THE FARMER REVIEW OF THE UK CONSTRUCTION LABOUR MODEL

MODERNISE OR DIE

Time to decide the industry's future

This review adopts a structure of evaluating the construction industry's current and future state which has a strong medical process analogy:

- Identify the symptoms
- Diagnose the root causes
- Provide a prognosis
- Establish a treatment plan for recovery
- Keeping the industry under observation

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INTRODUCTION

CONSTRUCTION LEADERSHIP COUNCIL FOREWORD

At the end of last year the government asked the Construction Leadership Council to identify actions to reduce the industry's structural vulnerability to skills shortages, taking account of the Council's wider work including that on business models and offsite housing. The Council welcomed this invitation. Our task is to be Ministers' go-to source of senior industry advice on the sector's major issues, and there is no more important question for construction than this one.

This review has been carried out for the Council by Mark Farmer, CEO of Cast Consultancy, and I am very pleased to present his report. It does not, however, make for comfortable reading. It is not the first report to set out the shortcomings of the sector's labour model, and prevailing business model, though few have done so in such a cogent and compelling way. What is new, though, is the force of the conclusion that – given workforce attrition exacerbated by an ageing workforce – we simply cannot go on as we are.

The report focuses in particular on housing, reflecting the original commission. In fact, while different parts of construction have different features, this issue is to be found throughout the sector. In infrastructure and commercial property the skills challenges arising from previous underinvestment are similarly pressing, and the imperative to act similarly strong. Here too we find the survivalist business model, the absence of alignment between industry and client interests, and of the incentives and means to invest, that Mark recognises are the heart of the problem.

Put simply, much of the industry does not make enough money, or, where money is being made, feel enough confidence it will stay profitable into the future. The consequence is underinvestment in training and development, in innovation, in raising productivity. The challenge the report sets us is to do things differently – to reduce the reliance on building in the same way that we have for decades if not centuries, with its heavy demand for on-site labour. We will not have the labour force to deliver what the country needs by working in those ways, and those ways will not create enough added value for clients or suppliers to allow construction firms to prosper, and make those investments in our people and performance.

As the report says, this is a challenge for all – the industry, its clients, and government. Its recommendations are focussed on finding and unlocking the drivers of change, including action to support predictability of demand, and on leadership to own the change. That is in part a role for the Leadership Council and its workstreams, though it will depend on the industry and its clients joining the journey.

The recommendations are well framed in recognising other work currently taking place. In July the government announced it will review the Construction Industry Training Board (CITB). That is a key organisation for this agenda, and the Council would like the review to be radical – to be the force for the changed industry that we need requires a changed organisation, with a remit centred on developing the skills of the future, and efficient and effective delivery and use of its resources.

Since we were asked to carry out this work the country has voted to leave the EU. This has highlighted again the growing reliance of some trades in some regions on migrant labour, and only underlined further, if that were necessary, the imperative to make our industry one that trains and develops the people we need.

Last, I should like to record the Council's gratitude to Mark Farmer and the colleagues who have supported him. We are enormously grateful for all the time and hard work and insight he has brought to the task. Perhaps the best thanks we as an industry could give him would be to make this report the moment when the recognition that we cannot go on as we are reached its tipping point.

Andrew Wolstenholme OBE
Co-Chair, Construction Leadership Council

Construction
Leadership
Council

INTRODUCTION

In accepting the daunting challenge of leading this review, I was very clear in my mind that this had to be an exercise that led to change. This was never going to be just another report about the 'construction skills crisis' in isolation, it had to look much deeper at the fundamentals of how we deliver and why. There are numerous studies that analyse the well-rehearsed woes of the construction industry. Many also look to exemplars of activity to illustrate how things might be done at scale in a Utopian world. These approaches are both important but only in the context of how we then use that knowledge to effect modernisation and improve our industry at a strategic level. The hardest challenge for this review was always going to be how to avoid a straight rehearsal of what we already know, and really focus on what the fundamental change agents are and how this can be connected into an industry-wide transformation programme. This review is therefore deliberately as much about the 'how' as the 'what' and 'why'.

I was given clear terms of reference (page 71) and guidance from both Department for Business, Energy & Industrial Strategy (BEIS) and the Department for Communities and Local Government (CLG), which included not expecting a big pot of taxpayer money to throw at the problem. In addition, the overarching guidance from the Construction Leadership Council has been clear – do not pull any punches, look to challenge accepted norms and indeed be controversial if it will provoke debate and lead to the desired outcomes.

This review has looked to cover the ground in terms of taking soundings and evidence across many areas of the construction industry, with a particular focus on house building. It has become clear during the course of this work that the most important and effective drivers for change do not necessarily sit within the industry itself so a more holistic view has had to be taken that heavily influences the nature of the recommendations contained herein.

During the period of concluding this review, there have been tumultuous events in British politics centered on the decision to leave the EU. This has made the relevance of this review even greater with the need to find a 'home grown' solution to our problems now crucial, assuming less future reliance on migrant labour.

A by-product of the June 2016 referendum was a fresh government commitment to 'industrial strategy'. This is welcomed as the principles contained herein can essentially be viewed as some of the building blocks of a strategy to create a modernised and sustainable construction industry.

Many may see elements of my conclusions as being harsh or negative and indeed some of the recommendations as being controversial or overly ambitious. Some may also feel that the recommendations divert attention from the primary responsibility of the construction industry to resolve its own failings. This is not the intent and careful reading of this review will hopefully demonstrate a balanced and integrated analysis of the evidence that has then been developed into a series of logic linked recommendations.

I am hopeful that the issues identified and the principles established should enable all parties to step back and understand the seriousness of the predicament facing the construction industry. This also has direct ramifications for clients as end users of the industry and government as the custodian of the UK's economic and social welfare. I am very clear that if we do not address in short order how the construction industry operates and delivers, we will see a long-term and inexorable decline in its fortunes. This is not just another ''must do better' school report where the industry and its clients shrug their shoulders and carry on as normal. This review warns of potential marginalisation and deterioration that might not be recoverable. I do not believe construction's perilous future state was so clearly evident at the time of Latham's *Constructing the Team* in 1994 or Egan's *Rethinking Construction* in 1998. If this review does only one thing, it must be to bring the likely reality into greater focus.

The acceleration of the wider digital revolution combined with a shrinking traditional construction workforce are two issues I would highlight as being critical to the future fortunes of the construction industry. One could argue that the 'stars are aligning' and now is the time to allow the opportunities from digitisation to offset the risks of continued reliance on labour intensive techniques.

It is important to clarify that I do not want to create a divisive binary future industry where innovators or early adopters at the vanguard of change leave the laggards in isolation. This is about creating a vibrant, re-skilled, fully integrated, more predictable and productive industry such that traditional working and new approaches can co-exist and complement each other, driving much wider longer-term benefits..

All interested parties should consider and reflect on the impacts set out in this review of potential industry decline, not only from their own perspective but also hopefully prompting the desire for us to collectively create an appropriate legacy for future generations. I truly believe that being part of the engine room delivering our nation's built environment and by implication, economic prosperity, offers a massively dynamic and fulfilling career. However, continuing as we are is not an option if we are going to be able to make that claim in the years ahead.

Mark Farmer, October 2016

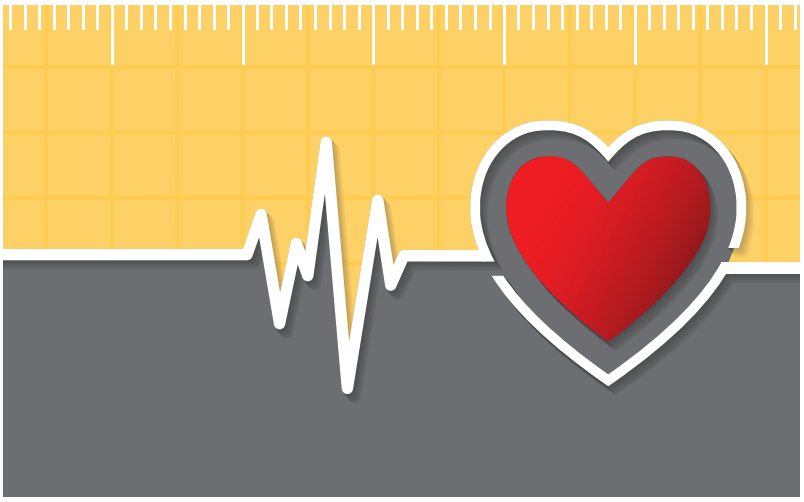
EXECUTIVE SUMMARY

The construction industry and the clients that rely on it are at a critical juncture and it is time to review the seriousness of the future outlook. Deep-seated problems have existed for many years and are well known and rehearsed, yet despite that, there appears to be a collective reluctance or inability to address these issues and set a course for modernisation.

This review adopts a structure of evaluating the construction industry's current and future state which has a strong medical process analogy:

- Identify the symptoms
- Diagnose the root causes
- Provide a prognosis
- Establish a treatment plan for recovery
- Keep the industry under observation

The medical comparison is unfortunately apposite as this review concludes that many of the features of the industry are synonymous with a sick, or even a dying patient.



SYMPTOMS

The critical symptoms of failure and poor performance have been identified in this review as:

DIAGNOSIS

Sitting behind these ten features and characteristics are three identified root causes that explain not only why we see these issues in the industry but also confirm why things may not change without strategic intervention:

One

The industry has evolved a 'survivalist' shape, structure and set of commercial behaviours in reaction to the environment in which it operates. That environment is fundamentally characterised by low capital reserves and high demand cyclicality.

Two

The industry and its clients usually have non-aligned interests reinforced by traditional procurement protocols and a deep-seated cultural resistance to change pervading across both parties.

Three

There is no strategic incentive or implementation framework in place to overcome the issues above and initiate largescale transformational change. The issues of variable demand, resistance to change and lack of alignment / integration with clients have become *de facto* accepted norms for the industry.

PROGNOSIS

The evidence reviewed indicates that the construction industry and its labour model is at a critical crossroads in terms of its long-term health. Whilst the diagnosis points to a deep-seated market failure, there are certain industry trends and wider societal changes happening now that represent both unprecedented risk and opportunity for the industry and its clients. If the opportunities are not harnessed, the risks may become overwhelming.

The prognosis for the industry, if action is not taken quickly, is that it will become seriously debilitated. It is facing challenges that have not been seen before, which create an absolute imperative for change. Previous calls to arms have not been acted on by the industry or its clients at any real scale and somehow the industry has continued to 'muddle through'.

It is unlikely, based on past evidence and the pressure of delivering their own business requirements, that clients will simply stop using the industry until it improves its proposition. However, recent capacity-led construction cost inflation experienced in some parts of the industry has certainly undermined project viability, especially in the residential sector where the issues are most acute. This has led to projects stopping as they have become unaffordable or in some instances physically undeliverable as good quality production capacity is not available. Possible future demand weakening may now support a complacent view that a natural realignment of supply and demand is taking place that will allow the construction sector to 'sort itself out'. History suggests this will not happen and we need to look beyond any short-term correction if we want to break out of a continuing boom and bust cycle of overheating followed by permanently damaging attrition in a downturn.

The real ticking 'time bomb' is that of the industry's workforce size and demographic. Based purely on existing workforce age and current levels of new entrant attraction, **we could see a 20-25% decline in the available labour force within a decade.** This scenario has never been faced by UK construction before and would be a capacity shrinkage that would render the industry incapable of delivering the levels of GDP historically seen. Just as importantly, it would undermine the UK's ability to deliver critical social and physical infrastructure, homes and built assets required by other industries to perform their core functions.

Prior to the vote for Brexit, some might have seen migrant labour as a solution to the shrinking workforce. Without entering the wider political debate, it is recognised that migrant labour has historically played a key role in providing capacity in UK construction, especially in London and the South East. A report by the National Institute of Economic and Social Research[1] suggests that over half the workforce in London comprises migrant labour, whereas the rest of the UK shows no over representation of migrants in the construction sector.

However, increasing substitution of a reducing domestic workforce by migrant labour comes with substantial risks. Furthermore, it is now uncertain how the UK's vote to leave the EU might affect the availability of migrant labour moving forwards.

Where overseas developers and contractors have entered the UK market, the early signs suggest that their model is not going to assist long-term capacity building. Models adopted so far have relied on joint ventures to allow cross-fertilisation of knowledge at senior management and supervision level. This has not extended down to the supply chain labour force. A significant increase in the labour force from foreign corporate entrants is therefore not likely to be possible without an acceptance of much more radical 'outsourcing' with all the political and economic difficulties that brings.

The current pace and nature of technological change and innovation in wider society is such that unless the industry embraces this trend at scale, it will miss the greatest single opportunity to improve productivity and offset workforce shrinkage. Failing to embrace change will also further marginalise the industry by reducing its attractiveness to a new generation of workers who will have grown up in a digital world. This review suggests there is a tipping point that is likely to be reached in the next 10 years where industry will see all of the failure symptoms highlighted in this review getting worse to the point where decline possibly becomes irreversible.

There are some early signs of manufacturing-led foreign corporates considering entering the UK market and overcoming traditional barriers to market entry through use of pre-manufactured construction products as opposed to traditional construction methods. New foreign entrants in this field, if meeting technical and quality standards, would potentially be a much needed boost to UK housing supply capacity. But reliance on foreign entrants would represent a lost opportunity for the UK to retain value added, including direct and indirect employment, IP development and to potentially build an export base.

A final issue that could define the future outlook for the residential construction sector, is its apparent growing reliance on the 'for sale' housing model, with which it has never been more deeply synchronised. As the social housing sector has changed its model to private sale led cross subsidy and surplus generation in response to a series of policy changes, there is now less opportunity, in the event of a private market correction, to create a 'soft landing' through a social housing build programme. This is a real risk to housing delivery in the UK due to the potential for even greater cyclicality than seen previously.

Government has a strategic choice to make about the future role of grant funded social housing, which has historically been used as a counter-cyclical demand tool. This also brings into question the role that may be played by direct delivery measures across all tenures either at a central, regional or local government level.

There is also a significant opportunity presented by the Build to Rent sector to create acyclical and at scale demand that could underpin significant investment in innovative ways of building and the development of new skills across the industry.

More tenure diversity would immediately imply different supply chain and delivery models that may better promote innovation. In time, this may in turn influence core housebuilder delivery models but it is considered unlikely that large scale innovation will start in the volume housebuilder market.

[1] Heather Rolfe and Nathan Hudson-Sharp, The impact of free movement in the labour market: case studies of hospitality, food processing and construction. National Institute of Economic and Social Research (NIESR), 27 April 2016.

RECOMMENDED TREATMENT PLAN

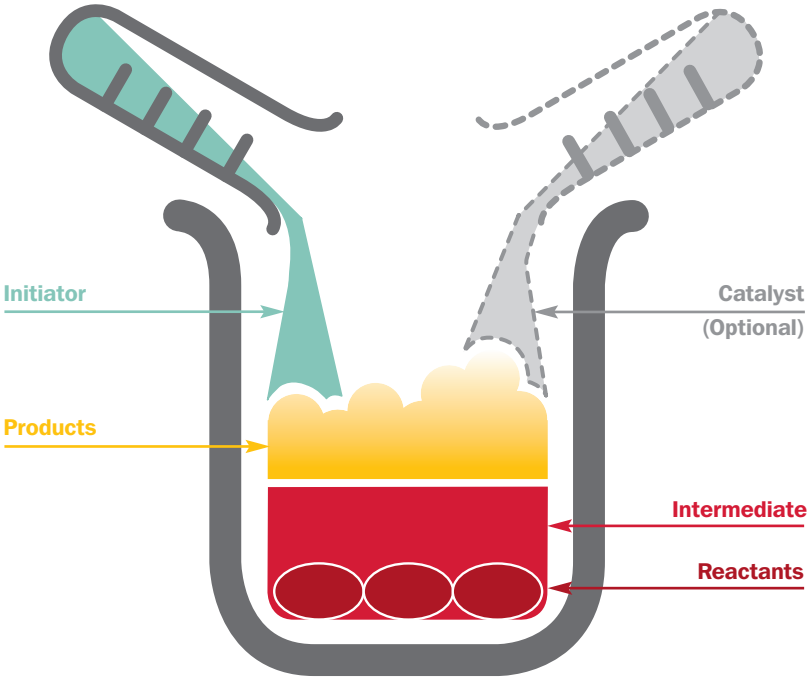
The required treatment plan and recommendations need to reflect that the construction industry is chronically underinvested due to a combination of economic, market and behavioural factors. It requires a wholesale and coordinated 'special measures' approach to drive transformational change that at the heart of any recommendations needs aligned stakeholder intent, sufficient funding and ultimately, scale.

Critically, a plan for change needs to recognise, based on past evidence, that the industry will not change itself unilaterally at scale. It needs to be led by clients expressly changing their needs and commissioning behaviours or government acting in a regulatory or strategic initiation capacity to drive positive disruption.

Any such disruption needs to be appropriately structured, with strong leadership so that it affects the market in key areas that will have the greatest and quickest impact and is ultimately supported by a sound business case; not just optimistic ambitions, target setting or aspirational statements of intent.

At the heart of this review's recommendations, and on the basis of the defining principles set out above, it is proposed that a new, ambitious and mutually beneficial ***tripartite covenant*** is established between the construction industry, its end clients (private and public) and government acting as a strategic initiator.

With an ultimate goal of creating long- term transformational change across such a complex and multi-faceted entity as the construction industry, it may be useful here to compare the component parts of the recommendations to the basic ingredients for creating a chemical 'chain reaction'. The 5 key components that would usually be necessary and their analogies for this review are:



Reactants – the key elements necessary to be part of the reaction - **Integrated Tripartite Leadership across Clients, Government and Industry**

Intermediate – the enabler of a reaction - **A Reformed CITB**

Products – the desired outcomes that arise from the reaction and which also self-perpetuate the reaction - **Client & Industry Process Integration, R&D & Innovation, Skills & Training, Industry Image**

Initiator – the means by which a reaction is commenced - **The Role of Government in Pump Priming Change**

Catalyst – a mechanism to accelerate or speed up a reaction - **An Option for Accelerating Behavioural Change**

The headline recommendations of this review are as follows:

Recommendation 1: The Construction Leadership Council (CLC) should have strategic oversight of the implementation of these recommendations and evolve itself appropriately to coordinate and drive the process of delivering the required industry change programme set out in this review.

Recommendation 2: The Construction Industry Training Board (CITB) should be comprehensively reviewed and a reform programme instituted.

