



Infrastructure
and Projects
Authority

Proposal for a New Approach to Building: Call for Evidence

Contents

Introduction	1
What will happen next?	2
How to respond	2
FOI and privacy statements	2
Construction in the UK	3
The case for change	3
Opportunities	4
Our proposal: a Platform approach to Design for Manufacture and Assembly (P-DfMA)	5
Introduction	5
Description of the proposal	5
First Principle: Design for Manufacture	6
Second Principle: Use a Platform Approach	6
Third Principle: Open for Manufacture, Use and Procurement	7
Benefits and risks	8
Box A	9
Box B	9
Lines of Enquiry	10
General	10
Technical and commercial	10

Introduction

In order to achieve the objectives of its Transforming Infrastructure Performance (TIP) programme, Transport Infrastructure Efficiency Strategy (TIES), Construction Sector Deal and Industrial Strategy, the government is committed to using its investment in social and economic infrastructure and supporting the construction sector to:

- increase productivity;
- drive innovation;
- develop and train workers in the skills they will need in the future; and
- improve the delivery, performance (including energy use) and information management of built assets to build a globally competitive sector.

Adopting digital and manufacturing techniques wherever appropriate in government-led building projects will help drive better performance in the construction sector and ultimately achieve the above goals.

At Autumn Budget 2017 the government committed to leveraging its buying power to support modernisation of the construction sector and create a stable cross-government pipeline of demand by announcing that five central government departments (the Ministry of Justice, Department of Health and Social Care, Department for Education, Department for Transport and Ministry of Defence) would adopt a presumption in favour of offsite construction.¹ It also announced an investment of £170m to support innovation and skills in the industry as part of the Construction Sector Deal.²

While we recognise that there are other potential approaches which could improve performance in government-led building projects and we remain open to further proposals, we are setting out a proposed approach to building, to be adopted across government departments, which is aligned to these commitments. We have called this a **platform approach to design for manufacture and assembly or “P-DfMA”**.

By proposing details of a specific approach on how the presumption in favour could, where it represents value for money, be implemented and developed over time as part of departments' capital programmes, P-DfMA builds on the progress already made in a number of sectors which use offsite construction. It will be underpinned by significant further research, as part of the £170m Construction Sector Deal, to design, test, provide assurance for and develop the components, standards and practices needed to support it.

Through the call for evidence we hope to understand how the government can best adopt and embed a platform approach to design for manufacture and assembly in its capital programmes, and how prepared the sector is to adapt to this change and support the delivery of this approach (see Lines of Enquiry for further details). It aims to establish that an industry exists, or can exist, in the UK which has the technical capability to deliver the solution we are proposing and the capacity to meet the demand it will entail.

The call for evidence is open to everyone, but may be of greatest interest and relevance to construction, engineering, design and architectural companies of all sizes, as well as product suppliers, manufacturers, industry bodies, consultants and academics.

¹ <https://www.gov.uk/government/publications/autumn-budget-2017-documents/autumn-budget-2017>

² <https://www.gov.uk/government/publications/construction-sector-deal>

What will happen next?

Results from this call for evidence will feed into the development of the P-DfMA strategy for government, to be led by the Infrastructure and Projects Authority (IPA) and the Department for Business, Energy and Industrial Strategy (BEIS). It will continue to align with the implementation of the TIP programme, the Construction Sector Deal and TIES.

Alongside this, we will work with pilot construction projects to make use of a Platform approach to Design for Manufacture and Assembly approach, building on the progress made by existing projects such as the case studies illustrated in Boxes A and B.

We will use the analysis from this call for evidence to inform how this approach to construction can be implemented through next year's Spending Review.

How to respond

Please respond by email to pdfma@ipa.gov.uk, by 17 February 2019.

FOI and privacy statements

Information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the Freedom of Information Act 2000 (FOIA) or the Environmental Information Regulations 2004.

If you want information that you provide to be treated as confidential please be aware that, under the FOIA, there is a statutory code of practice with which public authorities must comply and which deals, amongst other things, with obligations of confidentiality.

In view of this it would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information, we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as binding on the Infrastructure and Projects Authority.

