



# Smart construction

**How offsite manufacturing can  
transform our industry**

April 2016

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# Foreword

Many construction projects have a reputation for being completed behind schedule and over budget.

While these companies have tried to improve project time, cost and quality by using technological and commercial industry innovations such as Building Information Modelling (BIM) and collaborative supplier engagement models. But they have largely failed to reverse the trend of poor productivity and project uncertainty or counter the growing challenge of industry skills shortages.

Offsite construction offers an alternative to this current construction status-quo by promising transformative improvements across the asset lifecycle in time, cost, quality and health and safety. But most importantly, offsite construction offers predictability.

I am grateful to my colleague Joshua Southern for his research and authorship of this report, which evidences the value of that predictability to the construction industry.

We call on construction industry clients to collaborate with suppliers across whole portfolios of construction projects, to invest in and then unlock the value of offsite construction.

**Richard Threlfall**

Partner

UK Head, Infrastructure, Building and Construction

KPMG in the UK

# Executive summary

## The challenge

While the construction industry is buoyed by predicted growth and expansion, it continues to underperform in four strategic areas: productivity, certainty in delivery, skills shortage and data transparency. Offsite construction - the prefabrication, modularisation and standardisation of construction processes and assets within controlled factory environments - continues to be quoted across government and industry as a potential catalyst in meeting these challenges. It also has a role to play in addressing the UK's housing shortage.

But if it is so important, why does data show that the offsite market only contributes 7% to UK construction GDP<sup>1</sup>. And why don't government and private clients mandate the consideration of offsite solutions in procurement tenders?

## Barriers

There are many barriers often cited, including: high cost of entry, requirement for fully front-loaded supplier engagement and lack of confidence in the product quality and certification<sup>2</sup>. But, as more innovative contractual models become commonplace, offsite products gain more insurance recognition and quality certification, and public and private sector companies commit to longer-term investment funding, these barriers are slowly becoming less inhibitive.

KPMG believes a core reason for the slow take-up of offsite can be attributed to the lack of any substantive demonstration of the value of offsite at project, portfolio and asset whole-life levels. Indeed, a 2005 study by Loughborough University looking at barriers and opportunities in offsite found that only 51% of client respondents considered offsite to increase value (*Goodier n.d*). Without that recognition there will be no commercial drive nor any compelling case for change.

This paper provides context and meaning behind current industry data to show;

- Where the value of offsite lies;
- Ideas as to how the industry can exploit this value to drive market growth;
- How offsite can help overcome some of the wider industry challenges.

## Findings – value across the lifecycle

**Project level:** Independent KPMG research found that in spite of the increased construction costs associated with one-off offsite construction projects, financial net savings of 7%

were possible as a consequence of the shortened construction period. These project savings enabled faster

rental revenue income and savings from construction inflation costs. Together that equated to £36m savings on a 50-storey central London office building. In reality, the saving to a commercial or public sector client is likely to also include savings on any interest on loans, improved project predictability, and improved quality – however these have not been quantified here.

**7% net financial project savings when applying offsite construction**

**Portfolio:** Our study did find that offsite project level construction unit costs were greater than an onsite equivalent. However, the economies of scale achieved by applying a standardised product catalogue approach mean that significant unit cost savings are possible when using offsite across a portfolio.

**Anglian Water realised 30% in efficiency savings by standardising treatment facility modules across their portfolio**

**Whole life value:** The current available qualitative data suggests that offsite manufactured assets may reduce whole life cost. The main driver for which is in the improved manufactured quality - indeed a study (*Goodier n.d*) in 2005 found that 77% of all contractor respondents recognised the increased quality of offsite products.

This improved quality lowers the failure rate of the assets, thereby improving predictability and reducing quantum of asset maintenance costs.

## **Offsite manufacturing offers clear improvement in quality, but as yet no clear data exists to link this to reduced whole life cost**

However, only 41% of all client respondents reported a reduced whole life cost after applying offsite. Right now, we don't have enough quantitative data to substantiate the value of offsite manufactured assets across the lifecycle. For an industry progressively more focused on reducing totex costs, finding data sets to demonstrate this whole life value in offsite is crucial to the success of the offsite industry.

### **Opportunities**

KPMG believes there may be latent capacity within the UK modular and prefabrication market, and there are growing signs that early adopter client and suppliers are taking advantage of this by developing strategic partnerships, most recently between Legal and General and Laing O'Rourke. However, we don't have sufficient data to reliably assess the offsite market value and supplier capacity. Greater transparency of offsite supplier capacity will improve client confidence in its use, but also enable timely investment of facilities in meeting future offsite demand.

Offsite itself is not the panacea to all the industry's ailments. For offsite manufacturing to stimulate a transformation across industry, KPMG believes there is an onus on clients and suppliers to quantify its longer term asset value and start to develop more suitable business cases that include whole-life cost analysis.