Recommendation 3: Industry, clients and government should work together leveraging CLC's *Business Models* workstream activity, to improve relationships and increase levels of investment in R&D and innovation in construction by changing commissioning trends from traditional to pre-manufactured approaches. The housing sector (spanning all tenures) should be used as a scalable pilot programme for this more integrated approach.

Recommendation 4: Industry, government and clients, supported by academic expertise and leveraging CLC's current *Innovation* workstream activity, should organise to deliver a comprehensive innovation programme. This should be fully aligned to market, benefits case led and generate a new shape of demand across industry (with a priority on residential construction). It should quickly define key measures of progress and report regularly against these as a check on the possible need for more radical measures. It should, in turn, also help to shape CITB reform proposals in relation to technology and innovation grant funding initiatives.

Recommendation 5: A reformed CITB should look to reorganise its grant funding model for skills and training aligned to what a future modernised industry will need. Industry bodies and professional institutions should also take a more active role in ensuring that training courses are producing talent which is appropriate for a digitally enabled world, making sure that the right business models are evolved with appropriate contractual frameworks.

Recommendation 6: A reformed CITB or stand-alone body should be challenged and empowered to deliver a more powerful public facing story and image for the holistic 'built environment' process, of which construction forms part. This responsibility should include an outreach programme to schools and should draw on existing industry exemplars and the vision for the industry's future state rather than just 'business as usual'.

Recommendation 7: Government has recently reaffirmed its commitment to having a strong industrial strategy. The Government should recognise the value of the construction sector and be willing to intervene by way of appropriate further education, planning and tax / employment policies to help establish and maintain appropriate skills capacity.

Recommendation 8: Government should act to provide an 'initiation' stimulus to innovation in the housing sector by promoting the use of pre-manufactured solutions through policy measures. This should be prioritised either through the conditional incentivisation of institutional development and investment in the private rented sector; the promotion of more pre-manufactured social housebuilding through Registered Providers; direct commissioning of pre-manufactured housing; or a combination of any of the above. It should also consider planning breaks for pre-manufactured approaches.

Recommendation 9: Government, as part of its housing policy planning, should work with industry to assemble and publish a comprehensive pipeline of demand in the new-build housing sector. This should be along the same lines as the National Infrastructure Pipeline, seeking to bring private developers and investors into this as far as possible to assist with longer term innovation and skills investment planning.

Recommendation 10: In the medium to longer-term, and in particular if a voluntary approach does not achieve the step-change necessary, government should consider introducing a charge on business clients of the construction industry to further influence commissioning behaviour and to supplement funding for skills and innovation at a level commensurate with the size of the industry. If such a charge is introduced, it should be set at no more than 0.5% of construction value, with a clear implementation timetable. Clients should be able to avoid paying this by demonstrating how they are contributing to industry capacity building and modernisation by directly or indirectly supporting skills development, pre-manufacturing facilities, or other forms of innovation and R&D.

1 A SYMPTOMATIC ANALYSIS OF THE CONSTRUCTION INDUSTRY

DEFINITIONS

As an important preface, it is worth defining three key terms that will be used throughout this review.

Industry – The use of this term designates the 'doing' part of the construction process, which creates or modifies a built asset. This includes design as well as physical construction. The scope therefore includes the construction supply chain, ranging from major main contractors, to sub-contractors through to suppliers. It also includes the consultancy part of the industry. This review, although having a focus on housing, also uses the term to include physical and social infrastructure and commercial construction. It also does not differentiate between new-build or repairs and maintenance type work or private and public sector activity.

Clients – This term represents the various parties that directly commission the *industry* (as defined above) to create or modify built assets. This is not necessarily the end user or *owner* of the asset. Clients of the industry can include central government (when procuring construction activities through government agencies or departments or via regulated industries), regional or local government, Registered Providers, private real estate developers, directly or indirectly developing investors, corporate occupiers, and at the domestic end of the market, the public at large (although this review is not chiefly concerned with the public's direct interface with industry). An interesting hybrid situation exists in the shape of the housebuilder model. The review references this sub sector extensively but it is important to note that its characteristics are different to other client types in that it can also be seen, at least partly, as a component of *industry*. However, this review takes the stance that housebuilders really need to be defined as a *client* in that they are commissioning the wider supply chain to execute work and are the final piece in the construction value chain prior to onward sale or leasing to end consumers.

Pre-Manufacture – Many different terms are used in the realm of construction innovation including 'off-site manufacture' 'modern methods of construction' or 'pre-fabrication'. This review uniformly adopts the term *pre-manufacture* as a generic term to embrace all processes which reduce the level of on-site labour intensity and delivery risk. This implicitly includes a 'design for manufacture & assembly' approach at all levels ranging from component level standardisation and lean processes through to completely pre-finished volumetric solutions. It also includes any element of on-site or adjacent to site temporary or 'flying' factory or consolidation facilities which de-risk in-situ construction, improving productivity and predictability. 'Industry 4.0' is a term often used to reference the fourth industrial revolution underpinned by cyber-physical 'smart' production techniques. It is however clear that in many respects, construction has not even made the transition to 'industry 3.0' status which is predicated on large scale use of electronics and IT to automate production. It is important therefore to see this as the immediate goal and to use terminology and definitions based on industrial strategy benchmarks that reflect this current reality.

KEY THEMES

The following is a summary of 10 thematically categorised features and observations about the industry that are overt manifestations of more deep-seated issues identified in Section 2.

Whilst the review is tasked with looking at the 'Construction Labour Model', there is a need to zoom out to macro industry-wide issues before focusing back in on how these are impacting the construction labour market and its skills challenges.

This section is not meant to be a definitive list as many of the issues highlighted have been covered at length in other reports and commentaries. However, rehearsing the main points is important in illustrating why the actions that the review is ultimately suggesting are necessary.

Where the review has found evidence of current exemplary activity, it has highlighted these as short case studies throughout to show what an aspirational, industry-wide level of behaviour or outcome might look like and to contrast this against current industry norms.

Low Productivity

One of the critical features of the industry is its extremely poor level of productivity. When assessed against other industries, especially manufacturing led ones, the differential is stark, not only in current absolute terms but also in how the gap has widened over time. Other industries have harnessed wholesale process improvement by embracing and commercialising the role of technology and have effectively reinvented themselves by driving a paradigm shift in their end-to-end delivery. In 2005 Professor Michael Ball published a report entitled *'The Labour Needs of Extra Housing Output'*[2] that highlighted house building's inability to achieve the significant annual productivity gains that are seen in some other industries. This can also be said to apply to the wider construction industry beyond house building. There has been little change in the situation in the last decade. The UK industry is by no means alone in this issue. The recent World Economic Forum Report *'Shaping the Future of Construction'*[3] shows a 19% fall in productivity in US construction since 1964 whilst all other non-agricultural industries have, by contrast, shown a 153% improvement in the same period (see Figure 1).

A similar position of no significant change in productivity is evident in Figure 2 showing productivity change across Europe from the recent report from The Chartered Institute of Building (CIOB) *'Productivity in Construction'*.[4] This stated that "…poor productivity growth in construction is not just a UK phenomenon…" in part reflecting the difficulty in measuring productivity in construction but also alluding to something much deeper about generic industry characteristics that set the scale of the challenge to improve.

Figure 3 also shows UK productivity growth since 1994 by industry. Productivity in construction has been essentially flat in that period, in contrast with other industries, particularly manufacturing, where output per hour worked in 2015 was over 50% greater than 1994 levels.

"…poor productivity growth in construction is not just a UK phenomenon…"

[2] Professor Michael Ball, *The Labour Needs of Extra Housing Output: Can the housebuilding industry cope?* CITB and HBF, 2 December 2005.

[3] *Shaping the Future of Construction: A Breakthrough in Mindset and Technology,* World Economic Forum in collaboration with the Boston Consulting Group, 4 May 2016.

[4] Brian Green, *Productivity in Construction: Creating a Framework for the Industry to Thrive*, The Chartered Institute of Building (CIOB), 24 May 2016.

The upturns of UK productivity in construction that can be seen in Figure 2 and 3 tend to coincide with economic slowdowns. This indicates that in high output periods, less productive workers enter the industry and dilute overall productivity. This is noticeable in construction due to labour still being the dominant determinant of overall unit productivity; whereas in other industries, automation effectiveness is much more significant.

Numerous failures account for the industry's poor productivity, including fragmented transactional and risk transfer interfaces, lack of early well-defined client briefs, a propensity for clients to change their requirements late in the process, design – procurement – construction process separation, and large scale industry re-working and defects rectification. The BIS report *'Supply Chain Analysis into the Construction Industry'*[5] argued that construction can accommodate change too readily and at too low a cost at the point of the change. Although there is a peripheral awareness of 'Lean' and other optimisation techniques used in other industries, there is no mainstream shift towards embracing such thinking as a catalyst for process and productivity improvement. There are however some interesting exceptions that appear to be driven by clients of the construction industry whose core business lies in more advanced sectors such as manufacturing, pharmaceuticals or defence (see Case Study 1).

Figure 1: From Shaping the Future of Construction: A Breakthrough in Mindset and Technology, World Economic Forum in collaboration with the Boston Consulting Group, 4 May 2016.

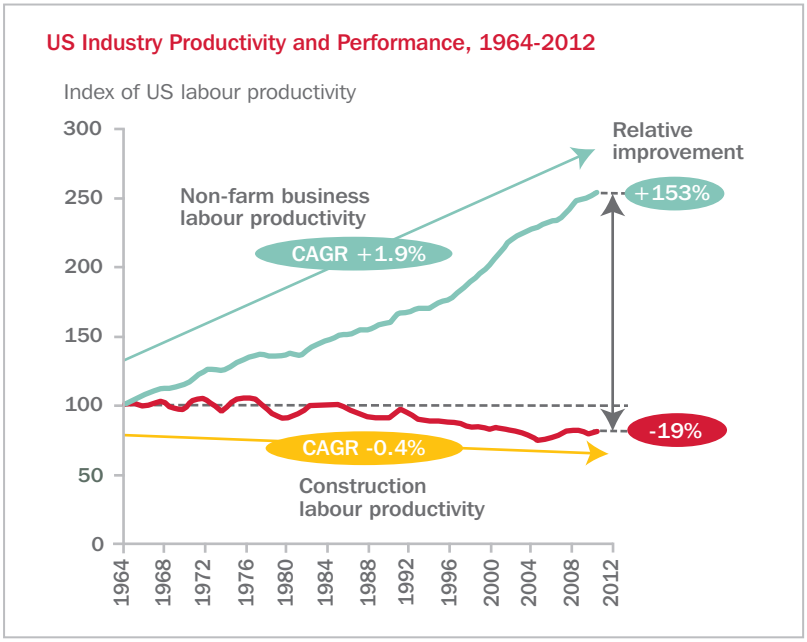


Figure 2: OECD Productivity and ULC by main economic activity (ISIC Rev.4) data, 2015

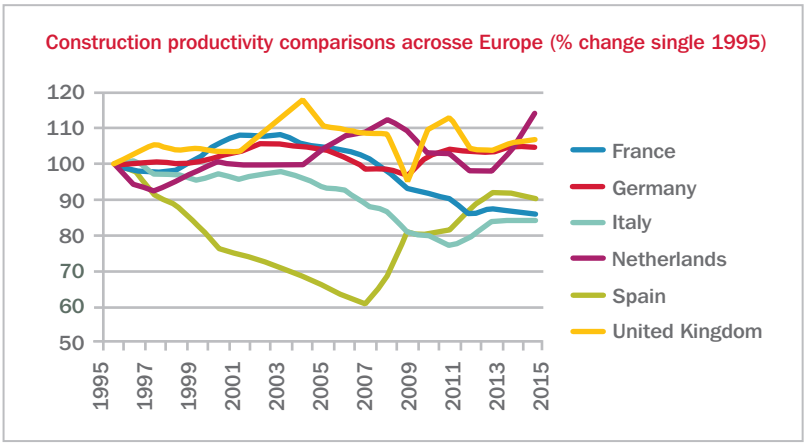
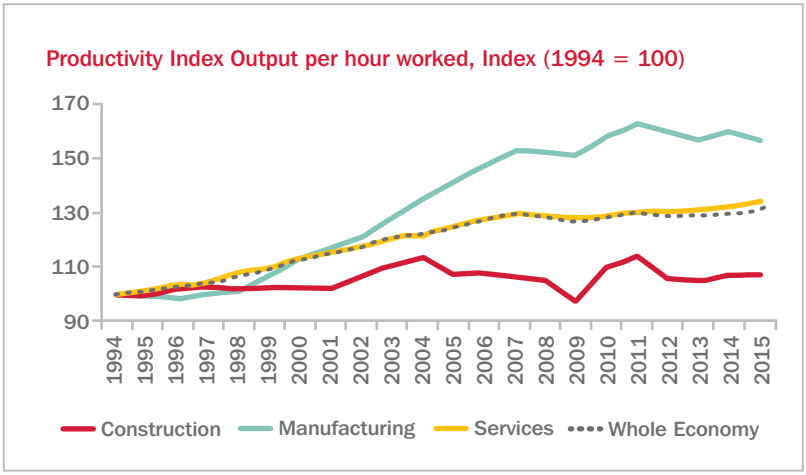


Figure 3: ONS Labour Productivity, Q4 2015. Table 1 and 8. April 2016.



[5] BIS Research paper no.145, *Supply Chain Analysis into the Construction Industry: A Report for the Construction Industry Strategy,* October 2013.

CASE STUDY 1

GSK "FACTORY IN A BOX"

Pharmaceuticals multinational GSK's 'Factory in A Box' is a building packaged as a repeatable commodity. The boxes are in fact shipping containers that contain every component packed in the reverse order needed for the re-assembly process.

The project responded primarily to GSK's need to develop factories and packaging facilities in emerging markets, particularly in Africa and Asia, that would meet very high internal compliance standards without spiralling costs. The hypothesis was to fit all elements into a shipping container that could be sent anywhere to be built by anyone.

Developed for GSK by innovative design and management consultant Bryden Wood, the "Factory In A Box" cuts the construction programme from 12 weeks to four and delivers an estimated 30% saving compared to the same facility built conventionally.

Bryden Wood's approach was to standardise and commodify the design and construction process by breaking the problem down into 'chips', or groups of related components, described by Jaimie Johnston, Director at Bryden Wood, as "the Lego bricks of the process." Connecting the chips in a workable order delivers a schematic for a functioning production facility, meaning the GSK team can draw up a reliable cost estimate of a bespoke new facility within a matter of days – and then modify its capacity or layout equally quickly. The chips are based on standard GSK functions across its property portfolio, such as storage areas, clean rooms, blending chemicals or packaging.

A crate of coloured brackets and fixing connections, which match to coloured stickers positioned on the components during the manufacturing process.

The team break down the processes and create a database about each chip defining its physical characteristics, its energy requirements, air change requirements and how many operatives it will need and the training they require. The chips are both physical and digital entities containing all the related BIM object data, so that the actual building will be an exact representation of the digital model, with its components assembled in the same sequence.

Cataloguing repeatable components and systems in this way also means that components can be tagged with 2D bar codes and tracked through manufacturing distribution and on to site, generating accurate data on the actual cost and labour requirements.

GSK plan to introduce elements of the project into the company's construction programme in the UK to deliver greater cost certainty. Longer-term, the aspiration is evolve similar solutions that could be applied to the health, education and residential sectors, leading a process revolution in the UK construction industry.

Case study sourced from Bryden Wood and article by Elaine Knutt, 'The Building Built by Gurkhas' in Construction Manager Magazine, 3 February 2016.

Poor predictability

Alongside its productivity failings, the industry suffers a related inability to accurately deliver to plan. Success factors can be measured by different parameters but typically will relate to clients' core ambitions for *time, cost and quality.* Irrespective of whether the absolute standards being promised by industry in each of these categories are the best that they can be, the more concerning issue is that what is promised, regardless of how challenging, is often not delivered. The 2016 Scape Group survey *'Sustainability in the Supply Chain'*[6] found 58% of all supplier and contractor respondents had identified skills shortages as contributing to poor quality of workmanship. In addition 40% of private sector and 80% of public sector respondents to this survey attributed skills shortages to budget overspends. Failure incidence does also seem to correlate with building project technical complexity (difference in programme certainty between low and high rise buildings in Figures 4 and 5) which infers a basic inability to 'scale up' by coordinating and managing larger and more challenging tasks.

This lack of certainty has become an accepted norm in large parts of the industry and is often associated with its site based nature and the impact of 'unforeseen issues' such as unexpected ground conditions or poor weather. The reality is that the causes of failure are multi-faceted and often cannot be blamed on such issues. There appears to be a general acceptance of failure and underperformance both by industry itself but also begrudgingly by clients.

The true purpose of contingency and risk provisions within the industry have unfortunately been corrupted in many instances from being a pro-active business management tool to one of reactively masking preventable failures and poor planning. The exceptions are mostly in relation to more recent large infrastructure projects, where highly structured and robust approaches to project planning, combined with more integrated and long-term design and construction collaboration and incentivisation, have been driving different behaviours and less tolerance of underperformance. The higher risk profile and longer time periods associated with major infrastructure still makes low predictability an inherent feature of this sector of industry but irrespective, it would appear the wider construction sector does want to adopt the same levels of disciplined risk management that would promote better performance.

> "There appears to be a general acceptance of failure and underperformance both by industry itself but also begrudgingly by clients."

Figure 4: Managing the Risk of Delayed Completion in the 21st Century, Chartered Institute of Buildings, 2008

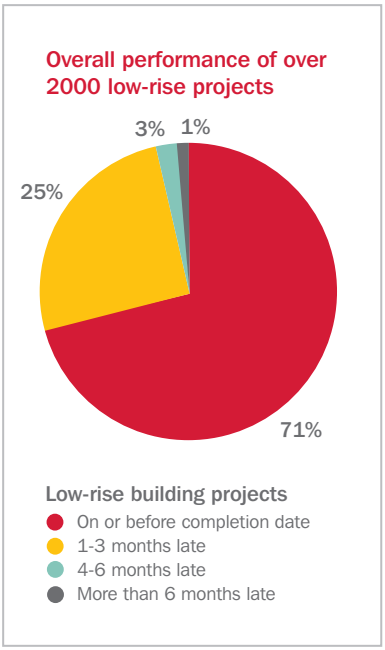
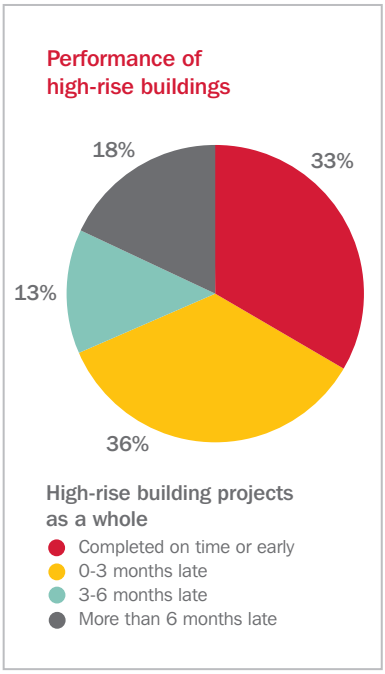


Figure 5: Managing the Risk of Delayed Completion in the 21st Century, Chartered Institute of Buildings, 2008



[6] *Sustainability in the Supply Chain*, The Scape Group, 22 August 2016.