The Infrastructure and Projects Authority will process your personal data in accordance with relevant data protection law.

Construction in the UK

The case for change

The mission of the Infrastructure and Projects Authority (IPA) is to continuously improve the delivery of major government projects. Construction projects, which account for a significant portion of the government's capital expenditure, are often instrumental in that delivery. With around £130bn publicly funded infrastructure and construction in the government pipeline to 2020/21, government support of improved practices in the construction sector will see the value for money of construction projects increase, resulting in decreased costs for the taxpayer.

In addition to improving the value for money of publicly funded social and economic infrastructure, the government has an interest in supporting productivity and growth in the construction sector, which is a key component of the national economy. The construction sector, encompassing contracting, product manufacturing and professional services, had a turnover of around £370 billion, adding £138 billion in value to the UK economy, and exported over £8 billion of products and services in 2016. It employs 3.1 million people (9% of the total UK workforce).³ However, the potential of the sector is held back by poor productivity growth: since 1997 the year-on-year average has been 21% lower than the wider economy.⁴

Summarised below are some of the highlighted factors behind this problem taken from the Farmer Review, published in 2016. The review concluded that transforming the industry would require shared leadership by the industry, its clients and the government.

Low productivity: Despite its significant contribution to the economy outlined above, productivity growth in construction has lagged behind other sectors of the economy compared to, for example, manufacturing, where there has been a 50% increase in output per hour worked between 1994 and 2015.⁵ There is currently no mainstream shift towards a change in thinking, with exceptions driven by construction sector clients whose core business lies in advanced sectors such as manufacturing.

Poor predictability: Alongside its productivity failings, the sector suffers a related inability to accurately deliver to plan, with only a third of high-rise building projects being completed on time or early.⁶ While success factors can be measured by different parameters, but typically will relate to clients' core ambitions for time, cost and quality, there appears to be a general acceptance of failure and underperformance not only by industry itself, but also by clients.

Impending skills shortage: The construction sector is exposed to significant labour risk. Analysis from 2015 showed that the UK needed to recruit nearly 100,000 additional workers by the end of the decade, and retrain a further 250,000.⁷ Yet parts of the UK are heavily reliant on EU migrant labour for construction: over 30% of construction workers in London are EU migrants.⁸ Furthermore, the impact of demographic change on the sector will be significant,

³ *Transforming Infrastructure Performance*, Infrastructure and Projects Authority, December 2017

⁴ *Construction Sector Deal*, Department for Business, Energy & Industrial Strategy, 5 July 2018

⁵ *The Farmer Review of the UK Construction Labour Model*, Construction Leadership Council, October 2016

⁶ *ibid.*

⁷ *The National Infrastructure Plan for Skills*, HM Treasury, September 2015

⁸ *Migrant labour force within the United Kingdom*, Office for National Statistics, June 2018

with one third of the construction workforce in the UK aged over 50.⁹ A reduced workforce, brought about by a combination of reduced migration and demographic change, has the potential to create significant labour and skills shortages in the construction sector.

Low investment in innovation: The level of investment in industry innovation appears to be very low, with Office for National Statistics (ONS) data showing construction to be the lowest performing industry when comparing research and development spend across different UK industry sectors. Negative perceptions of the industry led to innovative design or process which businesses had invested in being viewed as high risk.

Opportunities

Primed by the government-led Building Information Modelling (BIM) mandate, parts of the construction sector are already using advanced technologies, paving the way for our proposed approach. The House of Lords' Science and Technology Committee's July 2018 inquiry into Offsite Manufacture for Construction revealed significant efforts are already underway among the construction sector and its clients to adopt innovative construction practices that deliver better outcomes.¹⁰ The proposed strategy of P-DfMA follows that momentum and seeks to leverage government buying power to accelerate innovate and the adoption of industry best practice.

The publication of the government's Industrial Strategy and Construction Sector Deal, which included announcing the Industrial Strategy Challenge Fund and the Transforming Construction Programme, represent timely opportunities to develop a robust strategy for an innovative approach to construction.