The industry, and clients in particular, must also look to re-develop compatible procurement and contractual strategies to enable more collaborative investments in offsite.

**'Offsite manufacture of residential housing is the key to addressing the UK's housing crisis. It means we can build homes quicker, cheaper and better whilst achieving greater certainty over costs. This is the change that is needed to institutionalise investment in residential housing.'**

Tom Ground, Chief Executive of  
Legal & General Homes

# Introduction

## Vision of smarter construction

The joint government and industry industrial strategy, Construction 2025, sets out a vision of the industry's future using three strategic priorities: smart construction and digital design, sustainable construction and improved trade performance. For the Construction 2025 targets to be met, smarter and more effective methods of construction must be applied wholesale across the industry. But for this to happen, a more compelling case for investment in modern methods of construction (MMC) must be made.

**“For the industry to truly value offsite construction and the benefits it brings, we must actively do more to quantify its value and recognise the crucial part it will play in transforming our industry”**

Andrew Wolstenholme, OBE, Co-Chair of Construction Leadership Council

This and other industry papers go some way in driving discussion and stimulating change, but ultimately it is the clients that must drive change.

**“Clients must make a ‘presumption for offsite’ when going to market to ensure the supply chain sufficiently invests in, and develops offsite construction solutions”**

John Pelton MBE, Strategic Projects Director, Crossrail

## Economic ‘push’ and ‘pull’ factors

Some clients have tried to drive greater use of modern methods of construction. A survey conducted by Inside Housing magazine in March 2014, showed that over the three successive years, 56.8% of 22,544 homes planned by 17 of the UK's largest housing associations will be constructed using offsite methods.

In October 2014 the Hyde Group housing association, which has 55,000 homes<sup>3</sup> called for support to offsite by allowing properties built using modular technologies to qualify for mortgage support on the same terms as traditionally built homes.

An alliance between Laing O'Rourke and Legal and General was announced in 2015 in a public land housebuilding venture to build 2,000 new homes a year; potentially indicating a change in how future investments in offsite are made.

In addition, future infrastructure clients like HS2 are specifying the 'presumption for offsite' in future tenders and The Housing Corporation and English Partnerships are requiring that 25%<sup>4</sup> of funded units be constructed using MMC.

Government interest in offsite manufacturing also appears to be increasing. In 2015, the Department for Business Innovation and Skills awarded a £22.1m grant to a consortium led by Laing O'Rourke to develop advanced methods for the manufacture of homes, buildings and infrastructure. It is part of the four-year, £104m Advanced

**“Much of existing demand for offsite construction is driven by the supply chain ‘pushing’ offsite solutions to clients by consequence of site logistics, skills and schedule constraints. Client ‘Pulling’ solutions from the supply chain do exist but are often inhibited by misconception of offsite construction benefits”**

Callum Tuckett, Group Commercial Director, Laing O'Rourke



Manufacturing Supply Chain Initiative. In 2016, Ministers re-emphasised the need for industry to consider, 'new models of construction such as offsite'<sup>5</sup>.

While both public and private clients are beginning to show signs of greater interest in offsite, the offsite industry is still largely driven by supply chain 'push' factors and has failed to gain traction across a wider client spectrum.

### Supplier over-capacity

A 2004 study<sup>6</sup> by The Housing Forum on the UK capacity in offsite manufacturing found that between 2000 and 2002, offsite manufacturers were producing maximum plant output at 72% of capacity. Respondents to this survey commented that this was achieved only by using single shift staff patterns; implying that the real capacity was actually higher. The Building Cost Information Service estimated in 2005 that 'most suppliers could cope with a doubling of demand by using spare capacity'<sup>7</sup>.

Whilst we lack more recent data to confirm this over-capacity in the supply chain, what we can extrapolate from the over-arching construction industry suggests this is still so. In real terms, construction output in 2012 was 88% of that recorded in 2008<sup>8</sup>— indicating a market with excess capacity. Without more client demand for offsite products, this excess factory capacity discourages the supply chain to invest in new factories and technology.

## **“A clearer picture of UK offsite factory capacity and utilisation is needed to help clients and investors better exploit latent capacity in the market”**

Joshua Southern, KPMG

### Increasing client demand

There are signs of new alliances and partnerships being formed in order to secure client demand and share investment risk, but most of this activity is focused in the housing sector. Demand there is desperately clear. This paper, however, looks to articulate the case for a wide range of clients to invest in offsite and aims to demonstrate the value of offsite at project and portfolio level, and across the asset lifecycle.



# State of the industry

## UK construction industry

The construction industry currently makes up 6.5% of the UK economy and forecasts suggest a healthy growth rate of 3.6% in 2016<sup>9</sup>, returning output to pre-recession levels. Growth is being driven by demand for infrastructure, public and private housing and commercial buildings.