Structural Fragmentation

The construction industry is often characterised as an example of 'market failure'. This usually refers to its highly fragmented structure (both vertically and horizontally), introverted nature and unusually high levels of self employment (see Figure 6).

A Review of Industry Training Boards[7] published by BIS in December 2015 referenced 40% of total construction contracting jobs as being self-employed compared with 15% across the whole economy.

The structural make-up of the industry and its organisational separation from clients is an important defining characteristic of construction, which differs from other more collaborative industries. Contractors and their supply chain tend to have limited involvement with clients upfront in the feasibility stage of a project.

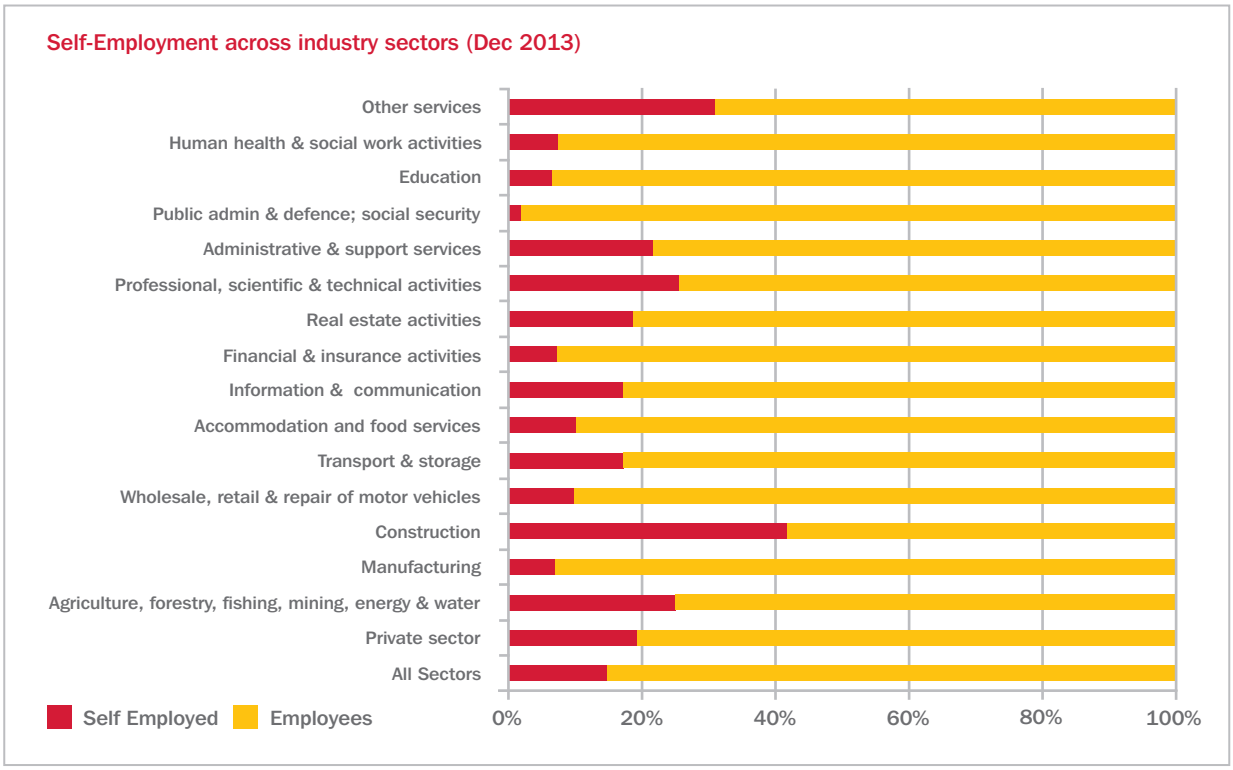
The lack of integration across the supply chain, manifested in a wide-scale use of sub-contracting and tiered transactional interfaces is commonplace. This has created significant non value add costs in the supply chain through multiple on-costing, downward and often inappropriate risk transfer. This leads to an industry that tends to be cost-focused rather than value-focused.

There is a high volume of SME businesses in the construction industry with just under a fifth of all SMEs working in construction[8] at the start of 2015 as shown in Figure 7.

In addition, there is little evidence of corporate overseas new entrants coming into the core UK construction market and directly competing with the large domestic 'tail' of the industry. The CBI reported in July 2015, *Fit for the Future: Strengthening Construction Supply Chains*[9], that 93% of the UK construction supply chain is sourced domestically. This confirms the high barriers to entry for corporate level importation of physical construction activity (i.e. productive labour as opposed to management or plant and material supply).

A natural consequence of fragmentation is that those tiers of the industry closest to clients or indeed forming parts of clients' organisations themselves have effectively become process managers for a wider cascaded supply chain rather than having direct delivery control by employing their own workforce.

Figure 6: From Combined Triennial Review of Industry Training Boards (Construction, Engineering Construction and Film), Department of Business, Innovation and Skills, December 2015

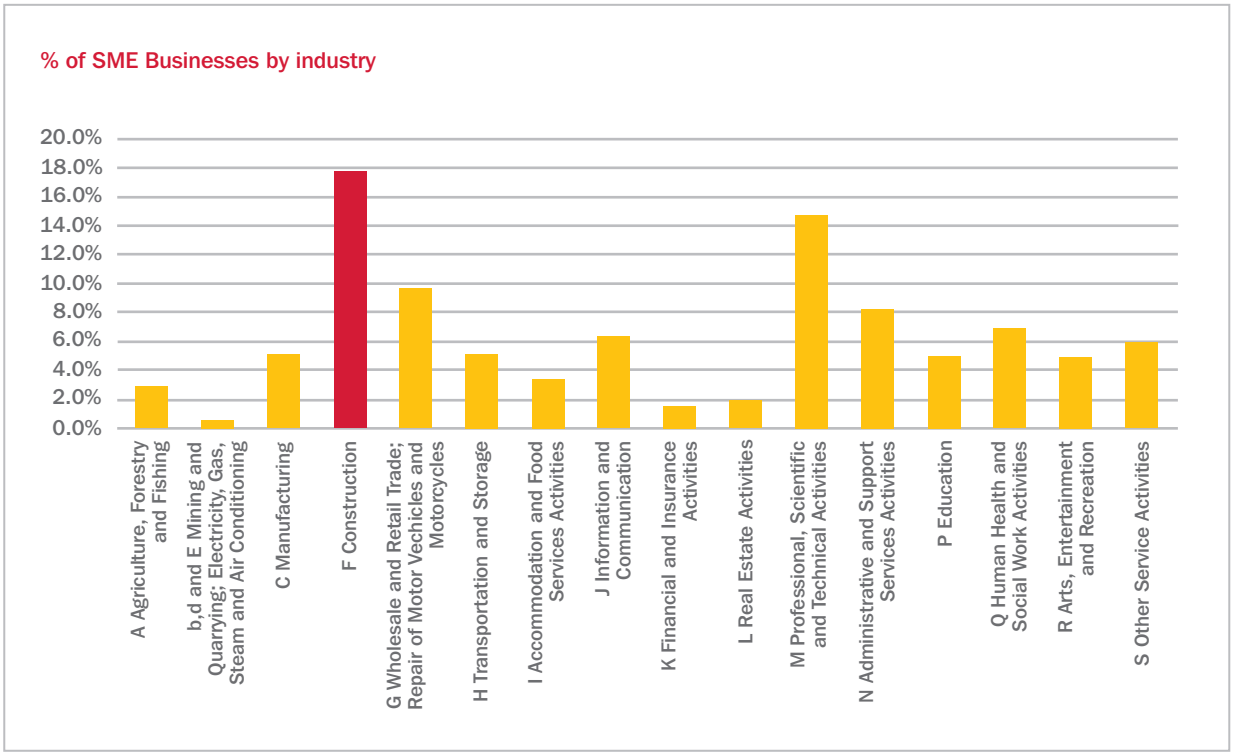


[7] Combined Triennial Review of Industry Training Boards (Construction, Engineering Construction and Film), Department of Business, Innovation and Skills, December 2015.

[8] Business Population Estimates for the UK and Regions 2015, Department of Business, Innovation and Skills, October 2015.

[9] *Fit for the Future: Strengthening Construction Supply Chains.* CBI, July 2015.

Figure 7: from Business Population Estimates for the UK and Regions 2015, Department of Business, Innovation and Skills, October 2015.



In this regard, **the terms 'housebuilder' and 'contractor' are now potentially misnomers as the physical delivery is largely done by others.** *'The Homebuilding Supply Chain Research Report'*[10] published in October 2015 indicated that housebuilders subcontract the majority of construction work to their supply chain; in most cases this was 90-100% of the work. The residual management and supervision deployed by these organisations is the only chance to drive value for their clients and themselves. Often this is hampered by distance from the broad components of a supply chain that might include designers and other consultants, as well as specialist and non-specialist sub-contractors and a multitude of suppliers.

The recent advent of employment intermediaries or umbrella companies has further cascaded reluctance to directly employ labour down the supply chain and increased the distance between employment and the top tier transactional interface and between the end client and industry.

The lack of control and organisational proximity to resource is exacerbated in times of high demand as fragmentation is compounded by high levels of itinerant self-employed labour not fully controlled by those owning contractual responsibility for out-comes, even two to three levels down the supply chain.

There are few examples where the industry or indeed clients have looked to vertically integrate their supply chain through either single point ownership or much stronger collaborative cross-corporate alliances as seen in other industries. Where there have been moves in this direction, they are often seen as a last ditch response to poor industry performance. Such approaches are often viewed suspiciously by others as an exception to the unwritten rule that the industry is defined by its flexibility and lack of willingness to hold a large work force or fixed cost investments. This review heard evidence in a few isolated instances of a desire from certain large main contractors and housebuilders to increase the proportion of their directly employed PAYE trade workers, mostly in response to concerns over labour security in the future. However, this is not a widespread trend and is certainly yet to be evidenced in practice.

Recent indicators suggest some structural disruption to this 'accepted' model in the UK (see Case Studies 2 and 10). This approach is being challenged by a few isolated client or industry participants that are able and willing to move to a higher level of self-delivery and direct control over the wider built asset creation process.

[10] *The Case for Collaboration in the Homebuilding Supply Chain.* CITB, HBF, Skyblue, October 2015.

LAING O'ROURKE COMMITMENT TO DFMA AND NEW VOLUMETRIC FACTORY

CASE STUDY 2

Within the construction sector, market cyclicality and the pressure to efficiently match supply and demand are creating both significant challenges and substantial opportunities. Smarter processes pioneered in other industries, such as aerospace and automotive; are now being adopted by some pioneers in the UK construction industry.

Laing O'Rourke is rethinking the way they design, engineer, construct and operate their buildings and infrastructure. They believe that construction and engineering must break away from traditional processes to evolve and deliver projects quicker, safer and more sustainably; to a higher quality, with greater certainty.

Laing O'Rourke's Design for Manufacture and Assembly (DfMA) approach redefines the traditional phases of project delivery; agreeing and locking down the design phase much earlier to allow the manufacturing, assembly, testing and commissioning phases to be compressed and run in parallel, rather than in one long linear sequence, driving greater efficiencies in how resources are mobilised.

DfMA is enabled through the investment Laing O'Rourke have made in digital engineering and in manufacturing facilities, anchored by Explore Industrial Park (EIP), Nottinghamshire, producing an often complex set of building system components in a controlled factory environment, prior to delivery to a construction site for installation.

Laing O'Rourke residential projects including Elephant Road, London benefitted from DfMA, with manufactured components shortening the delivery phase of the programme. The approach is being replicated on other live projects including Two Fifty One, Southwark. Laing O'Rourke's ambition is to build and operate a new Advanced Manufacturing Facility alongside the existing factory at EIP. The AMF will use intelligent design, precision engineering and fully automated processes to deliver a new range of automated residential solutions that could revolutionise house-building in the UK.

Explore Industrial Park, Nottinghamshire

Leadership Fragmentation

Distinct but related to the structural fragmentation issues highlighted above is the highly fragmented nature of leadership and decision making in the industry. This is underlined by a fundamental lack of collective responsibility for change and improvement across all stakeholders involved in built asset creation, modification and operations.

The first observation would be that **the industry and its clients appear to be operating to a large degree in two distinct spheres with little sign of the inter-dependence that, on paper, should exist between the two.** The real estate and built asset investment and development sector is completely reliant on having a properly functioning and effective construction industry to deliver its aspirations which are then either traded or held as financial, social or operational investments, whether it be major civil engineering led infrastructure, schools, hospitals, homes or commercial buildings.

There is no single large scale representative body that represents both industry and clients across all types. The Construction Leadership Council (CLC) does have membership spanning central government (which is also obviously a client), stakeholders from within industry itself (including main contractors, suppliers, SME sub-contractors and consultants) and indeed, the housebuilder client sector. However, it does not have a wider mandate to represent and lead on behalf of the collective industry and its clients. Indeed, looking in the other direction, the British Property Federation (BPF), representing many real estate developers and investors does not appear to have any formal mechanisms in which to interface at scale with the construction industry it so heavily relies on despite having its own construction committee.

The CLC is not a dedicated full time executive body and it has an unenviable task of trying to initiate change, by setting an agenda that has to then be socialised and sold to industry, assisted by CLC members leading by example. Its link to government in a strategic capacity is perhaps the most powerful tool it has rather than scalable direct industry and client wide influence.

The industry's own representative bodies are, generally, highly fragmented and, by implication, often serve only particular subsets of the industry due to the priority being their own members' interests. There has essentially been a lack of joined-up strategic thinking that brings together government, clients, major contractors, specialist contractors (across both building and engineering) and relevant professional bodies. At the time of writing this review, the *National Housing Taskforce* has just been convened in conjunction with the All-Party Parliamentary Group for Housing and Planning to look at the issues behind housing supply in the UK. This shows a welcome, more joined up approach involving the CIOB, RIBA, RICS, RTPI as well as key representatives from the finance and social housing sector. Although it still does not give 'front line' ownership to private client representatives and industry supply chain participants, which this review highlights as key, this better integration of constituent parts is most certainly the direction of travel required. It is vital that the 'Skills, Materials & New Technology' workstream within this forum thinks both strategically and practically and explores the different mechanisms that can promote construction industry modernisation. It is considered likely that in a housing context, these will sit outside of the traditional housebuilder approach and this should influence focus and effort on formulating its recommendations which it is hoped will be influenced by the findings of this review.

Turning to the government's role in leadership, it is worth highlighting that although government wants to drive an industry improvement agenda, its direct influence as a commissioning client is limited. The CLC's *Construction 2025 Report*[11], which sets out government's and industry's joint ambitions with targets for lower-costs, increased speed, carbon reduction and more exports, look impossible to achieve based on the findings of this review. The focus to date has been on leveraging government's role as a client through adoption of best practice and attempting to influence wider improvements. However, government's role as a client is itself fragmented, with different commissioning agents at national and local level across a range of economic and social infrastructure, including transport, hospitals, schools and housing. It is important that government continues to improve its ability to commission intelligently, with the Government Construction Board providing a forum for this.

In this regard, it is crucial to note that only 25% of the industry's output relates to public sector works (excluding infrastructure). The *Construction Output Bulletin* from ONS published in May 2016 (Figure 8) showed the value of public sector works as being relatively stable since 1997: moving between 23-26% (other than immediately after the 2008 economic downturn when public sector works represented over 30% of output).

[11] *Construction 2025 Industrial Strategy: Government and Industry in partnership, Construction Leadership Council,* July 2013.

CASE STUDY 3

BUILD UK

Build UK provides a strong collective voice for the construction supply chain, bringing together Main Contractors and the leading Trade Associations representing over 11,500 Specialist Contractors. The most recent evolution has been to bring large construction clients to the table with Almacantar, Argent and Great Portland Estates leading the way here. This will hopefully start addressing the lack of integration between clients and the construction industry that this review highlights.

Build UK focuses on key industry issues that can deliver change and enable the construction supply chain to improve the efficiency and delivery of construction projects for the benefit of the UK economy.

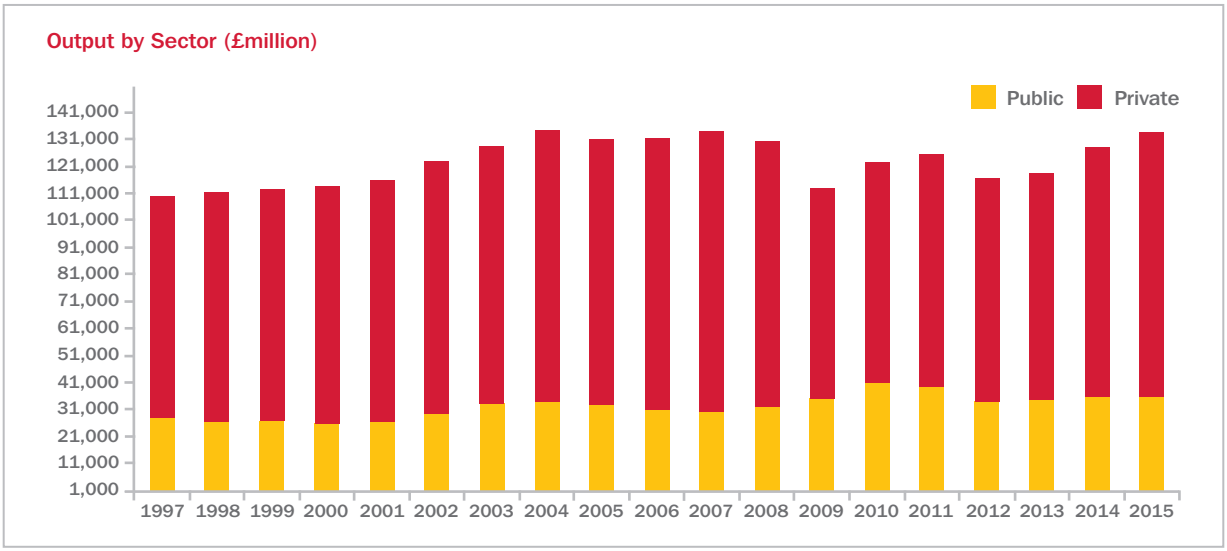
Providing influential and dynamic leadership, Build UK ensures a joined up approach from the supply chain as the 'go to' representative organisation for industry stakeholders around issues such as pre-qualification, payment and the wider industry image.