There are potentially significant benefits that could be achieved by the public sector if it adopted a consistent and strategic approach to procuring, designing, constructing and operating infrastructure assets across the whole of central government. These potential benefits include, but are not limited to:

1. revitalising the UK construction sector and improving productivity in construction;
2. improving certainty in project delivery, with more projects completed on time and on budget;
3. supporting the Industrial Strategy's Clean Growth Challenge and the transition to a low carbon economy by reducing deliveries and waste;
4. supporting the creation of higher quality manufacturing jobs and automation opportunities (potentially as part of new regional manufacturing hubs in different parts of the UK); and
5. delivering significant and sustainable efficiency savings;
6. making better investment decisions, based on whole life cost, supported by better data.

Finally, there is an opportunity for the UK, which has untapped capability in construction technology, to lead the market in digital construction and manufacturing technologies: the global construction market is forecast to grow by 70% to US\$15 trillion in 2025.¹¹

⁹ Farmer review, 2016

¹⁰ <https://www.parliament.uk/business/committees/committees-a-z/lords-select/science-and-technology-committee/inquiries/parliament-2017/off-site-manufacture-construction/>

¹¹ 'Global Construction 2025' (2013), Global Construction Perspectives and Oxford Economics

Our proposal: a Platform approach to Design for Manufacture and Assembly (P-DfMA)

Introduction

Given the compelling case for change set out above, the government needs to drive the adoption of modern methods of construction.

There are many types of modern methods of construction, from volumetric construction whereby manufactured parts (rooms or even complete small buildings) are assembled offsite in controlled factory settings and transported to the building site as a fully furnished product, to offsite frame construction where a building's frame is built in a controlled setting and transported to a site where it is assembled and the building completed using traditional methods.

There are many good examples of where modern methods of construction are already being applied across government and the wider public sector. However, the full benefits of a manufactured approach will only be delivered by a more consistent and strategic approach that creates a pipeline of demand and changes the way in which the industry delivers built assets.

Ensuring value for money (including whole life cost and value) remains the core principle for departments. It remains the responsibility of industry to innovate and provide best value solutions, and by outlining an approach we aim to provide the sector with a sense of direction without introducing strict measures which would remove competitive tension or space for innovation.

Our preferred approach was selected for a number of reasons. Firstly, the preparatory work required to enable this approach will be beneficial in itself. Secondly, it does not require that all government buildings are made in this way for government to benefit from an economy of scale. And finally, we want to follow and accelerate what is currently the most promising trend in the construction and engineering sector.

Description of the proposal

We are setting out a proposed approach to modern methods of construction, a variant of design for manufacture and assembly ("DfMA").

DfMA is a broad term that describes the process by which building products, or components, are designed in a way that enables them to be made on a large scale using machinery and then put together in one place.

A platform approach to DfMA (P-DfMA) means that we will use a set of digitally designed components across multiple types of built asset and apply those components wherever possible, thereby minimising the need to design bespoke components for different types of asset. For example, a single component could be used as part of a school, hospital, prison building or station.

We expect that the definition and development of the components will be done by industry. We recognise that industry will rely on government to set out its requirements for the components, in terms of performance specifications and interoperability standards.

We are therefore defining P-DfMA using three principles. The principles will be rules that the government would follow when it is planning, designing, procuring and constructing new infrastructure. Maximising the benefits of P-DfMA, and MMC more generally, would rely on applying these principles a consistent way, and at scale. The details of how we would do this are still being considered and are within the scope of this call for evidence.

The three principles are:

1. Design for Manufacture;
2. Use a Platform Approach;
3. Open for Manufacture, Use and Procurement.

First Principle: Design for Manufacture

This means we would ask that the design, procurement and construction of built assets use a defined set of standardised and interoperable components. These components should be designed to be manufactured efficiently at scale using repeatable processes. The details of what these components will look like will emerge from the research and development process.

Second Principle: Use a Platform Approach

This means we would propose that the use of the same components across different types of infrastructure is maximised by adopting a platform approach. The standardised and interoperable nature of the components would mean they can be used across different types of built asset and across different sectors.