While the industry is currently buoyed by predicted growth and expansion, it continues to underperform in four key areas:



**Productivity** – The construction industry continues to suffer from low labour productivity rates, and has failed to realise any substantial growth in productivity in the last 20 years<sup>10</sup>



**Certainty in delivery** – Despite some high profile success stories including the Olympics and Crossrail, the sector has a reputation for unreliable project delivery times and costs – in 2015 only 69% of projects were completed on budget and only 40% on time<sup>11</sup>



**Skills shortage** – The industry is struggling to provide the skilled workforce needed to meet the demand for current and planned projects – 82% of respondents to a CIOB survey believed a skills shortage exists across the construction sector<sup>12</sup>



**Data transparency** – A lack of timely and accurate project and investment performance data adversely impacts client decision making.

The construction industry is highly fragmented with little cohesion or guidance from government or industry bodies. Some industries, like aerospace<sup>13</sup> and automotive<sup>14</sup> have incorporated sector-wide roadmaps and guidelines that have successfully driven step-changes in innovations and performance by contrast, the construction industry repeatedly fails to make the changes it needs to. The industry tends to be shaped by smaller incremental improvements at local project and organisational levels that are not spread more widely. Hence the industry fails to make those bigger leaps.

## An onsite focused industry

Traditional construction activities use onsite labour and resources to build assets using raw aggregate materials and some prefabricated components (e.g. manufactured steel and bricks). Although this approach allows construction companies to adapt quickly and effectively to changing client requirements and design, it consequently breeds uncertainty in project delivery performance, project cash-flow and ultimately meeting the client's strategic objectives.

Though industry challenges aren't exclusively caused by the nature of a predominantly onsite focused industry, there are causal and influencing drivers linking them. Understanding these linkages would enable a more compelling offsite construction case for change to be developed. Some of the onsite causal factors to the current industry challenges are expressed in [Figure 1](#).

Industry strategic challenges	Onsite causal factors
<b>Low productivity</b>	<ul style="list-style-type: none"> <li>– Onsite construction delivery is inherently dependant on site conditions, weather and location</li> <li>– Complex onsite supplier interdependencies are difficult to manage and lead to cross-over vagaries and inefficiencies</li> <li>– Bespoke onsite designs are unable to be scaled up across projects and portfolios</li> </ul>
<b>Low certainty in delivery</b>	<ul style="list-style-type: none"> <li>– Many layers of onsite trades and suppliers creates uncertainty in delivery timescales and costs</li> <li>– Lack of early Tier 1 and 2 contractor engagement to influence design increases risk of buildability issues</li> </ul>
<b>Skills shortage</b>	<ul style="list-style-type: none"> <li>– Broad range of onsite skills required creates over reliance on large number of small group of specialist resources</li> <li>– Uncertainty in skills requirements for onsite projects reduces ability to plan successfully and deploy resources across a portfolio</li> </ul>
<b>Data transparency</b>	<ul style="list-style-type: none"> <li>– Onsite multi-contractual relationships reduces ability to capture and report live and relevant project data</li> <li>– Lack of joined up shared digital platforms</li> </ul>

Figure 1

## The offsite manufacturing industry

### Market value

Almost all construction projects today contain some degree of offsite manufacturing, but in aggregate it remains a very small part of the industry. A 2013 paper by the UK Commission for Employment and Skills, using projected data from 2009, estimated a total market value of £6bn<sup>15</sup> (equating to 7% of the total construction sector).

At one end of the spectrum is traditional construction where prefabricated manufactured components such as bricks, steel components and other mechanical and electrical equipment are extensively used, and have been for many years. At the other end is a fully integrated design and construction strategy producing fully offsite manufactured components and modules.

The opportunity for greater utilisation of offsite manufactured components across the industry is significant. According to Mike Putnam, chief executive and president of Skanska UK, more than 70% of each project can now be constructed using offsite manufactured components<sup>16</sup>. This growth opportunity has the potential to transform the UK's construction delivery performance. To unlock this growth the industry must articulate the underlying market trends, the push and pull factors and the case for change of offsite.

**“To unlock offsite construction’s growth potential, clients and suppliers must do more to articulate the case for investment”**

Joshua Southern, KPMG

### Contract and procurement

Construction delivery methods used today are still mainly based around traditional linear design and procurement relationships. Onsite construction typically follows the traditional, client > designer > contractor contractual path, where designers and contractors remain distinct. For this reason, construction designs are really only tested for their buildability once teams are onsite, where it is also most costly and disruptive to rectify mistakes. It is these very design changes, as well as construction build quality defects, that are often the most detrimental to project delivery success – indeed, according to (Love 2008) design-induced rework is purported to contribute 70% of the total amount of rework on construction projects, with the total cost of rework amounting to 5% of total project costs (*Robin McDonald n.d.*).

Offsite manufacturing alone will not overcome these challenges. To do so requires a partnership with an integrated design process, like the Design for Manufacturing Assembly (DfMA) model developed by Laing O’Rourke. DfMA is an approach to design - successfully applied on the Heathrow Terminal 5 project<sup>17</sup> - that enables optimal assembly of prefabricated modules on site by engaging multi-discipline and multi-tier suppliers ideally from the beginning of the design development process.