Founded in 2015, Build UK continues to grow on the back of successes in driving change in the industry, such as the Training Standards programme launched to address the skills shortages highlighted in this Review.

The Safety Helmet Colours initiative has highlighted Build UK's commitment to improving health and safety on construction sites and professionalising the image of construction. Highways England has confirmed it will adopt the Safety Helmet Colours Standard from 2017, demonstrating not only Build UK's reach but also the willingness of the industry to present a more joined-up approach across different construction sub-sectors.

Safety Helmet Colours introduced April 2016

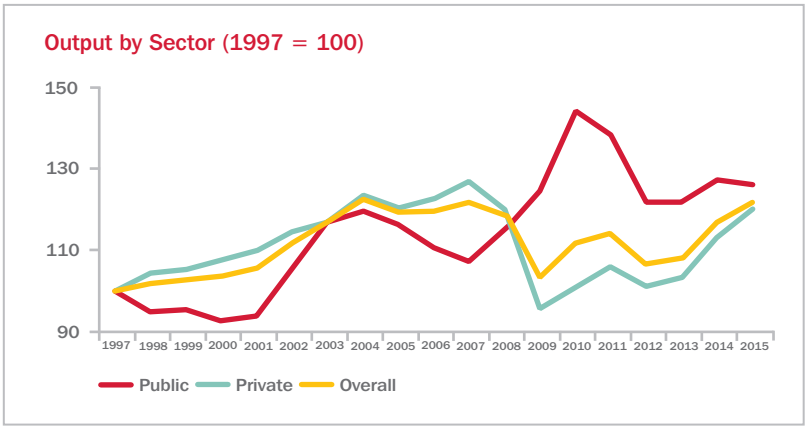
Figure 8: Output in the Construction Industry, Table 2A, Office for National Statistics, July 2016



The conclusion is that despite a large infrastructure led pipeline and government interest in that, circa 75% of all output is not in the government's direct control and there is not enough coordinated engagement with private clients of the industry, including real estate developers, investors, developing occupiers and to a lesser extent, housebuilders. This is a structural issue which limits the ability for overall strategic change to be achieved other than in pockets, often in isolation from other parts of the construction sector. Unless the whole spectrum of private and public clients are involved in effecting change, it is suggested that the industry will not be able to transform itself in response to client demand changing.

"circa 75% of all output is not in the government's direct control and there is not enough coordinated engagement with private clients of the industry"

Figure 9: Output by sector rebased to 1997, Output in the Construction Industry, Table 2A, Office for National Statistics, July 2016



The Construction Industry Training Board (CITB) has a specific leadership role that is important to describe and review. The CITB's implementation issues are covered in more detail on page 25, but in a leadership context, it clearly has responsibility for leading both training and external industry promotion on behalf of the businesses that it collects levy from. The fragmentation and lack of joined up thinking highlighted above is exemplified by the separate series of initiatives that CITB has been forced to launch in partnership with individual trade and representative bodies. Although they are all trying to create better outcomes, the fact that they are being led by fragmented coalitions is not conducive to single point ownership of modernisation across a supply chain that is many instances shared between house building and general or specialist contracting. The concern here would be the danger of insular 'sub-sector' thinking that starts to compartmentalise industry due to the inherent inability of CITB through its terms of reference, available infrastructure and the fractionalised nature of its 'industry partners'. This fundamentally undermines CITB's ability to lead a true industry-wide change agenda that spans house building, civil engineering, commercial construction, building services engineering and also has the voice of clients' needs sitting behind it.

There is also a realisation from the evidence this review has seen and heard that specialist interest groups or small minorities trying to change wider industry behaviour are battling a tide of industry scale and lethargy. This conclusion is a hard one to accept but reflects the challenge faced. The recently announced merger between Constructing Excellence and The Building Research Establishment (BRE) signifies a greater potential impact of these important bodies through aggregation and scale but all of this still requires 'hard wiring' into the mainstream industry and its clients to maximise its scalable impact. Similarly, Buildoffsite has done good work trying to promote the importance of a modern, pre-manufacture led industry and has in particular made significant inroads to the fundability / warranting of off-site construction through its 'Buildoffsite Property Assurance Scheme (BOPAS). Its ability to lead a wider and compelling message to market though on behalf of its members is limited by the conservatism of many clients and often the scepticism of their advisors.

Low Industry Margins, Adversarial Pricing Models & Financial Fragility

Interlinked with the issues of productivity, predictability and structural fragmentation covered above, is the nature of the commercial returns model seen across industry. Total output for UK construction is in excess of £100 billion per annum. While there is no definitive measure of financial performance across the industry or sectors within it, recent published results of many listed UK construction businesses, as well as the high level of insolvencies and financial failures in the industry, would indicate that blended margins, especially when viewed on a long-term trended basis across economic cycles, are very thin relative to many other industries.

> "The low level of cost predictability is not just a problem for clients but is also one for industry itself"

Low profitability is a long standing problem for the industry. It was cited by Sir John Egan in his watershed report *Re-Thinking Construction (1998)*[12] in which he stated a deep concern that ***"the industry as a whole is under-achieving. It has low profitability and invests too little in capital, research and development and training"***. KPMG[13] analysed the finances of many of the UK's major contractors which revealed that the financial position of many firms remains uncertain despite the industry emerging from recession. Operating margins, a key performance indicator had fallen by almost 60% from 2.8% in 2010 to an average of 1.2% in 2013.

The industry has recovered further since 2013 however margins remain under pressure. Construction News, produces an annual survey of the Top 100 UK construction contractors. The latest available survey (for 2015) indicates that the average operating margin for the Top 25 fell from 2.5% in 2014 to 1.2% in 2015. The overall figure for the Top 100 was slightly better with firms seeing their average operating margins fall from 2.4% to 1.9%.

The annual industry survey of construction KPI's from Glenigan[14] paints a slightly more positive picture. Glenigan reported a median operating profitability for 2014-2015 of 2.8%, and that conditions in the sector were improving; however recent figures from ONS suggest that the sector has (technically) entered recession as the result of a combination of factors, including on-going uncertainty arising from the recent referendum result. Overall, the ONS figures suggest that conditions in the sector are becoming increasingly challenging which has further implications for profitability.

In times of growth, it is observed that margins in some parts of the supply chain increase significantly, underpinned by limited delivery capacity relative to demand for their particular goods and services. However, this does not offset the longer-term structural margin position, particularly when factoring in periods of under-utilisation and the risk of losses due to market led input cost movement or their own or others' delivery failure after the point of fixing a price. In periods of lower economic activity, margins appear to collapse, which is exacerbated by an accepted industry practice of taking on 'loss leader' work as a way of keeping cash flow running and hoping bottom line losses are offset by a future upturn and improved margins. The tendency for self-employed labour to have a 'floating price point' adds to the variability of pricing experienced in the industry and the potential for exploitation, both by the labour force itself and also those businesses who contract them depending on where the cycle is.

[12] Egan Report – *Rethinking Construction – The Egan report, 1998*, The Construction Task Force, Sir John Egan.

[13] *Cash position and margins unsustainable for the construction industry,* 2014, KPMG.

[14] *UK Industry Performance Report* based on the UK construction industry key performance indiicators, Glenigan, 17 September 2015.

The low level of cost predictability referenced on page 16 is not just a problem for clients but is also one for industry itself in that the initial planning and estimation of margins prior to work commencing is undermined and put at risk by variances that occur for all the reasons outlined above.

The use of competitive tendering is widespread throughout the industry and there appears to be very low usage of more collaborative and integrated design, procurement and construction delivery models. Clients tend to fixate on lowest initial tendered price and this is often perpetuated by their advisors, who, in a traditional procurement model, are implicitly employed (at least partly) to manage a fixed and adversarial transactional interface between clients and industry. The cost-based procurement model often hinders the ability to focus on value, outcomes or performance if appropriate weightings are not made.

Adoption of more collaborative or incentivised commercial engagement models appears to be limited to certain clients that have either large scale infrastructure projects or have a delivery programme where longer-term outcomes and benefits are driven by harnessing process improvement and commercialising the benefits of large scale demand that can be committed to with a reasonable degree of certainty.

The reality is that many clients, especially in the real estate development sector, are simply conditioned to operating in an adversarial way with industry and do not see a case to move to more collaborative and integrated approaches for fear that a lack of commercial tension will impact their own financial outcomes. In many instances, the unavoidable conclusion for both clients and industry is that in competitive tendering, whoever wins a project is often the party that has made the largest mistake in pricing it!

This leads on to an analysis of how industry appears to drive higher commercial returns after setting its 'entry price'. The industry has a reputation for being a cash flow rather than margin led sector. The derivation of this is difficult to pinpoint, but seems to have been driven by the fragmentation described on page 17. The multiple and tiered sub-contracting interfaces within the industry and between industry and its clients has generated a further non-value add process whereby some businesses higher up the supply chain will use other businesses' money lower down to temporarily support and enhance their own cash flow. Many consulted as part of this review referred to the payment practices within industry as poor, with a tendency to rely on extended payment terms. There is also often an imperative to maximise the final differential between internal and external value, not just the cash flow differential between what is received and what is paid out. This drives a culture of set off, counter claim and dispute.

Accepted industry traditions include such measures as payment retentions and liquidated damages held by one party pending timely and proven completion and defects rectification. In reality these are reflections of poor expectations of the industry's performance, but are also often abused to drive adversarial positions that lead to cash flow strangulation between clients and industry and the further cascading of issues down the industry supply chain.

There are some unfortunate but thankfully not endemic commercial behavioural issues associated with peaks in demand in the industry. These reflect a level of industry opportunism that perhaps is seen as the *quid pro quo* for the difficult times seen in downturns. These issues include instances of anti-competitive practices as well as unilateral, end of negotiation period price escalation at a point where clients are unable to change their strategy. None of this helps bond the relationship between clients and their advisors with the supply chain but in reality these stresses are simply a by-product of the dysfunctional commercial arrangements that exist.

Clients' propensity to change their mind (sometimes reinforced by advisors who do not drive the right level of discipline and impact analysis) as well as the need to overcome omissions or errors in tendered designs, are both used as a major source of widening entry margins. Just as many clients may be expecting failure from industry, industry often expects clients and their advisors to be masters of their own downfall by instigating revised product definition or other types of project change. With any form of adversarial contractual interface, this eventuality will often drive uncertainty, dispute and can be used to mask completely unrelated performance issues. Client change however, does not appear to be the root cause of the woeful productivity position set out on page 13.

Despite more recent measures in construction contract drafting to make the impact of change more transparent and allow better client decision making, the need for many clients of the industry to vary their requirements either in response to their own volatile end user demands or more worryingly due to mistakes in the early project planning process are often seen as an accepted part of built asset creation.

A Dysfunctional Training Funding & Delivery Model

Funding of Training

An important feature of the UK construction industry is its industry training board and levy model. It is not the intention here to undertake a detailed critique of the CITB and the levy but it is worth understanding the effectiveness of this body and the levy system as a basis of further recommendations outside the scope of this review.

The CITB is triennially voted for by industry as a body which collects a levy from its member employers and is then charged with reinvesting and distributing the funds to positively influence industry-wide training and skills development. This is supported by the Industrial Training Act, which defines the scope and detail of the levy. The money is distributed through a combination of directly organised initiatives and a grant system that requires levy payers to submit applications for qualifying areas of expenditure. It is important to note that the mandate CITB works to focuses on skills and training and does not necessarily apply equal importance to innovation and technology. This must be considered a critical weakness.

Interestingly, the extent of 'in scope' levy payers is not a comprehensive representation of the whole construction industry. For instance, the building engineering services trades which represent over 10% of annual construction output, are not levy payers and stand outside the CITB registered employers. This is a legacy from circa 25 years ago, when it was felt by these trades that CITB was not representing their interests and was too skewed to more traditional building construction trade training rather than mechanical and electrical services related training. This is another unfortunate example of the fragmentation described earlier.

Figure 10: Levy Intake and Distribution, CITB, 2015

Employer Size	Contracting Industry % Recovery of Grant relative to Levy Paid	Housebuilders % Recovery of Grant relative to Levy Paid
Large	92%	74%
Medium	82%	41%
Small	61%	29%
Micro	52%	22%

It is worth noting, housebuilders do fall within the scope of the CITB levy due to their hybrid model of directly managing the construction process, but subcontracting the labour, which delivers the assets they subsequently sell.

In the last year approximately £180 million was collected through the levy albeit only £140million was distributed back out in grants etc. There is also a significant reserve that has accumulated of historical unexpended levy funds.

The pattern of money paid in and levels of recovery back out in the last year is quite telling when segmented against turnover ranges for businesses (see Figure 10 above).

The clear correlation is that the smaller, SME end of the industry is recovering proportionately less than the larger employers. This may well reflect what the review has seen evidence of in terms of larger employers being able to dedicate full time staff to pursue grant payments and this has created a 'cottage industry' of recovery that might not ultimately be in line with the industry's long-term needs and welfare. It also does not adequately address and benefit the important 'tail' to the industry that is physically delivering construction rather than just managing the process. It is suggested that a disproportionate level of funding and investment support needs to be proactively 'injected' at this end of the supply chain, not the opposite which is currently the case.

The latest Triennial Review of CITB showed industry agreeing with the need for the functions that CITB performs but there exists a need to improve its effectiveness and in particular the level of support offered to SMEs. Perhaps not surprisingly, the levels of satisfaction expressed with CITB largely correlate with the size of businesses and the level of relative grant recovery achieved in line with Figure 10 above.

It is also worth recognising that **many at the smaller end of the industry also see training as a 'loss leader' in terms of funding relative to costs.** Low levels of post qualification retention, due to a draw towards self-employment, and the lack of long-term pipeline to de-risk payroll burden against are major barriers to seeing training related costs as a long-term business benefit. Smaller businesses often feel they are left 'holding the baby' in a downturn and bear the brunt of an ever increasing reskilling and recruitment challenge in an upturn without others shouldering the burden equally. This so called 'free-rider' concept, identified in the last Triennial Review of the CITB, is a major reason why there is a challenge around driving a more equitable system of payment and distribution of the levy.

CASE STUDY 4

PERSIMMON COMBAT TO CONSTRUCTION

The Combat to Construction Traineeship is a Persimmon Homes recruitment, training and employability programme which will enable male or female service personnel leaving the Armed Forces, at any level, to transfer their existing skills or gain a rewarding second career within the house building industry. Persimmon will train and employ service leavers and commit to pay them a living wage during their training, which will lead to a recognised qualification and above all, a fulfilling and rewarding career with the Company.

The skills and experience of many service leavers are highly comparable with those required to work within construction. The Combat to Construction Traineeship builds on those skills to help them start a rewarding new career with us. Just as in the Armed Forces, Trainees will be working as part of a highly professional team in which every member depends upon their colleagues to get the job done. Their military training will have given them the flexibility, discipline and loyalty to be adaptable and prepared to travel at short notice, allowing them to make a vital contribution, wherever the action is.

The qualification is an NVQ Level 2 Framework in Trowel Occupation (Bricklaying) or Wood Occupation (Joinery) that can be achieved with hard work and commitment to qualify them into the industry. The training is free and they will receive a living wage to allow them to complete their qualification.

The programme starts with a 1 week block training period and assessment to ensure that Trainees will be able to complete the training to an acceptable level and so that Persimmon can quality-assure the Programme. There are no fees for the training.

On successful completion of initial training the trainee will be offered a contracted start date with Persimmon which will tie them into the company for a minimum of 3 years.

Persimmon Homes CEO Jeff Fairburn, Brigadier Bibby and ex-soldiers at the launch of Combat to Construction

The pricing and payment of the CITB levy is often (but not always) seen more as a 'cost' than an 'investment'. It is often not overtly linked to what final clients of the industry pay and is 'lost' in the overall selling price. This appears to be different to commercial norms in the process engineering industry where, promoted by an emphasis on cost reimbursable contract forms, the Engineering Construction Industry Training Board (ECITB) levy seems to be recognised as an express part of what clients are paying. It is visible at the highest levels of the transaction chain rather than just being deemed to be part of a market set selling price to a client, standing the risk, as would appear to be the case with the CITB levy, of getting squeezed as an offset against margin when demand is weak.

At the time of writing this review, the impending Apprenticeship Levy is causing some concern in the industry. The imposition of a second levy in Spring 2017, set against a context of low margins and a mind-set of it being a cost not an investment is symptomatic of deep-seated inertia against increasing levels of investment in industry training when set against thin margins.

The reality is that notwithstanding the laudable principles of the levy, and even when factoring in how much industry pays in implementing training over and above the net cost of paying the CITB levy as well as the extra investment projected via the Apprenticeship Levy, the absolute levels of industry self-investment for training in construction are extremely low when viewed against other UK industry benchmarks.

In 2015 UKCES[15] research showed percentage of the workforce trained, when compared to other industries, is third lowest with only 53% of the workforce trained in 2015. The survey data also shows that only 57% of

Figure 11: Employer Skills Survey: UK Results, UK Commission for Employment and Skills, 2015

Figure 12: Employer Skills Survey: UK Results, UK Commission for Employment and Skills, 2015

construction sector employers provided any training in 2015 – 2nd lowest of all sectors.

£180million of CITB levy (with only £140m issued back in grants) in a £100 billion industry with 2.3million employees does not bode well in terms of ability to have any scalable impact.

As an example, housebuilders contributed £16million of levy in the last period and got grant back for £7million. This suggests either large scale lethargy in implementing training in this sub-sector (i.e. they accept the levy as a straight employment cost) or the smaller enterprise end of this sector are carrying out training without grant recovery which reduces margins and ability to invest in further initiatives and improvements. The larger volume housebuilders who are often recovering proportionally more are also to some degree delivering training in areas other than the capacity constrained core construction trades due to the simple fact that they no longer directly employ such tradesmen on their payroll.