We would be committed to ensuring products are made to consistent quality standards and are interoperable, meaning components produced by different manufacturers can be used in the same built assets. This will help to drive innovation, and its beneficial spill over effects will open the public procurement market to new entrants.

Components would be designed by industry to have as wide a use as possible. This might require some compromises, such as simplified building standards, in design. However, certain types of built assets will have specific requirements in relation to issues such as security and safety, which would need to be taken account of during the design process. As a result some sectors might have components that are unique to their sector and won't be more widely used.

There should be no restriction on what sectors or parts of the industry this approach would be applied to. However initially, government would build a market and demand for this approach when building new social infrastructure sponsored or delivered by the **Department for Education**, the **Ministry of Justice**, the **Department for Health and Social Care**, and the **Ministry of Defence**. These bodies and the organisations for which they are responsible,

such as arms-length bodies, would look to use the approach increasingly across their capital programme over the coming years as the supply base grows and becomes sustainable, where the approach represents value for money.

The **Department for Transport** (DfT), and the wider DfT family of delivery bodies (e.g. Transport for London, Highways England, High Speed 2 and Network Rail) will also seek to use this approach for selected parts of the capital programme, and they may look to the roll out of automated design for components that are unique to transport infrastructure.

Other parts of central government and the wider public sector could adopt this approach in the future. This approach could also be adopted by the private sector, either where they are responsible for the design, build, maintenance and operation of social infrastructure or for entirely commercial assets.

Third Principle: Open for Manufacture, Use and Procurement

For the approach to achieve maximum implementation anyone should be able to make, use and buy the components, for legitimate purposes consistent with our overall objectives. It would mean that a diverse range of firms and construction clients have the ability to design, manufacture and use components together in a single building.

This could be achieved by making widely available the intellectual property (IP) relating to key elements of the design of the built asset, individual components and interoperability standards. This does not mean that components made by different manufacturers will be identical: in order for the components to be made, used and bought by anyone they will only have to conform to the agreed standards and be interoperable.

Manufacturers and designers would produce new component designs, optimising cost, quality and other features. We would anticipate collaboration between manufacturers.

However, any part of the components' design which would need to be used by multiple manufacturers, for example connections, would require appropriate intellectual property protection to allow for innovation and new entrants to the marketplace.

The most successful technological innovations would rely on access to core IP information and accessible platforms which allow for maximum creative experimentation and widespread uptake. This principle is intended to make provision for the growth of a healthy market which is not reliant on a single supplier, and encourage innovation across as broad a range of companies as possible.

Benefits and risks

Manufacturing would help maximise repeatability, quality and safety. Furthermore, building using a manufactured and predefined set of components would streamline the procurement process, reduce the amount of waste produced by the construction industry and reduce the amount of work needed onsite, which is slower, more labour intensive, more disruptive and brings with it a higher risk of health and safety incidents.

A manufactured approach to construction can support the Zero Carbon Building policy by allowing sustainable technologies, for example for insulation, space heating and cooling, to be embedded within the components, avoiding the need for a later retrofit. Standardisation of construction practices could also lead to a reduction of materials waste, reducing the requirements for their manufacture and avoiding the associated emissions.

The preparatory work required to support a manufacturing approach can help reduce fragmentation in the sector and build a better approach to benchmarking, alignment, integration and procurement. Should this proposed approach therefore fail to bring about a full manufacturing capability, a number of significant benefits will nonetheless still be achieved.

This approach would rely more heavily on the design process, playing to the strength and world leading position of the UK in this field. The UK construction sector, supported by the Centre for Digital Build Britain, is leading in the uptake of digital technologies, such as BIM Level 2. In time and if successful this approach could open significant export opportunities for UK firms. Conversely, if we do not move quickly there is a risk that other countries develop this technology and benefit from early entrant advantage.

Manufacturing processes deliver value for money when applied at scale and by using this approach government, as the single largest client of construction services, has an opportunity to leverage that benefit.

However, if each department, arm's-length body and devolved authority pursues their own agenda for modernising construction practices, economies of scale will be lost and the transformation process will be slow and fragmented. Furthermore, should the P-DfMA approach be shown to not be suitable as we currently envisage, we will have brought about a number of useful lessons learned which can support future initiatives.