**“The Design for Manufacturing and Assembly approach along with early supply chain engagement are crucial factors in enabling offsite solutions to be considered and realistically applied at project level”**

John Pelton MBE, Strategic Projects Director, Crossrail

# The offsite case for change: KPMG findings

## Project level value summary

A lot of anecdotal evidence already exists to demonstrate the benefits that offsite construction brings, including, faster delivery, better quality and safer working sites. But since most clients continue to commission the vast majority of projects using traditional construction, it is clear that there is a lack of sufficient and persuasive evidence as to the value to the client of an offsite approach.

With this in mind, KPMG undertook independent research to assess the possible project financial savings when applying offsite manufactured solutions. For this analysis the Leadenhall office building<sup>18</sup> was chosen as the offsite case study - as 85% of all components were fabricated offsite. For comparison, the cost for a hypothetical onsite constructed office building was estimated using industry benchmark cost data for a high-rise central London office building construction<sup>19</sup>.



**Offsite construction was found to be 6 months quicker with financial net savings of £36m**

## Onsite currently offers lower construction costs

We found the construction costs for the offsite-focused Leadenhall building project (up to and including commissioning of the asset) was £18m higher than the hypothetical onsite comparison – equating to an 6%

cost increase. These additional construction costs for offsite can largely be attributed to the added complexity through the design development. By its nature, offsite manufacturing demands higher levels of design resources earlier on in the project to allow for designs to be robustly tested for buildability and then digitally submitted for manufacturing.

## But offsite offers a shortened and more reliable programme

Industry performance metrics show that construction projects continue to perform poorly at predicting delivery timescales. In 2015, design and construction phases of UK construction projects were delivered either on time or better only 53% and 48%<sup>20</sup> of the time respectively – meaning that almost 50% of all onsite construction projects failed to predict reliably their programme completion dates.

Evidence from Buildoffsite suggests that schedule savings of upto 60% are possible when compared against conventional construction<sup>21</sup>. For this analysis, however, more conservative schedule savings of 10% (or 6 months off of a 5 year project) have been assumed to reflect the added logistical complexities of construction in central London. As shown in *Figure 2* (pg 11), traditional onsite projects tend to release designs for construction in phases, allowing continuation of work on site, but consequentially increasing the duration of professional fees being incurred across the project; conversely, offsite projects incorporating DfMA type design processes tend to have a longer design but shorter construction phases. This consequently adjusts the cash profile across the project and ultimately increases front-end design cost attrition rate. Notwithstanding this, due to the nature of the Leadenhall project, the duration of the design phase below has been assumed equal, but with a higher level of effort, compared with a conventional onsite project.