Implementation of Training

The incentives for employers to train and directly employ are impacted by a fundamental lack of stability at workforce level and the 'free rider' concept referenced above. The wide-scale incidence of self-employment is a reflection of a desire for flexibility, with little confidence in long-term employment prospects and a feeling that opportunism around inflated market labour rates in booms offset risks of low utilization, poor wages and no employment benefits in a downturn.

[15] *Sector Skills Insights: Construction Evidence Report 50*, UK Commission for Employment and Skills (UKCES), July 2012.

There is often an unfair burden placed lower in the supply chain to train. It is clear though that despite the financial risk, some parts of the supply chain have actively embraced long-term thinking around skills and training (see Case Study 6). This seems to be often led by a non-financially motivated sense of collective responsibility to do the right thing and maintain a sustainable level of resources for the industry in the future. Unfortunately, this is not the industry-wide approach and is not inherently scalable.

Construction's trade training crisis has without doubt been exacerbated by a widespread and possibly misplaced fixation in this country with progressing to Higher Education (HE) rather than a fuller consideration of more apprentice based or vocational courses. The sea change shift to HE in the last 20 years has disproportionally damaged the depth of the resource pool that construction draws from.

Current low industry attraction levels (see more on page 40) are being further compounded by a funding regime for Further Education (FE) Colleges which is acting against wide-scale investment in modern, fit for purpose courses that are producing workers with the right skills in the right locations, including a new generation of digitally aware multi skilled workers. There are some notable exceptions (see Case Study 5). Future projections of declining numbers of new entrants and the structural funding issues highlighted above are also in themselves perpetuating a decline in training courses which may become critical if left un-arrested.

Perhaps contradicting the assertion that the industry is struggling with low numbers of new entrants, there also appears to be some evidence that it is actually the capacity and appropriateness of the FE sector, not the number of potential apprenticeship candidates, which is creating an exaggerated bottleneck of new resource development. There is also a major problem with the level of attrition between people starting courses, completing them and ending up in employment.

The implications of the new Apprenticeship Levy and moving purchasing power to employers via digital vouchers while focusing on longer-term outcomes and industry alignment remain to be seen in relation to impact on current skills planning and the Area Review process being undertaken in the FE sector. It is hoped they can only be positive.

Current investment in training and innovation is also not supported by the industry leadership fragmentation referenced on page 20. above. Separate training initiatives, borne out of representing members' interests, are not conducive to a single joined up strategy that will drive collective transformational change and reflect the needs of the industry as a whole, not just silos within it. This is important when there is so much transferability of skills within different parts of the industry.

Where exemplar activity in training and skills development has been observed by this review it is tending to be associated with longer-term programmes of activity or major infrastructure projects where the visibility of demand is longer-term and enables assessment of return on investment (see Case Study 7). These scenarios are the closest the industry gets to a reasonable level of demand planning and even then are often still linked to planning or regulatory obligations.

This review has also seen evidence of some interesting and high opportunity activity in the field of trade and professional re-training and re-skilling which has rightly been supported and embraced by industry. Such initiatives include ex armed forces training programmes (see Case Study 4) and initiatives looking to target workers from declining industries.

It has also been noted by this review, that the town planning system, through Section 106 agreements, often imposes insular training and employment related obligations on clients at a local borough level. There is clear evidence that such a geographically constrained approach is not leading to desired outcomes in terms of long-term permanent career opportunities and the supply chain is in many instances navigating the system to 'tick a box' including through flexible use of apprenticeship training agencies

Lastly, turning from trade based skills to professional services, there are some parallel observations that reflect a growing structural lack of skills availability. Many consultancies are now dealing with peak resource needs by increasingly relying on agency labour or by 'off-shoring' services to cheap international locations. A professional services equivalent of the casualisation of the trade work force has therefore begun to emerge in the latest cycle. The implications of this trend may not be as severe for UK construction as a reducing trade work force as digital enablement could make international labour substitution easier than for pure physical production. It does however bring into question the appropriate value add professional skills that we will need in the future to retain security of structural capacity in the UK and that we should therefore be nurturing domestically.

CASE STUDY 5

BARKING AND DAGENHAM COLLEGE

The issues faced in the construction industry regarding a shortage of skills are linked to Further Education's continued delivery of 'Biblical Trades'. The industry and its delivery approach has changed dramatically in terms of how projects are completed and this requires a different skill set than that of traditional approaches.

Barking and Dagenham College is working alongside CNet Training delivering a Network Cabling training programme born out of close collaboration with industry. The training programme was developed as part of London Olympics 2012 and continues today. CNet have dedicated training facilities at Barking and Dagenham College and the programme is designed for the industry recognising the need for educational standards and professional certification in this area therefore designed to create a standard and regulate the Structured Cabling Industry. Data is now known as the "4th Utility" and has a very important role in our lives. Ensuring the installation of Structured Cabling, Copper and Fibre Optic is installed professionally and by a workforce that is trained to the highest level is essential. The course offers a blend of both theoretical study and practical exercises achieving vendor acceptance.

This training programmme demonstrates the benefit and importance of Further Education engaging and working alongside industry to enable the right support on the programme. It seeks to allow industry to lead recognising their position as experts and wanting support from industry on keeping knowledge and skills of training providers relevant on new innovations and developments.

For more information visit:
www.barkingdagenhamcollege.ac.uk

Barking and Dagenham College

CASE STUDY 6

BRICKLAYING ACADEMY RUN BY BRICK BARON (SME)

Brick Baron Ltd are a specialist masonry contractors based in Hull with a geographical operating area throughout Yorkshire, Lincolnshire and Teesside, currently employing around 140 bricklayers, management and technical staff.

The skills crisis in the UK construction industry has created major challenges for Brick Baron Ltd over the past few years. Growth of the company has been much slower than intended simply due to the lack of available quality resources, and Brick Baron has reached capacity in Hull, with all experienced, quality bricklayers already employed by the company.

The quality, cost and reputational issues risked when using the remaining, less experienced and poor quality bricklayers are exacerbated by the tendency of large regional and national contractors working in the city to sub-contract the masonry element of their schemes to brickwork contractors from other cities, therefore taking business out of the city.

Having experienced issues with using agencies and experimented with foreign labour, Brick Baron determined that neither option was a long-term sustainable solution due to issues in quality, consistency, fluctuating cost and variance of build practices. The quality of apprentices under the existing schemes was also deemed to be an issue.

Therefore the Brick Baron Academy was formed in 2014 and currently has over 20 apprentices. Brick Baron are keen to expand further but have struggled to access apprenticeship funding or experienced gangs of bricklayers able to take on apprentices.

The Brick Baron Academy sets out to be different from other training providers, offering top quality training whilst earning on site and a guaranteed job afterwards. The Academy works in partnership with Leeds College of Building, who developed the training standards, now also in use in a further partnership with Hull College. Targeted support is given to less academic apprentices who struggle with functional skills (Maths and English) to get them up to the required standard as well as other funded training. Another partnership was formed with Hull Training, Hull City Council's own training division.

CROSSRAIL TRAINING AND INNOVATION INITIATIVES

CASE STUDY 7

Crossrail published its Skills and Employment Strategy in 2010. This set out several initiatives designed to support both the delivery of the project itself and the establishment of a longer-term skills and employment legacy. Just three of these initiatives are highlighted below.

TUCA

Crossrail opened its Tunnelling and Underground Construction Academy (TUCA) in Ilford in 2011. Between then and now, TUCA has delivered over 15,000 units of training. This has included specialist training and apprenticeships in tunnelling and related areas, filling a large hole in previous skills provision.

Brokerage

Between 2011 and 2016 Crossrail also operated a dedicated jobs brokerage, staffed jointly with Job Centre Plus. The Brokerage has worked closely with both employers and local referral agencies to match people to jobs. It has also partnered with Job Centre Plus and individual employers, as well as external organisations like Buildforce and Women into Construction, to provide enhanced opportunities for jobseekers from disadvantaged and/or under-represented backgrounds. By March 2016, when the Brokerage ceased operations, over 700 local and unemployed people had found work directly through this route.

Tier 1 contractors and supply chains

Finally, Crossrail has sought to use its procurement processes to commit Tier 1 contractors to deliver specific numerical targets, covering (among other things) local and unemployed job starts, apprenticeships, graduate training and work placements. These contractual provisions have been supplemented by a systematic performance management regime, focussing not only on contractors' delivery of 'outputs' (i.e. the targets themselves), but also the quality of management processes and other 'inputs' (e.g. engagement of supply chain employers in the delivery of employment and skills opportunities). To date, over 4,700 local and/or unemployed people have found jobs on the project, as well as over 600 apprentices and over 500 graduate trainees.

Legacy

With the project nearing completion, Crossrail is currently collating lessons learned and recommendations for publication on its Learning Legacy website (http://learninglegacy.crossrail.co.uk/). Already, however, Crossrail's experience has helped shape the Government's 2016 Transport Infrastructure Skills Strategy, committing the sector to create 30,000 new apprenticeships by 2020.

Celebration of Crossrail's 400th apprentice. Photo: Fatima Alghali

Workforce Size & Demographics

Perhaps most worrying of all of the symptoms identified in this section, is the fact that the pure physical capacity of the construction industry to deliver for its clients appears to be in serious long-term decline. This issue is dealt with further in section 2 of this review, but a combination of an ageing workforce, low levels of new entrants (linked to industry image – see page 40) and an overlay of deep and recurring recessions which induce accelerated shrinkage, now threatens the very sustainability of the industry. It is potentially in danger of becoming unfit for purpose.

In 2015, the Arcadis paper, *People & Money,*[16] highlighted labour availability within construction as being the biggest constraint on the industry over the next five years if it is to achieve the Government's aspiration of one million homes. It demonstrated a need to recruit another 700,000 people to replace those retiring / natural leakage to other industries, this is in addition to the extra workforce needed of 120,000 to deliver capacity growth. The 2011 Census data (Figure 13) shows us 30% of the workforce at the time aged over 50 therefore if we look to ten years from now in 2026 this represents around 620,000 people, based on the construction classification used, who will have retired from the industry.

Figure 13: From Nomis, 2011 Census estimates, ONS Crown Copyright Reserved, Accessed April 2016

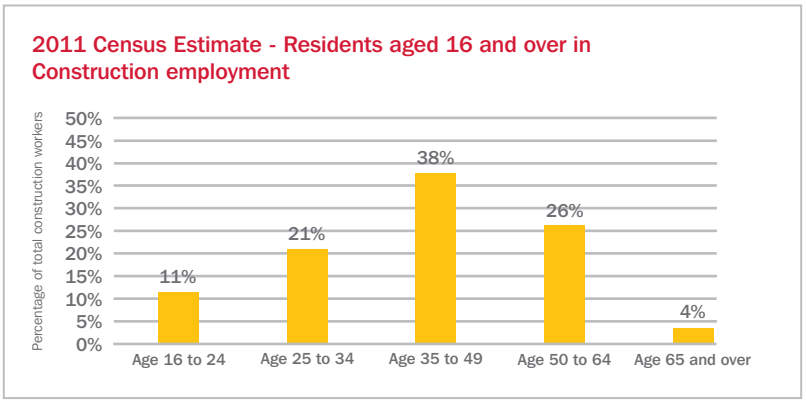


Figure 14: From The Labour Market Story: Skills for the Future, UK Commission for Employment and Skills, July 2014

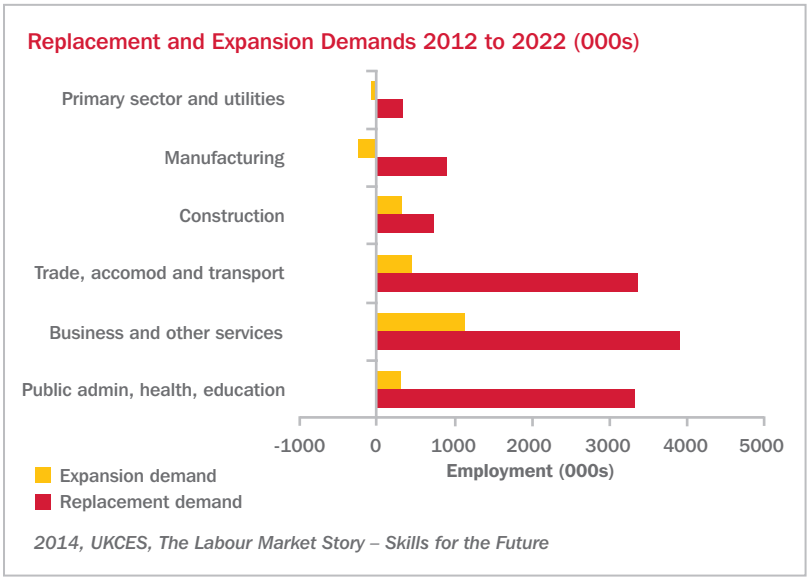


Figure 14 from UKCES shows the number of replacement demand needed in the construction industry as being more than double the expansion demand.

We can already see that based on the current situation of an 'ageing workforce' and the need to deliver at least 250,000 homes each year, Figure 16 highlights that we are a long way from having the right size of labour.

It is worth noting however that despite the headlines above, the level of stress created through labour led capacity shortages is geographically highly sensitive. The most acute problems align with cities and conurbations where economic activity and GDP contribution is highest. The construction skills crisis can therefore be characterised as a national problem but with regional hotspots. London's particularly challenging construction labour market issues cannot be ignored due to its importance to UK plc.

[16] *People & Money: Fundamental to unlocking the housing crisis, Arcadis,* 4 June 2015.

On the basis of a looming demographic 'time bomb' combined with the fact that industry productivity is not improving as set out on page 13, this means continued pressure is still being put on workforce replenishment and expansion as being the solution to the problem. This must now surely be seen as increasingly unrealistic in the light of the projected imbalance between workers leaving the industry and those joining as well as the overlay of a likely Brexit induced reduction in new migrant labour flows and possible risks to retaining our current migrant work force.

The impact of Brexit on construction has already been debated at large in the weeks spent finalising this review. Although it is likely that certain markets such as London, which are more heavily reliant on European tradesmen and professionals, will be adversely affected, the reality is that the relative proportion of migrant labour as a component of overall workforce was not going to be large enough to offset the size of the gathering problems ahead and was never the solution to the more deep-seated problems identified.

Figure 15: From Cast presentation at ULI UK Capacity Conference, 26 April 2016

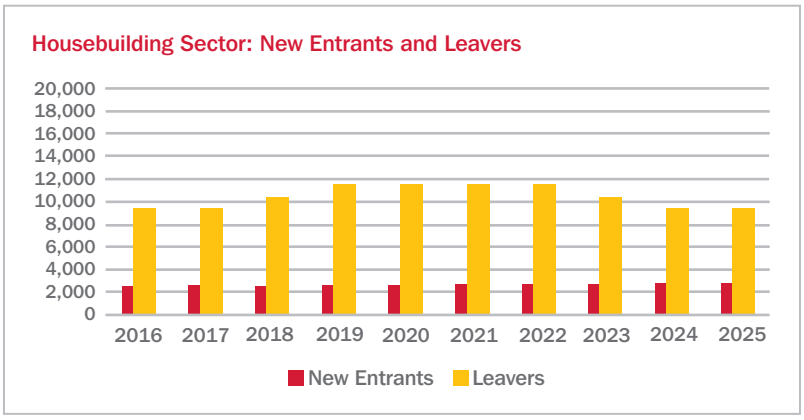
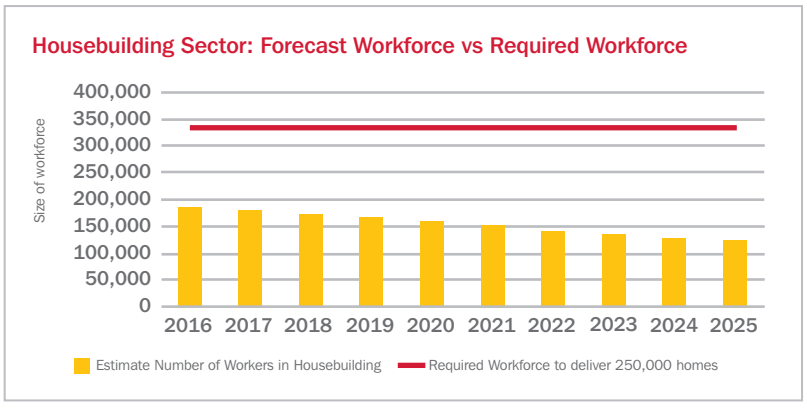


Figure 16: From Cast presentation at ULI UK Capacity Conference, 26 April 2016



"On the basis of a looming demographic 'time bomb' combined with the fact that industry productivity is not improving, this means continued pressure is still being put on workforce replenishment and expansion"

Lack of Collaboration & Improvement Culture

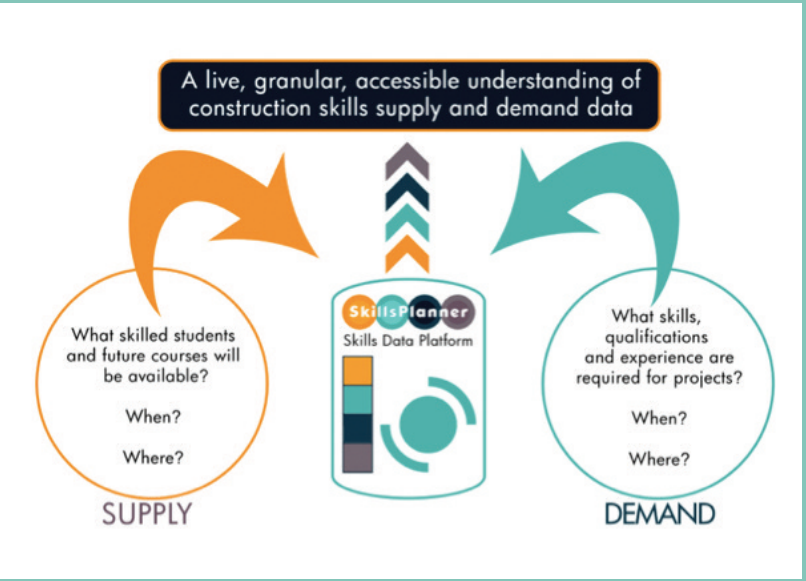
The construction industry's 'collaboration problem' is at the root of its change inertia. It prevents itself scaling up, sharing risk more appropriately and creating more business plan certainty. The industry is currently conditioned to using adversarial margin protection and expansion tactics referenced on page 24. This underlines the tensions that often exist between the industry and its clients that prevent more acceptance of collaboration within industry and between industry and its clients.

