims, S., & Bosetti, N., (2016). Stopped: why people oppose residential development in their back yard. Centre for London. London
 27. KPMG, (2016), Smart Construction: how off-site manufacturing can transform our industry. KPMG.
 28. Farmer, M., (2016). The Farmer Review of the UK Construction Labour Model. The Construction Leadership Council (CLC), London.
 29. <http://www.dragages.com.sg/en/content/singapore-reaches-high> Accessed 11/04/17
 30. <http://www.legalandgeneral.com/pensionrisktransfer/knowledge-centre/press-releases/legal--general-set-to-create-over-400-jobs-in-leeds-with-launch-of-modular-housing-business.html> Accessed 11/07/17.
 31. Goulding, J & Arif, M., (2013). Off-site production and manufacturing. Research Roadmap Report. CIB.
 32. Farmer, M., (2016). The Farmer Review of the UK Construction Labour Model. The Construction Leadership Council (CLC), London.
 33. Goulding, J & Arif, M., (2013). Off-site production and manufacturing. Research Roadmap Report. CIB.
 34. UKCES, (2016), Working futures 2014-2024. Annexes. UKCES.
 35. <https://www.attheamp.com/> Accessed 11/04/17