### Onsite construction compared with offsite construction (over 5 years)

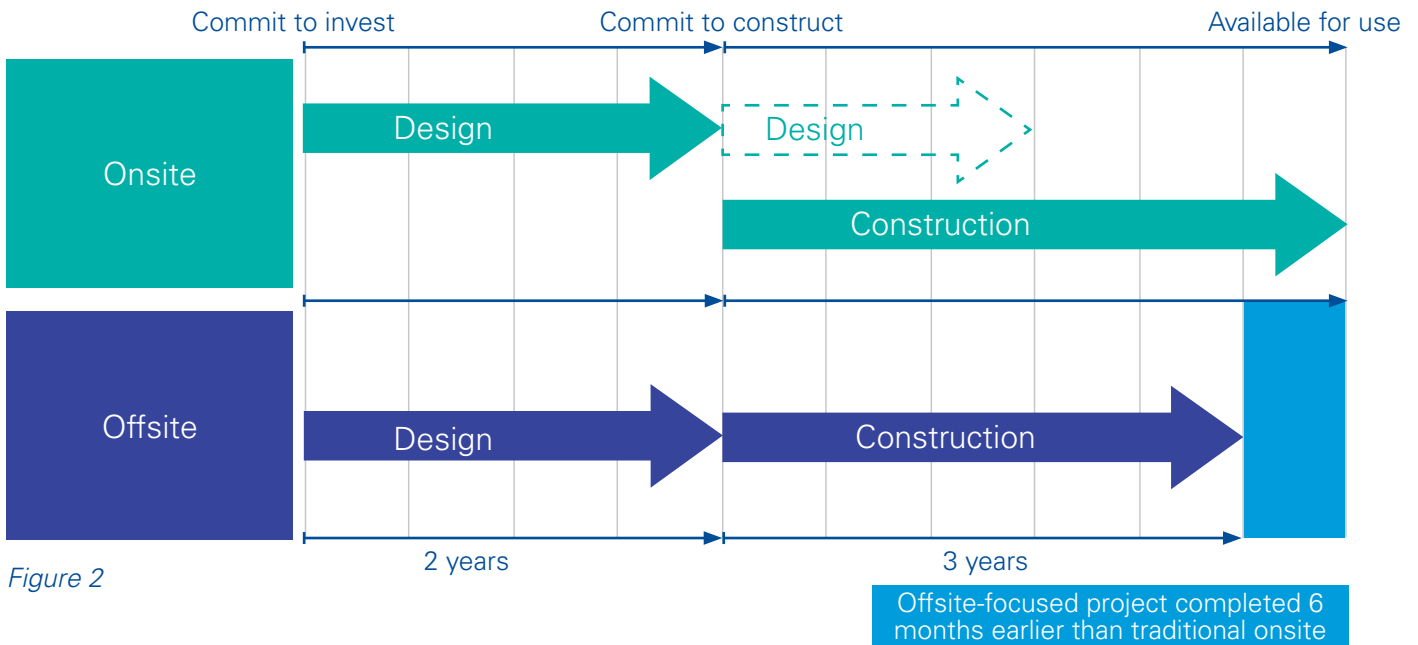


Figure 2

### And earlier revenue generation

This time saving crucially alters the cost dynamics when comparing the two construction approaches. The financial benefits associated with earlier start of rental revenue was found to create an additional income of £29m based on recent central London office rental values<sup>22</sup>. Additionally, the 6-month shorter construction programme could save £7.5m on construction cost inflation and save on borrowing interest for the project when comparing against traditional onsite construction. This equates to a total project saving of £36m, or 7%, against the hypothetical onsite base case as shown in the project cash profile in *Figure 3* (pg 12).

Pockets of the industry have also attempted to quantify the value of earlier project completion to commercial revenue generation. A paper by the Steel Construction Institute found that steel modular construction could reduce the construction period of a project by 33% compared with conventional onsite steel. Whilst the capital cost of modular steel was found to be more than traditional steel construction, the reduced time on site

still produced significant financial savings and increased developer profitability. In the Steel Construction Institute study, sales of the completed buildings started 30% sooner, developer IRR increased by 43% and peak cash-flow throughout the project was reduced by 7% compared with traditional onsite steel use<sup>23</sup>.

**“A total project financial saving of 7% is possible with offsite, not including savings made in the interest on borrowing, improved cost and time predictability, reduced noise disruption during construction and improved health and safety”**