Industry-wide adoption of digitisation through media such as BIM (discussed further on page 36) is predicated on collaboration. The BIM model sits at the heart of any project and only functions fully if traditional design and construction barriers are broken down by multi-party liaison and working.

Lack of collaboration and joined up thinking also means the ability to use 'open linked / big data' principles to guide the industry on current and future skills requirements have not been maximised. The increasing importance of data means that such approaches would better enable the business case for investment in training and new ways of delivering by better aligning investment to a demand pipeline (see Case Study 8). This is mirrored on the demand-side in the real estate client community where there is often a reluctance to be too transparent or definitive on long-term development plans and timings as the financial markets then measure success or failure by deviating from such statements. The culture of 'data silos' within the industry needs to be broken as part of the wider societal democratisation of data.

SKILLSPLANNER: OPEN NETWORKED DATA TO ALIGN SKILLS AND DEMAND

CASE STUDY 8



SkillsPlanner is an industry-led collaborative project to develop a Linked Data construction skills platform.

SkillsPlanner will allow employers, skills providers and other stakeholders to share past, present and future skills data. The platform will integrate and interpret this open networked data, supporting stakeholders to plan for and meet current and future employment requirements and thus working to align skills supply with demand.

The aims and objectives of SkillsPlanner are to:

- Improve the understanding of skills supply and demand
- Create a better connection between skills supply and demand

A £1.3m two-year EthosVO initiative that commenced in October 2015 and is funded by Innovate UK and project partners, SkillsPlanner has over fifty-five collaborating organisations advising and engaging with its development. These collaborators represent the four main SkillsPlanner workstreams of councils, industry, training and brokerage, with over twenty key industry collaborators that include:

- Tideway
- Crossrail
- Laing O'Rourke
- Morgan Sindall
- Mace
- Class of Your Own
- Royal Institute of Chartered Surveyors
- Institution of Civil Engineers
- Electrical Contracting Association

Expertise is also coming from four London councils (Camden, Westminster, Islington and Greenwich), Department of Work and Pensions and over twenty private, Further and Higher Education establishments, facilitated by the Association of Colleges. Whilst the initial focus is on the Tideway project (London), the aim of SkillsPlanner is to be the single networked platform across the industry and across the UK that enables access to current siloed construction skills data, thus enabling greater visibility of existing data and bringing a live, granular focus to skills supply and demand data.

SkillsPlanner is being built by its end users and is developing rapidly. The platform is aligning with a social enterprise jobs brokerage (BuildLondon) and working closely with Tideway contractors to standardise workforce competencies and qualifications, thus ensuring a robust 'common language' of data that will significantly boost the value that SkillsPlanner seeks to add to industry.

Lack of R&D & Investment in Innovation

The level of investment in industry innovation including associated links to driving a digital led skills and training agenda appear to be very low. Industry drawdown of R&D Tax Relief in engineering and construction relative to all claims made is neglible. Of a total of £1.75 billion offered to SME's in the UK through the R&D Tax Credits Scheme, only 324 construction businesses have taken advantage of the scheme[17] – The amount claimed is undefined but likely to be a very small amount. This is symptomatic of a lack of interest in or incentive to consider modernisation in the industry despite meaningful tax offsets being offered.

It can be seen immediately that the UK is at the lower end of the spectrum in terms of its proportionate share relative to other developed economies. Figure 17 shows construction as the lowest performing industry when comparing R&D spend across different UK industry sectors. It is said that measurement and classification errors may arise in official statistics due to innovation being undertaken but not formally accounted for as R&D. However this data suggests construction R&D is running in the order of only 0.1% of output

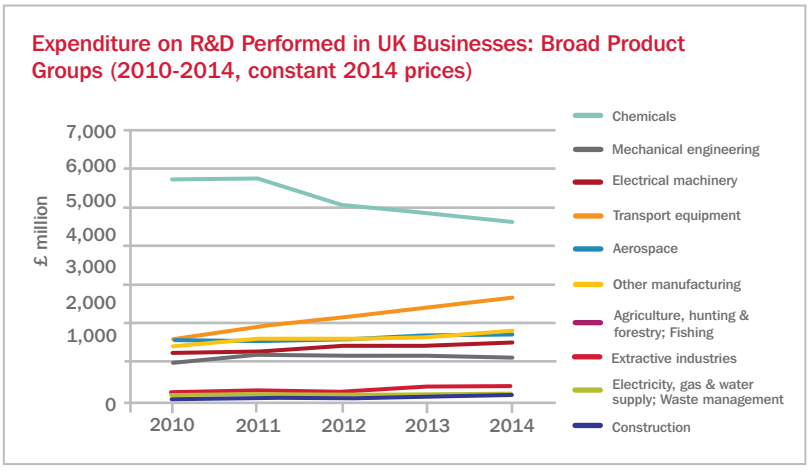
This review heard evidence from businesses that are investing in innovation but appear to meet problems in getting new products and propositions to market at any scale. This is often due to a deep-seated perception of risk within the wider supply chain, advisors and designers, commissioning clients, building control inspectors and ultimately, insurers and funders. The barrier seems to be a need to see a robust, if not guaranteed benefits case before adoption. Negative perceptions have in turn led to many innovative approaches to construction design and construction processes immediately being considered as high risk. This is not helped by the numerous financial failures of businesses who have invested heavily in different approaches that would have benefited both construction productivity and predictability but were never adopted by clients at scale. The industry therefore seems to be locked into a self-fulfilling 'chicken and egg' impasse when it comes to investing in, technically and commercially proving (for industry and clients) and then deploying innovation at scale.

It is clear that the higher the sunk costs in R&D or fixed physical costs such as machinery and equipment, the more the pressure exists to drive volume to underpin return on that investment. The cyclicality of construction demand is difficult enough to navigate for low overhead flexible businesses, but that fluctuation is amplified if you have not even managed to secure client confidence in a new product or approach which has been invested in and has to compete with more traditional solutions.

There is evidence that institutional funders, despite seeing superficial benefits in exploring pre-manufactured solutions, do not have enough technical reference points to get past seeing this area as an unnecessary risk. This is perpetuated by some client side technical advisors and also by a lack of awareness of or mainstream uptake of new insurance and warranty mechanisms specifically designed for manufacture led construction.

There is also evidence that senior debt providers lending development finance also do not see a reduced risk profile in delivery and have not modified term sheets to allow such projects to be easily procured though a combination of lump sum off site based procurement with early payments, and site based traditional trades that 'integrate' the final solution. Defaulting to a single lump sum contract owned by a conventional main contractor with only circa 20% of the cost directly owned and the majority of the balance pre-manufactured off-site, is not an effective value chain for clients who will likely pay a premium for such 'forced' lump sum ownership.

Figure 17: Research and Development in UK Businesses, 2014 – Datasets, ONS



[17] Russell Eggar. October 2015. Disruption in Construction Blog. https://www.cibcomms.co.uk/blog/disruption-in-construction#.V8bCc-n2aUk

Terminology such as 'modern methods of construction or 'prefabrication' are often viewed with suspicion due to historical associations with insolvency risk, poor technical or quality issues, and a need to collaborate early by committing to a specific technical solution rather than follow a traditional sequential tendering process and choosing the lowest price based on an 'apples with apples' comparison. The latter situation is reinforced by the non-collaborative culture within the industry.

Many that have pioneered businesses in the pre-manufactured sector have, for whatever reason, not been successful in proving the benefits case to the industry and clients at large. There are few evidence points of where a new product or process innovator has been able to empirically convince its end demand market leading to wide-scale adoption based on a proven business case compared to traditional approach. There would appear to be insufficient, quantified evidence for robustly comparing a pre-manufactured approach to a site labour intensive one that shows a strong overall quantitative and qualitative benefits case factoring in all variables of certainty, speed, quality, 'smart' technological enablement, capex and opex. Clients and Main Contractors therefore often view the concept as being in the 'too difficult' box. Addressing this situation must, by implication, be a priority for those looking to offer new solutions to the construction industry and its clients.

At the time of writing this review, there is considered to also be a danger that the current apparent increase in awareness, media interest and to an extent, the actual physical adoption of 'off-site' or 'modular' pre-manufactured solutions, is being driven by some clients having an immediate need for a cheaper, quicker outcomes at a time in the cycle when labour costs have been high and project delivery failures have increased in frequency. There is a chance this appetite for new approaches may wane if the labour market cools and build costs reduce. **The benefits case for cost, time, quality and predictability compared to traditional techniques therefore needs to be step-changed as a structural benefit for all parties** if wider, long-term adoption is to be achieved and a window of opportunity is not to be missed.

It has also been observed that concern over pursuing more manufacturing led techniques is often fuelled by a current lack of scale and capacity in the pre-manufactured market that might mean that any reasonable uplift in demand without parallel capacity building measures and investment will lead to similar market failure as seen in the traditional site based labour model. It is therefore critical that initial capacity building precedes higher demand. How this can happen before large scale supply and demand is firmly linked together thereby de-risking the initial investment, is a major challenge and perhaps represents that biggest structural barrier to wholesale modernisation in construction.

There are some signs that foreign corporates may force the issue here and some businesses, notably from Asia, are starting to see pre-manufactured solutions as a way of overcoming the many barriers to entering the traditional physical production side of the UK construction market with associated requirements for access to local supply chains, market intelligence and expertise. This can be seen as a much needed solution to increasing our industry's capacity but surely also as a lost opportunity to domestically grow a new sector and retain the gross value add within the UK economy. It may however need new international competitor / disruptor activity to reactively spur the UK industry into action but it would surely be preferable for this to be a planned and proactive response to an obvious opportunity.

Ultimately, innovation led modernisation continues to be inhibited at all levels by the lack of industry-wide strategic leadership with a more integrated client and industry agenda. It is also critically undermined by a fundamental unwillingness to collaborate if this involves divulging competitive advantage or intellectual property. There are deep-seated perceptions in the supply chain of short-term threats to market share and dilution of returns. The reality is that pre-manufacturing and traditional site orientated working will always co-exist across the industry. It is the relative proportions that need to change if we are to achieve meaningful modernisation.

Despite Building Information Modelling (BIM) being a critical change agent for the industry completely intertwined with the move to manufacturing led approaches discussed above, there appears to also be a large scale reality gap related to the industry's BIM adoption strategy. The government's own measures to lead this agenda as a client of the industry have not reached significant parts of the design and construction world, which unfortunately includes the majority of housebuilders and private developers. Investment in and adoption of BIM is being stymied, with some notable exceptions, by all of the issues highlighted already around lack of willingness to invest, collaborate and the inability to see the bigger picture business case. The industry's route map to collaboration and high efficiency new delivery models can only be underpinned by BIM and the importance of its adoption cannot be overestimated.

CASE STUDY 9

hoUSe CONCEPT BY URBAN SPLASH

Urban Splash were one of the leaders in the 'loft living revolution' of the 1990s but recognised that their customers were often struggling to stay in the city when they needed more space and could only find that in a terraced house in the suburbs.

The UK average 3 bedroom house size is just 796 sqft, contrasting with significantly larger averages in Europe: France: 1,210 sqft, the Netherlands 1,243 sqft and in Denmark 1,475 sqft, and apparently out of sync with the changing needs in modern lifestyles. Urban Splash discovered a consistent consumer demand for more space so developed the hoUSe concept to offer new-build, terraced housing in the city focused entirely around offering greater and more flexible space but embracing a pre-manufactured, customer choice led approach to the product.

Following a 3-step design process customers are asked to choose whether they would like either 1,000 sqft or 1,500 sqft of space plus private outdoor space for parking and gardens. They are then asked how they like to live i.e. upstairs or downstairs, and then how they would like to use the space, i.e. open-plan or with more private areas.

The hoUSe concept offers customers the chance to design their own home within a professionally guided process and guarantees a property at least 25% larger than the current national average for a new-build house in the UK.

On completion of design, the hoUSe is built in a dedicated factory where craftsmanship and design quality is key, before being delivered to site. The ambition is to increase both the scale and typologies of buildings being offered to market.

hoUSe, New Islington, Manchester

CASE STUDY 10

LEGAL & GENERAL MODULAR CONSTRUCTION FACTORY

Legal & General launched a business in 2016 to deliver precision-engineered homes more cheaply and quickly through the largest modular housing construction factory in the world, already open in Sherburn, Yorkshire. It represents one of the biggest potential disruptions in the UK residential sector with a manufacture led approach being used at an unprecedented scale.

The manufacturing process uses volumetrically pre-assembled and pre-fitted out cross-laminated timber (CLT) modules and can be used to construct most building types of various heights either stand alone or in conjunction with other structural systems.

Legal & General facility at Sherburn-in-Elmet, North Yorkshire

CLT is created from carefully selected solid, sustainably-sourced, softwood which will be glued and pressed into sheets. This creates an incredibly strong and solid cross-laminated timber sheet, which can be made up to 20 metres long and 6 metres wide. The factory also has its own lamination plant and is highly automated and digitally enabled using large CNC cutting machines creating walls and floor panels and cutting doors and windows to size as well as internal finishes. The factory labour force will be multi-skilled using 'plug and play' assembly rather than traditional tradesmen. All outputs leaving the factory will be warranted and accredited in the normal way.

Time spent manufacturing the volumetric modules will be dramatically reduced compared to the use of site based traditional techniques. Production and delivery to site will embrace 'lean' approaches, with residual site works coordinated to minimize overall project construction programmes and optimise integration. Using CLT materials combined with a highly automated manufacturing approach will increase the overall predictability of time, cost and quality.

Using CLT is no longer seen as unconventional and the technology has been proven across Europe. CLT has already been used in the UK in buildings up to 11 storeys high. In Austria, Germany, Scandinavia, as well as in Canada and Japan, use of CLT is increasingly considered mainstream.

CASE STUDY 11

AIMCh FEASIBILITY PROJECT

The AIMCh Feasibility (Advanced Industrialised Methods for the Construction of Homes) project is a collaboration between BRE, Stewart Milne Group, Barratt Developments and Crest Nicholson. It is part funded by Innovate UK. The project builds upon the very successful AIMC4 project looking into the volume production of low-carbon housing. The AIMCh research is intended as a feasibility project for a much larger piece of work, which will require further external financial support to be viable.

The consortium is very much aware that a variety of different offsite construction methods have been trialled in the past, but none have really been adopted, with the exception of open panel timber frame. In the research they have worked with a computer simulation company to model a building site, from initial land investigation through to completion, to try and understand the commercial and often unaccounted for barriers to the introduction of offsite systems and whether all the costs of building conventionally have been accounted for.

The model can be run with different forms of construction; masonry, open panel timber frame and advanced closed panels to compare their commercial performance. Although it is only a first cut model it is able to consider productivity implications and costs that would be hidden in a normal analysis, such as those incurred due to delays in materials, the non-availability of labour or poor weather. It is also able to analyse the responsiveness of the different build systems to variations in sales rates.

The model can explore a number of different scenarios for example with different weather patterns, varying degrees of offsite construction, different quantities and trades to assess the impact on timescales, costs, utilisation and productivity.

Results are due by the end of 2016.

If further external funding is forthcoming it is intended to refine the model to provide greater confidence in the results and to use it as a means of choosing a construction method, which will then be built out on a real site, in volume, to show what performance is like in reality. Developers would like to demonstrate, through evidence, how they would need to change their business to create a profitable offsite (or Smart) construction homes market.

Poor Industry Image

This final identified issue is, in many ways, a holistic one that both reflects and is a natural result of many of the previous nine symptoms. The construction industry is struggling with its public facing image which is influencing the career decisions of the next generation of potential workers. Public perception of poor job security, working conditions and health and safety prevail. Recent media coverage of blacklisting, CSCS card fraud and an endless raft of 'cowboy builder' media exposés also does not help here. There also seems to sometimes be a lack of conviction, belief and promotion by many participants in the industry, from unskilled and skilled tradesmen to professionals who should all be front line ambassadors to their friends, family and the public at large.

These problems are being further reinforced by a lack of early engagement in schools and embedded negative attitudes of teachers, careers advisors and also parents or siblings in many instances. The overall feeling of construction being a backward and insular industry also impacts diversity and inclusion relative to other industries. This unfortunately also goes beyond construction and into many aspects of the wider real estate sector.

"The industry's low level of self-esteem and poor image is further reinforced by the generally poor relations it has with its own clients."

This will not be addressed solely through current attempts to use modern social media to better connect. It is not the outreach medium that is the problem: it is the fundamental story that is being told that reflects poor health & safety, physicality, austere working environment, embedded prejudices and perhaps crucially job security. The industry needs to effectively reinvent and, to use a computing term, reimage itself.

The CITB's role, briefly discussed above, in representing the industry's image, through initiatives such as 'Go Construct' as well as administering the levy and enabling / delivering technical training requires very diverse skillsets which inherently creates conflict, lack of focus and 'initiative overload'. The structural funding base also limits scalability. Ultimately, the conclusion of this review is that CITB does not currently appear to speak for industry collectively and fundamentally this undermines confidence in its ability to execute its function of wider industry promotion and outreach to schools and colleges. Various companies and industry bodies are running their own initiatives divorced from CITB and the 'toolkits' provided. This is an indicator that more needs to be done and is in reality one of the greatest tests of collective responsibility the industry has.

Housebuilding and residential construction as a sub sector within construction appears to be suffering particularly from poor levels of attraction. Despite recent headlines of employment creation in house building, the reality is that this part of construction is seen as very labour intensive, prone to design changes that impair production, frequent project delivery failures and is generally considered as high risk sector by all levels of the supply chain. This is reinforced by a feeling in general construction circles that it is the sector most at risk of 'boom and bust' due to a strong alignment with the housing for sale market.

The industry's low level of self-esteem and poor image is further reinforced by the generally poor relations it has with its own clients. It is in many quarters not valued by commissioning clients who accept and often even plan for poor performance. It is often seen as a 'necessary evil' in the value creation chain. This is reinforced in the real estate market where land promoters and traders whose model is purely to secure planning consent related to speculative led land value uplift and see physical development of built assets as a risk that dilute returns not a value add process. That is a sad indictment of the industry's standing as part of the wider built environment planning, creation and operation cycle.

CASE STUDY 12

CLASS OF YOUR OWN AND THE DESIGN ENGINEER CONSTRUCT! LEARNING PROGRAMME

Operating throughout the UK, Class Of Your Own Limited (COYO) is a social business founded in 2009 by land surveyor Alison Watson to provide sector specific education resources for secondary schools.