Therefore, in order to benefit from this new approach, there will need to be a coordinated effort and a clear plan across government. The IPA and BEIS will work with departments, including the Treasury, to deliver this and to gather evidence on the benefits realised not only on a project-by-project level, but also a portfolio level, through the adoption of this approach.

As with the Presumption in Favour of Offsite Construction, the Ministry of Housing, Communities and Local Government (MHCLG) are not referenced in this proposal. Use of Modern Methods of Construction within housing developments responds to the different challenges which face that sector. Whilst the interaction between the public sector and the housing market is different from that between the public sector and construction projects relevant to this proposal, MHCLG and Homes England, as detailed in their strategic plan for 2018 to 2023, are aiming for similar outcomes in the residential housing market; including higher productivity, greater cost efficiency and a shift in industry capacity towards a manufactured approach in construction. We recognise that Local Authorities have greater visibility of their demand pipeline and may be able to react differently to challenges as they have greater levers over their housing stock.

The scale of the challenge of implementing this strategy is not underestimated. It would require significant change within a large and well-established market, in which both clients and suppliers sometimes lack the financial capacity for change. It would require an evolution

of procurement and assurance practices as well as some new performance benchmarks and different types of jobs in the labour force. Furthermore the fragmented structure of the construction sector will represent a challenge to co-ordinating a strategy and driving change.

BOX A – Procure 22 (Department of Health)

The Department of Health and Social Care's 'Procure 22' Construction Procurement Framework has a programme that develops standardised products, tools and designs, and continues to progress this work with its supply chains. The process is based on establishing evidence based design solutions, the required outcomes (in relation to both project lifecycle and healthcare delivery thereafter) and in undertaking Post Occupancy evaluation to review outcomes achieved.

The programme has developed libraries of repeatable room designs and preferred components, supported by supplier agreements, for the delivery of added value services and cost efficiency savings. Designs and other design project information are held in a centralised database under the NHS Royalty-free licence for use by other projects using the Framework.

BOX B – Northern Line Extension (Transport for London)

Transport for London's (TfL) contractors are using DfMA to deliver the Northern Line Extension (NLE) project to exploit BIM technology and design assets from libraries of modular components, which are then prefabricated in factories and assembled on site.

For example, the Ferrovial Agroman Laing O'Rourke (FLO) joint venture and designer Mott MacDonald produced designs which make maximum use of prefabricated components in the construction of the extension's new stations. This includes:

1. Precast platforms on Battersea and Nine Elms (over 800 units in total).
2. Precast beams at Battersea and Nine Elms, including exposed finish beams at Nine Elms.
3. Exposed finish coffered soffit panels (92 unites) at Battersea above the main public areas, which were suspended in place, rather than propped, before they were cast into the structure.
4. Electrical cable management modules which have just started to be delivered.
5. Roof structure for the Eastern head house at Battersea (main entrance), currently in design.

Lines of Enquiry

General

- Q1: How can the government best encourage the adoption and implementation of this approach in its capital programmes?
- Q2: Within your organisation or sector what changes are needed, including in relation to technologies, skills and commercial models, for this approach to succeed?
- Q3: How should government engage with industry to make sure this approach succeeds?
- Q4: How can the benefits of this approach best be measured?
- Q5: What risks and costs (including hidden and associated costs) would this approach create for your organisation or sector?
- Q6: How can this approach best be used to support the economy on a local and a national level?

Technical and commercial

- Q7: How would current contracting models and building requirements need to change, in order to best facilitate procurement from a product platform?
- Q8: What unique requirements, including security, do different government departments currently specify that could (not) be rationalised or simplified?
- Q9: How and by whom should product, process and interoperability standards be set, validated and maintained over time?
- Q10: What should the balance be between the core Intellectual Property (IP) which is retained and available to companies in the sector, and the proprietary IP that should be owned by individual firms?
- Q11: Are there any other issues that you believe need to be considered if this approach is to be successfully implemented?