Joshua Southern, KPMG

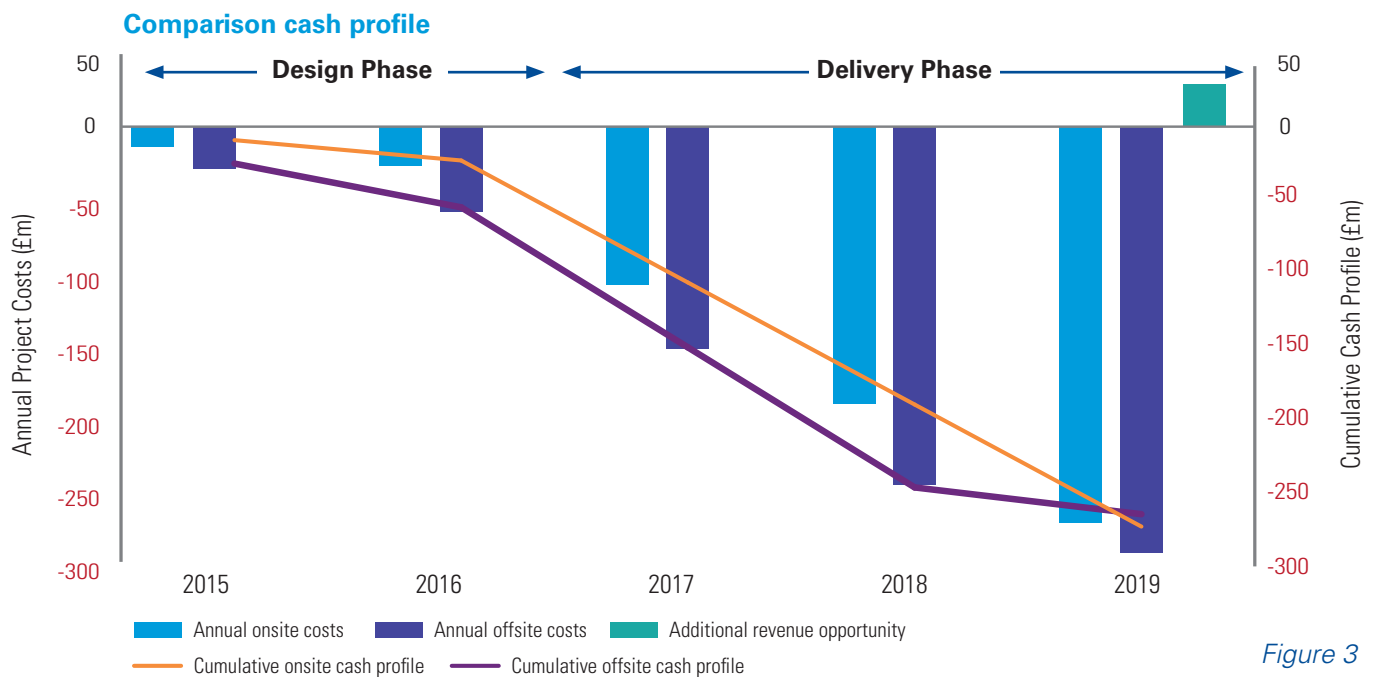


Figure 3

**Footnote**

- For the offsite case, the design and construction phases are assumed to be 2 and 2.5 years respectively
- For the onsite base case, the design and construction phases are assumed to be 2 and 3 years respectively assumed linear cost and resource spread across the design and delivery phases for both on and offsite
- KPMG findings are based on construction costs and rental value opportunities on a landmark central London building only. Caution must be applied when extrapolating these offsite project savings to projects outside of London where construction costs are reduced but so too are rental income opportunities. Additionally, for clients unable to profit from the earlier revenue income enabled using offsite it becomes more difficult to quantify project savings in fiscal terms. Instead, non-profit making clients, must recognise the improvements offsite can bring to business and operational performance and delivery predictability

**Improved predictability**

By developing and ‘locking down’ a complete modularised and proven buildable design before construction on site begins, clients are able to predict project cash-flow requirements and final forecasted costs with greater accuracy - currently only 69% of all construction projects are complete on or better than budget<sup>24</sup>. The reason for this improved predictability is because of the ability to validate the buildability of the components and modules virtually on a computer before getting to site and in the high precision nature of manufacturing, with consequential much reduced risk of onsite disruptions.

Whilst the construction costs for the offsite-designed project were 6% higher than the onsite alternative in the

findings above, onsite construction projects retain a much higher risk of a higher than expected outturn cost. The improved time and cost predictability afforded to offsite-designed projects can therefore help to significantly offset the increased unit cost of offsite versus onsite solutions.

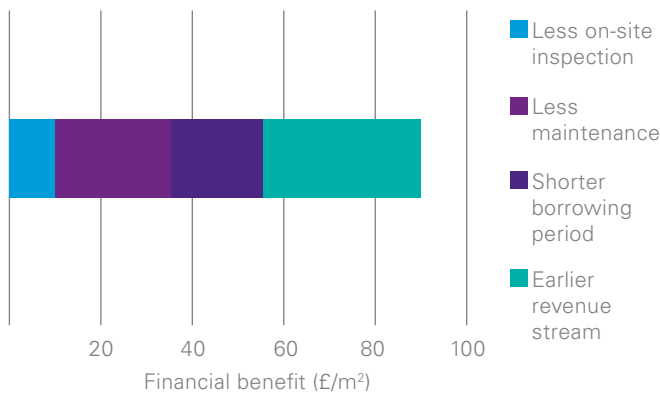
**Beyond the project level: Portfolio and whole-life**

In order to maximise returns from investment in offsite and to leverage fully the intrinsic financial, time and quality betterment it provides, KPMG believes a stronger case for investment in offsite can be made by assessing its value added beyond the project level and across construction portfolios and asset lifecycles.

### Across construction portfolios

Applying offsite standardised design solutions across a construction portfolio can drive further value and deliver portfolio financial savings. A 2005 study by the National Audit Office showed that unit costs of volumetric offsite manufactured modules for new houses was higher than traditional onsite brick work construction. However, the report concluded that by adopting volumetric modular construction solutions across a portfolio, financial benefits were found to equal £90/m<sup>2</sup> in 2005 prices<sup>25</sup>. The breakdown of these savings are shown in the chart below:

#### Financial benefits of volumetric modular construction



(Source: National Audit Office, 2005)

By applying the same repeatable, standardised components or modules across a construction portfolio clients would find capex savings in the unit cost of the components – through the economies of scale of production increasing commercial buying power and reducing professional design input. Within the AMP 5-year water investment period, Anglian Water Alliance teams were able to make a 30% efficiency saving on construction of a new water treatment facility by adopting a portfolio mind-set to standardise components with assembly and commissioning all completed offsite<sup>26</sup>.