Alison recognised the need for a major overhaul of built environment qualifications whilst working on the Building Schools for the Future programme. She met hundreds of young people and teachers as she was surveying school sites and found many had very little understanding of the technical and professional careers in the Construction industry. She set about writing a whole new curriculum believing that, if taught in the classroom as a respected, academically focused standalone subject, the digital built environment could be perceived as the most exciting industry in which to work.

Now one of the most respected programmes for young people backed by Academia and industry alike, the "Design Engineer Construct!" Learning Programme (DEC) is taught in schools across the UK and offers equivalency to GCSE and A levels in England and Wales, and SCQF level 4 and 6 in Scotland.

Critically, DEC is complemented by the groundbreaking 'Adopt A School' programme which provides each school with targeted employer support. Not only does this offer the technical input of highly skilled professionals to teachers and learners, it provides employers with access to a home grown talent pipe of digitally skilled, work ready, enthusiastic young people. DEC offers academic and high value apprentice routes into industry, with recent 16 year old graduates securing placements with top employers, including during sixth form study. DEC is attracting girls and boys from all backgrounds and cultures, and as such, is included in the Scottish Government's Gender Action Plan, and features in the UK Construction 2025 Industrial Strategy.

For more information about the DEC programme, visit: http://designengineerconstruct.com

Design Engineer Construct!

2 A DIAGNOSTIC ASSESSMENT OF CAUSATION

To summarise the preceding section, this review has observed major failure points in the industry which fall into 10 key themes:

- Low Productivity
- Low Predictability
- Structural Fragmentation
- Leadership Fragmentation
- Low Margins, Adversarial Pricing Models & Financial Fragility
- A Dysfunctional Training Funding & Delivery Model
- Workforce Size & Demographics
- Lack of Collaboration & Improvement Culture
- Lack of R&D & Investment in Innovation
- Poor Industry Image

ROOT CAUSES

One

The industry has deliberately evolved a 'survivalist' shape, structure and set of commercial behaviours in reaction to the environment in which it operates. That environment is fundamentally characterised by low levels of capitalisation / investment and high demand cyclicality.

Two

The industry and its clients usually have non-aligned interests reinforced by traditional procurement protocols and a deep-seated cultural resistance to change pervading both parties.

Three

There is no strategic incentive or implementation framework in place to overcome the issues above and initiate large scale transformational change across the industry. This includes lack of government policy or wider public client measures which more positively impact not only shape of demand but the way in which the industry responds to that demand. The issues of variable demand, conservatism and lack of alignment / integration with clients highlighted in the first 2 causal statements above have therefore become de facto accepted norms for the industry.

Rather than immediately proposing potential solutions to all of these issues it is first necessary to diagnose the root causes that are sitting behind the 'symptoms' identified.

It is clear that there are multiple linkages between the strands above. However, the review concludes that there are 3 core issues that go to the heart of understanding why the industry is dealing with the performance challenges highlighted above.

The third point is critical as addressing it could be the potential 'initiator' for change which then addresses the preceding two points.

Looking at this last point in relation to housing, **any government measures aimed at land and planning, development funding or demand stimuli initiatives that are disconnected from influencing how the construction industry upon which it relies actually delivers are potentially flawed.** They will tend to exacerbate capacity problems and the associated symptoms by increasing demand rather than influencing the physical delivery platform. This issue is mirrored at regional and local government level. As such, there is a significant lost opportunity to harness wider economic and social benefits from a fully integrated approach to modernising delivery of housing as part of government policy setting.

As outlined in Case Study 13, Singapore is a good example of a government that is setting a progressive construction productivity and modernisation agenda linked to housing delivery through specific policy measures.

Building on the potential strategic influencers for modernisation that might break or evolve the established causal links identified above, there is clear evidence that a significant opportunity has presented itself in the UK residential sector through new institutional sources of private finance looking to invest in income producing housing assets, driven by a private rental model. This so-called 'Build to Rent' sector, characterised by aspirations to build large, professionally managed and branded portfolios has, to date, struggled to deploy funds into construction at the full scale of its potential. This is partly down to the real estate dynamics of the financial model for rental versus for sale. It is also impacted by an unwillingness for most funds to take development risk, and their need for quick, predictable construction solutions that have embedded longevity and quality. Some of this money is being deployed opportunistically through housebuilders or developers who are relying on the existing industry supply chain to deliver their core products. This supply base is already capacity constrained and is largely biased towards traditional forms of construction. Therefore the conclusion is that without incentivisation or intervention, this new institutional money is in danger of being recycled through models that will not drive innovation or long-term thinking and may exacerbate labour shortages. Post-Brexit, we are likely to see this tenure model being used increasingly to partially de-risk housebuilder market cyclicality. If the opportunity is not viewed strategically, this unique and large scale new source of capital will not drive the long-term benefit to the supply chain and wider industry that is so desperately needed.

A good example of how a new Build to Rent developer is approaching the construction industry in a different way is Essential Living's use of a pre-manufactured solutions on their Greenwich Creekside Wharf scheme (Case Study 14) with a view to this potentially being rolled out across their wider development programme. It is suggested as part of this review that the connection between institutional finance in the residential sector and the investment needed to pump prime a new manufacture led construction sector is completely logical and scalable.

In summary, addressing the three causal issues identified above (in the reverse order of how they are presented) is critical in the opinion of this review to modernising the industry and ensuring it does not go into long-term decline.

SINGAPORE CONSTRUCTION PRODUCTIVITY AND CAPABILITY FUND (CPCF)

CASE STUDY 13

Singapore has a proactive approach to building regulations and driving innovation. The Building Control Authority (BCA) works with industry to raise construction productivity and fundamentally change the design and construction processes, encouraging the adoption of Design for Manufacturing and Assembly (DfMA) and, in particular, the use of Prefabricated Prefinished Volumetric Construction (PPVC). From 1 November 2014 it became mandatory for selected non-landed residential Government Land Sale (GLS) sites as per the Code of Practice on Build-ability 2015.

In 2016 the BCA also introduced a S$250-million Construction Productivity and Capability Fund (CPCF) comprising incentive schemes that focus on workforce development, technology adoption and capability development in Singapore's built environment. BCA has enhanced the CPCF alongside other workforce development and tax credit schemes administered by other agencies to provide stronger support to the industry in raising productivity and building up capabilities.

The Singapore government defines Prefabricated Prefinished Volumetric Construction (PPVC)" as a construction method whereby free-standing volumetric modules (complete with finishes for walls, floors and ceilings) are:

a. constructed and assembled; or
b. manufactured and assembled,

- in an accredited fabrication facility, in accordance with any accredited fabrication method, and then installed in a building under building works.

The BCA website states that: *"PPVC is one of the game changing technologies that support the DfMA concept to significantly speed up construction. It can potentially achieve a productivity improvement of up to 50% in terms of manpower and time savings, depending on the complexity of the projects. Furthermore, dust and noise pollution can be minimised as more activities are done off-site. With the bulk of the installation activities and manpower moved off-site to a factory controlled environment, site safety will also improve."*

In line with Singaporean regulations, Dragages Singapore (a local subsidiary of Bouygues Construction) announced in 2016 that its €100million condominium development for United Venture Development will use a modular construction system based on a reinforced concrete structure. Designed by ADDP Architects, the complex has two 140-metre, 40-storey towerblocks. This will enable the condominiums to meet the Singapore authorities' stipulation that 65% of the superstructure of the towers must employ PPVC (Prefabricated Prefinished Volumetric Construction).

Construction Productivity & Capability Fund (CPCF)

Workforce Development
Workforce Training & Upgrading Scheme
BCA-Industry Built Environment Undergraduate Scholarship
BCA-Industry Built Environment Diploma Scholarship & Sponsorship
BCA-Industry Built Environment Undergraduate Sponsorship (for part-time degree)
BCA-Industry Built Environment ITE Scholarship Programme
BCA-Industry Built Environment Building Specialist Sponsorship (Foreman & Supervisor)
BCA-Industry Built Environment Building Specialist Sponsorship (Crane Operations)
Technology Adoption
Mechanisation Credit (Mech C)
Productivity Innovation Projects (PIP)
Building Information Modelling (BIM) Fund
Capability Development
Construction Engineering Capability Development

Fund table taken from www.bca.gov.sg/cpcf/cpcf.html

CASE STUDY 14

CREEKSIDE WHARF, ESSENTIAL LIVING

On its Creekside Wharf scheme in Greenwich, Build to Rent developer-operator Essential Living has adopted a pre-manufactured solution using a volumetric modular approach.

From early 2017 fully fitted out modules will be delivered to site and, which will stack around the scheme's concrete core.

Creekside Wharf, developer: Essential Living, architect: Assael Architecture

The controlled factory environment being used means the fit-out for the product is of a better quality. As work can be done simultaneously on site, the overall construction period is also reduced by 25 per cent. This time saving is crucial for the rental model, allowing Essential Living to earn income far more quickly than if they had solely used on-site methods.

The use of pre-manufactured components also allows for easier operations and maintenance. Individual modules can be refurbished as needed, minimising disruption and void periods - an important advantage for a long-term asset holder like Essential Living. This approach is also more sustainable thanks to the fewer deliveries to site and lower levels of road congestion.

With two blocks standing at 23 and 12 storeys, the completed Creekside Wharf will be one of the tallest modular buildings in the UK and one of the first Build to Rent developments delivered this way.

3

A 'BUSINESS AS USUAL' PROGNOSIS FOR THE FUTURE

SHRINKING WORKFORCE & ECONOMIC CONTEXT

The evidence reviewed indicates that the construction industry and its labour model is at a critical crossroads in terms of its long-term health. Whilst the diagnosis points to a deep-seated market failure, there are certain industry trends and wider societal changes happening now that represent both unprecedented risk and opportunity for the industry and its clients. If the opportunities are not harnessed, the risks may become overwhelming.

The prognosis for the industry, if action is not taken quickly, is that it will become seriously debilitated. It is facing challenges that have not been seen before which create an absolute imperative for change. Previous calls to arms have not been acknowledged by the industry or its clients at any real scale and somehow the industry has continued to 'muddle through'. Other than in isolated examples of exemplar activity, many of which have been showcased in this review, it continues to organise itself and deliver sub-optimally. In turn its clients have begrudgingly accepted this.

It is unlikely, based on past evidence and the pressure of delivering their own business requirements, that clients will simply stop using the industry until it improves its proposition. Recent capacity-led construction cost inflation has certainly undermined project viability, especially in the residential sector where issues have been exacerbated, and has led to projects stopping as they have become unaffordable or in some instances physically undeliverable as capacity is not available. Indeed some clients have deferred construction commitment in expectation of future falling construction costs, in effect, a self-fulfilling prophecy. Possible post-Brexit demand side weakening may now create the feeling that a natural realignment of supply and demand is taking place that will allow the construction sector to 'sort itself out'. History suggests this will not happen and we need to look beyond this short-term correction if we want to break out of a continuing boom and bust cycle of overheating followed by permanently damaging attrition in a downturn.

The real ticking 'time bomb' that needs to be recognised is that of projected workforce size and demographics as highlighted on page 32. Although an ageing workforce is not a problem confined to the UK or just the construction industry, the scale of the problem is particularly acute in UK construction. In addition, we know from past experience that further workforce attrition will occur in an economic downturn such as we are at risk of entering following Brexit.

What is currently seen as a labour shortage can quickly become an endemically under-utilized industry with workers leaving to pursue opportunities elsewhere. Based purely on existing workforce age and current numbers of new entrants, we could see a 20-25% decline in the available labour force within a decade. **This scenario has never before been faced by UK construction and, other things being equal, would render the industry incapable of delivering the levels of output and GDP historically seen.** This would undermine the UK's ability to deliver critical social and physical infrastructure, homes and built assets required by other industries to perform their core functions.

Even before considering future resource attrition (and based on the current skills base and productivity levels), any aspirations of levels of house building on a sustainable basis, in excess of 200,000 units p.a. appears to be physically impossible using traditional methods. Furthermore, anything even approaching this level will stimulate cost inflation and exacerbate performance issues.

In reality, when factoring in projected workforce shrinkage, house building capacity might fall nearer to 100,000 – 150,000 p.a. in the medium to longer-term without intervention.

It is worth referencing the plight of Japan in the context of what an ageing workforce might mean for the UK. As a country with one of the most rapidly ageing populations in the world, Japan provides powerful future indicators for the UK construction sector that it should not ignore. Through a combination of age led retirement and the lack of new entrants, the Japanese construction industry has shrunk by approximately a third since 1997 with a peak workforce then of 4.6million now reduced to a little over 3 million.[18]

THE ROLE OF MIGRANT LABOUR

The rapid deterioration in Japan's labour force, which is in the same order of magnitude as that projected for the UK over the next decade or so, has led Japan to now urgently seek foreign worker support for its domestic construction capacity (catalysed by the Tokyo 2020 Olympics construction programme). **A post Brexit UK will potentially struggle to replicate the model of migrant labour additionality which it has historically relied on, so it makes the case for action even more critical.**

Prior to Brexit, some might have seen migrant labour as a solution to the shrinking workforce. Without entering the wider political debate, it is recognised that migrant labour has historically played a key role in providing capacity in UK construction, especially in London and the South East. However, increasing substitution of a reducing domestic workforce by migrant labour comes with substantial risks. For example, the US and many Middle Eastern countries now have a dangerously high reliance on migrant labour. Geo-political instability and shocks such as we seen with the EU Referendum result and which relate to trade and border security could have disproportionate impact on the construction industry if reliance was to grow significantly in the future. Furthermore, it is now uncertain how the UK's vote to leave the EU might affect the real availability of migrant labour moving forwards.

[18] Toko Sekiguchi, 'Japan Opens Door Wider for Foreign Workers: Tokyo Looks to Address Construction Labour Gap', The Wall Street Journal, 4 April 2014.

Building on the internationalist theme, the early signs from those overseas developers and contractors who have entered the UK market suggests that their model is also not going to assist long-term capacity building. Models adopted so far have relied on joint ventures to allow cross-fertilisation of knowledge at senior management and supervision level. This has not extended down to the supply chain labour force (although materials may well be sourced from the home country or region through leverage of existing purchasing agreements). These models may act as a stimulus for higher numbers of itinerant project-based foreign workers but that would again of course be dependent on immigration policy as it develops post-Brexit. A significant increase in the labour force from foreign corporate entrants is therefore not likely to be possible without an acceptance of much more radical 'out sourcing' with all the political and economic difficulties that brings.

TECHNOLOGICAL CHANGE

The current pace and nature of technological change and innovation in wider society is such that unless the industry embraces this trend at scale, it will miss the greatest single opportunity to improve productivity and offset workforce shrinkage. Failing to embrace change will also further marginalise the industry by reducing its attractiveness to a new generation of workers who will have grown up in a digital world. This has the potential to accelerate the rate of decline in structural capacity, with further declining workforce replenishment levels and continued reliance on traditional construction techniques both conspiring to constrain achievable output. This review suggests there is a tipping point that is likely to be reached in the next 10 years where industry will see all of the symptoms highlighted in section 1 getting worse to the point where decline possibly becomes irreversible.

Interestingly, the example of Japan cited above is also relevant in the context of embracing technology and manufacture led construction. Tokyo alone is still able to build nearly the same number of homes per year that the UK delivers nationally (circa 140,000) This is purely due to the reliance on a different delivery model for single family homes which benefits from the mass market cultural acceptance of pre-manufactured modular housing. In turn, this empirically confirms the ability to effectively offset workforce constraints, in housing at least, by changing the means of delivery. The cultural acceptance point is obviously valid here though and the town planning control of modular delivery in Japan is also very different. Both of these issues should be considered part of the potential solution in the UK and how we might develop our own, culturally and planning context aligned version of a Japanese model of housing delivery.

As highlighted on page 36, there are early signs of manufacturing-led foreign corporates considering entering the UK market and overcoming traditional barriers to market entry through use of pre-manufactured construction products. New foreign entrants in this field, if meeting technical and quality standards, would indeed potentially be a much needed boost to UK housing supply capacity. But reliance on foreign entrants would represent a lost opportunity for the UK to retain value added, including direct and indirect employment, IP development and potentially building an export base.

HOUSING TENURE DIVERSITY

A final issue, that could define the future outlook for the industry, specific to the residential construction sector, is its apparent growing reliance on the 'for sale' housing model, with which it has never been more deeply synchronised. As the social housing sector has changed its model to private sale led cross subsidy and surplus generation in response to a series of policy changes, there is now less opportunity, in the event of a private market correction, to create a 'soft landing' through a social housing build programme. This is a real risk to housing delivery in the UK due to even greater cyclicality than seen previously.

Government therefore has a strategic choice to make about the future role of grant funded social housing which has historically been used as a counter cyclical demand tool. This also brings into question the role that may be played by direct delivery and investment measures across all tenures either at a central, regional or local government level.

In addition, the opportunity highlighted in section 2 regarding the Build to Rent sector is a very real one to avoid the 'business as usual' prognosis and would create a more acyclical and at scale demand that could underpin significant investment in new innovative ways of building and appropriate new skills being developed across the industry.

These key choices on tenure diversity should be seen in the context of wanting to avoid a high level of synchronization between housing construction output and the very cyclical, private for sale, tenure model which could be very damaging to the industry for all the reasons already rehearsed. It also sets the scene for how important traditional housebuilders will and should be in future total housing delivery with less reliance on their output. **More tenure diversity would immediately imply different supply chain and delivery models that may better promote innovation.** In time, this may influence core house builder delivery models but it is considered unlikely that innovation at scale will start in the volume housebuilder segment of the market despite some interesting exceptions (see Case Study 11).

4 RECOMMENDATIONS – A TREATMENT PLAN FOR TRANSFORMATIONAL CHANGE

CONTEXT

This review has highlighted that the construction industry in the UK is chronically under invested due to a combination of economic, market and behavioural factors. Long-term productivity is stagnant. On top of this, the industry faces a major threat from declining workforce numbers.

It is clear that a flourishing construction sector will need continuing, improved and more efficient support for traditional building skills. These skills remain important and will always be needed. However, in isolation, they will not meet the UK's growing construction needs. This is particularly the case in housebuilding which is most reliant on traditional building methods.

To generate additional capacity in the sector, we need new business models, supported by new investment, and using new construction methods. This is essential to avoid putting additional pressure on the supply of skills (thereby inflating labour costs) and to overcome the factors which inhibit change, especially in the residential sector.