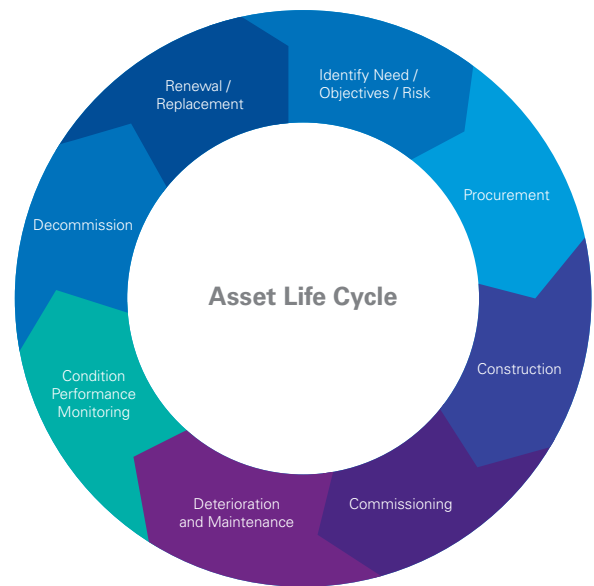
Furthermore, by applying greater use of economies of scale through standardisation and offsite manufacturing of components across the construction industry, unit costs would inevitably be reduced. Over time, as the wider industry becomes more efficient and more predictable, it is conceivable that the capital cost gap between offsite and onsite projects is reduced, even on single project commissions.

### Whole-life asset value

The construction phase is only one part of the wider asset lifecycle, yet is often the most important phase in ensuring optimal whole life cost savings are considered and locked in to the design.

KPMG believes that arguably the biggest benefits of applying offsite concepts across the asset lifecycle is in a client’s ability to:

1. Reduce whole-life cost of the asset
2. Improve asset management by optimising maintenance, renewals and retrofit of modularised built assets



**“Offsite construction offers benefits across asset lifecycle, not just during construction. It also allows for less complex asset replacement and enhancement due to the ‘Lego-brick’ modular structures”**

John Pelton MBE, Strategic Projects Director, Crossrail

## Reduced whole-life costs

Due to the difficulty in reliably comparing the whole life costs of an offsite manufactured asset to a traditional build, quantum for the whole life cost benefits of offsite construction are scarce, if non-existent.

Based on a combination of industry survey data and anecdotal evidence, it appears plausible that offsite manufactured assets can generate whole life cost savings. This is mainly caused by the enhanced build quality and specification of offsite that can lead to reduce occupant energy use, maintenance, renewal and repair costs over the life of the asset.

Whilst not in itself conclusive, a research study by (*Goodier n.d.*) in 2005 supported this view of reduced whole life cost. The study found that 77% of all contractor respondents recognised the increased quality of offsite products, and 41% of all client respondents reported reduced whole life cost after applying offsite to their construction projects.

Notwithstanding the limited quantitative evidence available that suggests offsite manufactured assets do offer whole life cost savings against onsite constructed assets, data to back this up remains elusive. For an industry progressively more focused on reducing totex costs, finding data sets to demonstrate this whole life value in offsite is crucial to the success of the offsite industry.

## Improve asset management

One of the key drivers for whole-life cost savings when using offsite manufacturing is in the enhanced quality of the factory product. Reduced failure rates and more reliable asset performance help to reduce opex costs over the life of the asset but also support the development of more accurate and robust asset management investment plans.

Offsite manufactured components and modules also allow asset managers to retrofit and renew existing assets far quicker and cheaper than existing. Offsite inspired buildings and assets can be designed to support flexible future use by incorporating a 'plug and play' function. By designing suitably flexible building structures, plant room equipment or bathroom module 'cassettes', for example, may be replaced in their entirety before failure point is reached or to upgrade to a higher specification.

Clients typically still fail to engage fully with their supply chain and the to-be asset operator and maintainer earlier enough in the project design development. Without this crucial engagement, supplier innovations aren't developed early enough to be included in the design, the design buildability is never tested and the commissioned new assets are unable to realise maximum benefits and may require costly retrofitting. By applying offsite manufacturing and DfMA principles to the design development, the considerations of all key stakeholders, including those of the asset manager, are more likely to be incorporated within the final design.







# Overcoming industry challenges

## Offsite

KPMG believes there are 4 key strategic challenges facing the construction industry today that are in some ways a consequence of the industry's reliance on onsite construction solutions. The following is a breakdown of how wider industry use of offsite can help meet some of these challenges.



### Productivity

***The UK is currently experiencing a flat line in productivity growth, with the construction industry showing no productivity growth in 20 years – can offsite stimulate growth within the construction sector?***

Applying offsite manufacturing not only decreases the time on site and overall cost of delivery, it also can improve the quality and reliability of the built assets due to process consistency and moderate temperature and conditions in factories. This in-turn improves working conditions and offers a change in "construction culture" by providing a safe, clean and secure place of work.

The following is a list of demonstrable improvements in productivity when comparing offsite to onsite construction:

- Work in factory environments is up to three times more productive than onsite labour and resources<sup>27</sup>
- Reduced time on site reduces a project's exposure to inherent onsite risks, like traffic disruption, weather and poor quality workmanship
- Improved quality of offsite manufactured component drastically reduces the need for re-design and re-work<sup>28</sup>



### Certainty in delivery

***Can the improved confidence in offsite delivery help improve cost and time certainty across the industry?***

By moving construction activities into safe and predictable factory environments, projects become less dependant on site conditions which in turn reduces risk in delivery. As a consequence of this, suppliers can develop more robust and accurate schedules thereby increasing client confidence in delivery. A recent government study showed that a new house can be erected in a single day using offsite manufacturing; reducing the cost of building the average home by at least 10%<sup>29</sup> and providing improved delivery predictability.

The improved predictability of offsite manufactured-based projects is perhaps best demonstrated in the Portakabin Groups<sup>30</sup> announcement in December 2015 that 99.7% of all their offsite projects were completed on time and on budget since 2003 – an almost 60% improvement on the industry average where 40% of projects are completed on time and 30.7% improvement on industry average of projects completed on budget<sup>31</sup>.



### Skills shortage

***Shortage of skills labour across industry continues to stunt growth potential. Can the manufacturing environment of offsite help bridge this skills gap?***

The broad range of existing onsite skills required creates an over reliance on a large number of small groups of specialist resources. Transferring site-based construction activities to factory environments is a tangible way of helping to overcome the industry's shortage of skills. Offsite manufacturing can attract and develop non-skilled

resource from across other industries without relying on limited pools of skilled tradespersons; indeed those with skills from other factory environments can also be easily transferred to the offsite industry. This in turn will allow government and private client construction to continue development despite labour constraints in accordance with anticipated investment plans.

In addition to its potential to help address the skills shortage, offsite manufacturing can also be expected to help change the culture and image of the construction industry altogether. With its better working conditions, reduced manual labour and embrace of technology, offsite can help the industry compete in schools and universities to attract the best and can help address the chronic lack of diversity in the industry.



#### **Data transparency**

***Could the factory line and modularised nature of offsite allow clients a straight line of sight to accurate and live project performance data?***

Due to the often complex contractual and technical supplier relationships in traditional onsite construction projects, project performance and as-built data are often not provided accurately or in sufficient time to allow the client to make informed decisions; in turn possibly leading to cost overruns and project delays.

Applying offsite allows for the accurate tracking of modules and components from the manufacturing line through to installation onsite using barcoding and recorded using project BIM and IT systems to provide the supply chain and the client with up-to-date data. This allows clients to measure progress of the project far more accurately than in an onsite environment.

# Conclusion

The KPMG research and analysis presented here indicates that there are financial benefits of applying offsite manufacturing at project level. Additional revenue and savings from inflation and interest on borrowings were found as a consequence of the shorter build programme; equating to a 7% project cost saving against traditional construction. This material saving demonstrates that offsite solutions ought not to be disregarded on account of cost alone. In addition to these quantified savings, offsite also offers many other less quantifiable benefits, including: improved time and cost predictability, reduced noise and traffic disruption during construction and improved health and safety rates (though these have not been detailed in this paper).

Furthermore, the evidence suggests that greater financial savings are possible when applying offsite across construction portfolios and the asset lifecycle. Through anecdotal and limited survey data, it has been shown that offsite construction can generate 30% of portfolio savings and has the ability to reduce asset whole life costs. This reduction is driven both by the improved failure rates of manufactured components, but also in an ability to replace modularised components with far greater ease than conventionally built assets. However, for an industry progressively more focused on reducing totex costs, finding data sets to demonstrate this whole life value in offsite is crucial for development of a compelling case for change to be made in client organisations.

In addition to the value added across projects, portfolios and the asset-life, the inherent nature of offsite design and construction can also help address wider industry strategic challenges in productivity, certainty in delivery, skills shortage, and data transparency. Suggestions as to how offsite can make improvements in these areas have been articulated in this paper, but KPMG believes more robust quantification of these benefits will add significant weight to the case for offsite investment, most strikingly in government.

## Next steps

For offsite construction to become the delivery model of choice across the industry, KPMG believes it must be client-led. This paper draws on currently available information and specific examples to argue that clients could expect to make material financial savings by adopting an offsite approach, particularly across projects and portfolios. The urgent need is for more clients to create the conditions where offsite solutions are actively considered and the business-specific case can be made. In particular we recommend:

- Clients should collaborate with suppliers to research and quantify the value that offsite could bring, looking beyond just the project level or capex costs to the whole asset life
- The industry, and clients in particular, must also look to re-develop compatible procurement and contractual strategies to enable more collaborative investments in offsite
- The government should mandate offsite construction on its infrastructure projects over a certain size. There is already a precedent here with the mandating of level 2 BIM on all government projects by 2016<sup>32</sup>
- Both government and industry to jointly assess existing offsite supplier capacity and offsite contribution to construction output
- Clients to assess existing utilisation of offsite across construction portfolios and set business-wide KPI targets to drive wider application
- The Construction Industry Council to sponsor an in-depth study of how offsite construction can address industry challenges, in particular in productivity and skills shortages

The industry must acknowledge that innovation isn't just about doing things incrementally better, it's also, and perhaps more fundamentally, about recognising when transformative changes to the existing model are required. By embracing offsite construction we can pave the way for a more progressive, data-driven and predictable industry boosting industry profits and the wider economy.

# Author biography



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