"The vision should be of a UK construction sector where traditional skills needs are efficiently met, with looming labour shortages at least partially offset by a greater and more focused investment in the appropriate skills that industry will require in the future. "

The vision should be of a UK construction sector where traditional skills needs are efficiently met, with looming labour shortages at least partially offset by a greater and more focused investment in the appropriate skills that industry will require in the future. Alongside this, purposeful and strategic industry leadership is needed, driving investment in new technology and manufacturing capability that will grow over time to boost capacity and productivity and reduce the reliance on labour in line with the likely future reducing availability. It is suggested that the residential sector will lend itself more easily to a large scale move to a manufacturing led approach but with the ability to evolve into other sectors subsequently. This is an imperative to meeting the UK's housing needs without adverse impacts on our ability to deliver vital infrastructure and commercial construction.

The prognosis for 'business as usual' highlighted in section 3 above is not an attractive one. The case for change is compelling and industry needs to modernise itself to become a more compelling proposition for prospective new entrants or face a future of decline and marginalisation. Modernisation through better productivity and harnessing technology should also improve long-term margins, decrease unit delivery costs, and create greater predictability by de-risking on site delivery – the part of the process where so many issues occur and create adversarial tension and non-value add effort.

CORE RECOMMENDATION PRINCIPLES

Below are set out the defining principles identified that have shaped this review's recommendations:

- Change in the construction sector will only happen through a strategic intervention that has strong leadership behind it and makes financial or wider outcome led sense for all key parties: industry itself, its clients (private and public) and government.

- Wide-scale change in the industry (beyond isolated exemplars) comes about only when clients expressly change their needs or as a result of government led regulatory or compliance issues.

- With 75% of industry's work commissioned by private clients, it is imperative that they are at the heart of the change process.

- Government also needs to play an active part in this step-change - beyond its role as a client of the industry - due to construction's political importance and its role in housing building and infrastructure. Longer-term quantifiable improvements to industry capacity and productivity need to be factored into assessment of this action plan, not just the upfront 'costs'.

- Incentives to change should leverage as many existing fiscal or policy tools as possible in a coordinated manner to make them more acceptable and practicable.

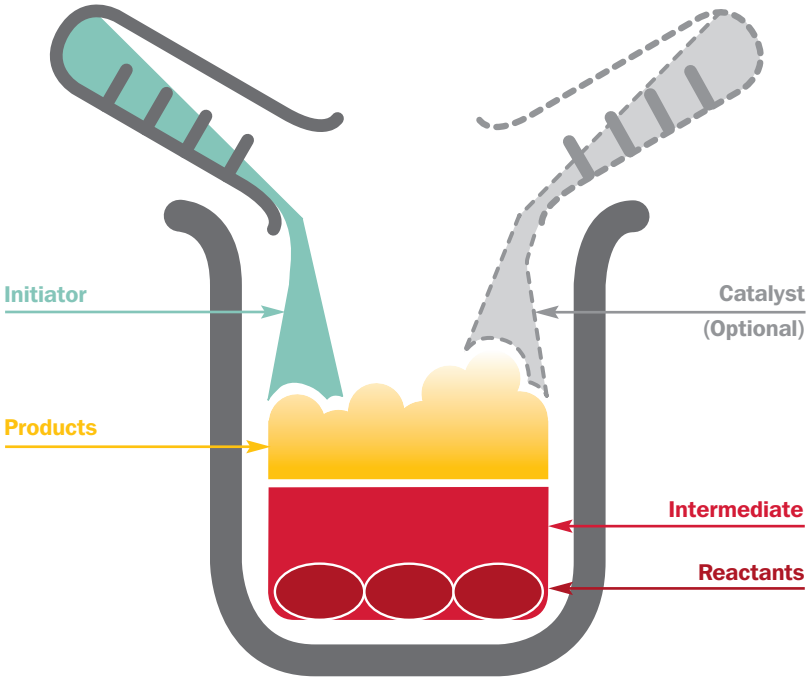
- Current government-funded demand-side stimuli for house building, measures to ease the planning system and public land supply initiatives should all better influence the construction process itself by effecting modernisation as well as targeting overall new housing numbers and specific tenures.

- Interventions need to be largely capable of cross party political support as time horizons for investment and delivery are mostly beyond a single parliamentary term. They should focus on tangible outcomes that help both the construction industry and its clients through such metrics as total housing supply, productivity, predictability or improved consumer choice.

- Transformation should focus on driving a step-change in industry investment in modernisation, underpinned by a more transparent, longer-term demand profile against which the required shape and size of evolving labour supply, its training and the adoption of new delivery technologies can be mapped and developed.

RECOMMENDATIONS

With an ultimate goal of creating long-term transformational change across such a complex and multi-faceted entity as the construction industry, it is considered useful here to build on the medical process analogy used throughout this review and compare the component parts of the following recommendations to the basic ingredients for creating a chemical 'chain reaction'. In this regard, it is worth highlighting 5 key components that would usually be necessary in such a reaction and their analogies to the recommendations made:



Reactants – the key elements necessary to be part of the reaction - **Integrated Tripartite Leadership across Clients, Government and Industry**

Intermediate – the enabler of a reaction - **A Reformed CITB**

Products – the desired outcomes that arise from the reaction and which also self-perpetuate the reaction - **Client & Industry Process Integration, R&D & Innovation, Skills & Training, Industry Image**

Initiator – the means by which a reaction is commenced - **The Role of Government in Pump Priming Change**

Catalyst – a mechanism to accelerate or speed up a reaction - **An Option for Accelerating Behavioural Change**

Each of these principles can then be applied in a logical manner to create an ideas framework which binds together the following set of recommendations.

THE REACTANTS –

Integrated Tripartite Leadership across Clients, Government and Industry

At the heart of these recommendations is the need to establish a new 'tripartite covenant' between the **construction industry,** its end **clients** and **government** which leads to mutual benefit for all parties. The aim is to bring about a step-change in investment in skills and technology across the industry, helping to maintain current capabilities and skills while building new capacity through new business models that embrace pre-manufactured techniques. The current separation that exists between private clients, industry at large and government needs to be fundamentally overcome if there is to be any chance of changing the way in which construction is commissioned and executed such that it enables modernisation and better outcomes for all parties.

The goal of such industry transformation must be owned at the highest level. The sector strategy *(Construction 2025)* developed by the CLC is a good starting point from which to take stock and establish detailed road maps for change which can be injected into real world application across industry. The actions needed to modernise the sector correspond to several elements of the CLC's current work plan, in particular its focus on *business models,* skills and innovation. As a senior forum for the industry, bringing together representatives from the supply chain, the consultancy sector, elements of the client sector and central government, it represents the logical choice of platform from which a longer-term dedicated executive and fully integrated leadership vehicle may possibly evolve.

It is recommended that there should be a balanced focus in the CLC between major infrastructure and building construction matters and also that major private clients should be better represented as part of the CLC to underpin the tripartite covenant principle set out above. There may also be a need for a more explicit link to the newly formed National Housing Taskforce (NHT) to drive a coordinated action plan in the wider housing sector (not just representing housebuilders) as well as securing, via the All Party Parliamentary Group for Housing & Planning's sponsorship of the NHT, cross party political alignment on an industrial strategy that is likely to span multiple parliamentary terms.

Whilst CLC can guide at a strategic level and report and make recommendations to Ministers, it is not a delivery body equipped to drive change on the ground. There is a need in any possible emerging integrated leadership model for sufficient resource and focus on how the implementation road maps being developed by CLC can be connected to industry at scale. CLC will need to create followship as far as possible across the supply chain, all types of private clients and government. This can only really be achieved by suitable balanced representation around the table.

The key mechanism by which leadership decisions can have the desired impact and implemented across the industry at large is dealt with in more detail below.

Recommendation 1: The Construction Leadership Council (CLC) should have strategic oversight of the implementation of these recommendations and evolve itself appropriately to coordinate and drive the process of delivering the required industry change programme set out in this review.

THE INTERMEDIATE –

A Reformed CITB

It is clear from the evidence seen by this review that the challenge facing the CITB and its consequential struggle to deliver across a multitude of different fronts, is leading to a loss of industry confidence across matters such as training and attracting new entrants to the industry. This appears to be partly down to the terms of reference under which the CITB operates. In particular, they do not properly enable funding of innovation and technology which seems bizarre when technology and skills are such inter-related synergistic issues. Such matters are a legacy of the historical legislative mandate under which it operates. It also has faced continuous widespread calls for efficiency improvements and a more effective deployment of grant. The reality is that it appears the sheer scale (and increasing politicisation) of the task facing CITB, has meant that such that it has struggled to get on the front foot and robustly deliver good value in the parts of the industry where the multiplier effect can be maximised.

It is important to state that the principle of a levy is considered by this review to be a sound one. The issue is really how the industry's sole self-funding mechanism can be turned into a high efficiency brokerage solution backed by a fit for purpose implementation body that maximises return for every £ of levy charged to members.

As such, it is recommended that the opportunity is taken as part of the next triennial review process to shape and evolve a more relevant and better equipped implementation body. This body can then act as the delivery medium for policy decisions originating from the evolving leadership vehicle referenced above in Recommendation 1.

The desire for comprehensive and single point levy paying and grant distribution coverage across the whole industry would suggest that efforts should also be made to try and reconsolidate membership across current 'out of levy scope' trade body members. It is appreciated that this may not be easy, but it will at least focus efforts on the need to create an inclusive, accountable, high efficiency organisation that will maximise training and innovation outcomes across the entire industry and avoid the 'siloism' that currently exists.

The following principles should be incorporated into any review of CITB:

- **A new focus on longer-term strategy explicitly linked to the needs of clients and government, as well as those of industry and linked to a new and integrated leadership agenda.**
- **A broader remit to support industry innovation and modernisation, with success judged by outcomes and the performance of the sector, rather than the achievement of consensus. The key parties represented should respect where financial support is best deployed to create more holistic, longer-term benefits.**
- **Greater digitisation and leaner overheads in operation, emulating high efficiency and digitally led large scale 'clearing house' platforms such as UCAS. This must minimise the cost of administration and unnecessary waste or diversion of resources.**
- **The ability to use its collection and distribution of funds strategically to encourage greater investment in skills and innovation. There should be broader criteria to determine contributions to CITB and, in turn, a broader range of activities funded by CITB.**
- **A drive to bring out of scope trade bodies back into a single umbrella levy and grant system and to leverage scale efficiencies in so doing.**

Recommendation 2: **The Construction Industry Training Board (CITB) should be comprehensively reviewed and a reform programme instituted.**

THE PRODUCTS –

Client & Industry Process Integration, R&D & Innovation, Skills & Training, Industry Image

Client & Industry Process Integration Priorities

It is fundamentally important, for the reasons already highlighted in this review, to involve clients in the process of industry modernisation. The recommendations for integrated industry leadership and CITB reform set out above are both predicated on clients at large helping to drive a new type of demand by physically commissioning advancements in way that we build. Industry, government and clients should seek to build an alliance aimed at fundamentally changing how we approach the entire process of built asset creation.

It is recommended that starting point for driving change should be the CLC's *Business Models* workstream. The mission of this working party is to drive asset owner and end user value from construction projects, which will require a shift in emphasis from the construction process to an outcome focus and better alignment of industry and client interests. To succeed there will need to be a change in the way that the construction industry works and the role of this CLC workstream is to identify, promote and lead this change.

Figure 18: Construction Leadership Council's Business Models workstream

1. *To understand how asset owners' behaviours influence supplier behaviours, and to identify ways where modifications to behaviours will produce better outcomes. This will involve:*
- Assimilation of GCB, IPA, LGA, ICG work to make Government, Public Service deliverers and Local Authorities "better clients".
- Making recommendations on consistency of approach across clients (both public and private sector).
- Investigating the role/influence of government to underscore changes to these behaviours.

2. *To work with academic institutions and build on well-documented case-studies and research in the construction sector and establish a clear picture of what "good projects looks like" - for example:*
- Organisational structures.
- Early contractor involvement in design.
- Greater collaboration.
- Simplified/standardised procurement.
- Fair reward and payment for all involved.
- Whole-life cost/value, not just construction.
- Continuous improvement and the up-take of best practice.

3. *To work with established industry groups, such as Build UK, Specialist Engineering Contractors Group, Professional Institutions etc, to consider the industry's business models, and identify ways to improve efficiency and productivity. In particular, investigate:*
- Conflicting vested interests in the project/programme life-cycle.
- Supply chain integration and interface management.
- Cash-flow throughout the project/programme life-cycle.
- Risk placement throughout the project/programme life-cycle.
- The role of labour only sub-contractors and SMEs.
- Definition of best value beyond capital cost.

4. *Make recommendations on what the business model could be, and the mutual advantages this brings to the asset owners and supply chain.*

5. *Create a narrative that shows what the industry can become and how this will be achieved.*

6. *Draw up an implementation plan to promote:*
- Understanding of the model by both asset owners and suppliers.
- Collective best interest of implementation.

7. *Use housing sector as a priority test bed for the new ideas.*

It is vital that this work is rooted in the real world and is able to empathise with and influence the large grouping of private real estate clients that exist in the industry and attempt to change their buying behaviours. It should not focus unduly on public sector, major projects or infrastructure aligned delivery models as there may be diminishing returns for effort deployed from this approach bearing in mind 75% of all output lies outside of these areas. It should also respect that real estate developers are not always the asset owner and, although they commission construction, they may not have aligned interests to the ultimate occupant or owner of an asset. There is also a large proportion of one off or occasional clients that need to be influenced as far as possible by the outputs of this workstream if wider industry change is to be achieved.

To create an initial scalable model, it is suggested that the housing sector is used as a client integration test bed. This should include not just traditional housebuilders but the likely new participants in a tenure and product diverse housing market including Central Government, Regional Government, Registered Providers, Local Authorities, Build to Rent developers and investors and specialist later living developers and investors.

Recommendation 3: **Industry, clients and government should work together, leveraging CLC's Business Models workstream activity, to improve relationships and increase levels of investment in R&D and innovation in construction by changing commissioning trends from traditional to pre-manufactured approaches. The housing sector (spanning all tenures) should be used as a scalable pilot programme for this more integrated approach.**

R&D / Innovation Priorities

With a framework in place to support the new tripartite covenant, it is necessary to build a coordinated programme of R&D and innovation that delivers productivity improvements throughout the construction sector, especially in housing. This should encompass utilisation of existing approaches such as Design for Manufacture & Assembly (DfMA), and product standardization and pre-manufacture from component level through to full volumetric level. It should also look to the future to understand the scalability and potential of newer technologies such as 3D printing, drones and on site robotics and the more holistic future impact of materials science advancements.

Any such initiatives should also be tied into an industrialised scaling up of benefit secured from the existing R&D Tax Credits Scheme. Construction should be securing its fair share of this tax benefit which it seems is currently passing it by. This point needs to link into the preceding leadership and implementation recommendations.

The CLC's *Innovation* workstream has set out a comprehensive plan for delivering many very relevant objectives and which this review has been party to and supports. It is recommended that the key issues that the working group must now champion are as set out below:

- **Centres of excellence and collaboration - Supporting and creating Centres of Excellence for skills and knowledge to share best practice, inspire collaboration and showcase new opportunities.**

- **Promote the idea of innovation hubs where ideas can be shared and developed on a 'pay as you go' or free basis as currently being pioneered in parts of the higher education sector.**

- **Promote the concept of 'factory sharing' (initially proposed by *Buildoffsite*) where SME businesses can coalesce and collaborate in a factory environment without fixed cost risk or by sharing that risk.**

- **Promote the concept of on-site factories or consolidation centres that enable pre-assembly and de-risk construction operations and can be shared by multiple projects / clients. These could be demountable and have a modular approach themselves and so create an immediate opportunity.**

- **Look to establish an industry-wide 'design for manufacture and assembly' (DfMA) protocol that enables a common platform to be created and supports possible interchangeability of components. This would create a more vibrant interactive trading market and be seen by clients as de-risking supply chain reliance, but needs to avoid concerns about retention of intellectual property and investments made.**

- **Demonstrator projects and business case - Supporting and promoting demonstrator projects to raise awareness with consumers, aid industry learning and demonstrate the benefits of 'smart' construction and built assets. This should also prove the business case for 'smart', and the ability to demonstrate benefits through in-use performance data and leveraging the increasing power of the Internet of Things (IoT).**

- **Work with the pre-manufactured construction industry to help it offer a much better quantifiable proposition to end clients. Predictability will be underpinned by BIM-enabled collaboration and greater pre-manufacturing adoption. Clients and their advisors also need to assess value in a different way and drive procurement away from project specific competitive tendering to more collaborative long-term approaches. Traditional cost plans need to move away from capex fixation and incorporate a new measurement of pre-manufactured value (PMV) which the CLC Innovation working party should look to formally define. This should be on a par with conventional Building Cost Information Service (BCIS) elemental definition protocols and should effectively inversely correlate to the level of on-site delivery risk (ie higher PMV = lower on site risk). Comparisons with traditional projects should focus on outturn positions in terms of time, cost and quality, not initial contracted positions. There also needs to be further development of more sophisticated cash flow and value chain mapping tools which can be deployed for pre-manufactured projects.**

- Specific priority should be considered for high PMV solutions that use lower-cost supply chains from UK regional locations (compared to higher cost, capacity constrained equivalents in London and the South East). The embedded build cost for such solutions in the residential sector could better enable low cost starter homes or discounted rental properties compared to traditional locally sourced approaches. This strategy will also free up more traditional skilled labour in areas such as London to be deployed on commercial and social / civil infrastructure construction.

- Understand how pre-manufacturing might align to the custom build or bespoke developer housing market using 'off the shelf' solutions that provide flexibility on layout and fitting, better replicating the customer choice found in the automotive industry.

- Liaise with central, regional and local government bodies to support direct investment into off-site solutions.

- Address risk-averse culture, lending, valuation and insurance - Work with the finance sector and the RICS to improve high PMV property valuation understanding and work to widen the availability and affordability of asset investment finance and insurance / warranty products for homes built with high levels of PMV. Such measures should take account of concerns over product durability and long-term investment value and addressing the risk averse culture that exists not just in construction but in related financial, design and commercial advisory sectors.

- Work with senior debt providers (and their advisors) to gain confidence in the development financing of higher PMV schemes and seek to promote the growth and mainstream acceptability of a quasi-Construction Management 'Integrator' professional delivery model for site based activities still required for a pre-manufactured solution. This avoids an inefficient and unaffordable lump sum 'wrapper' being forced onto developers or investors by historically led funder expectations. Also there is a need to ensure debt provider confidence in the greater need to drawdown higher levels of advanced off site payments subject to appropriate title security being obtained. This needs to be supported by appropriate contractual mechanisms to give comfort such as step in rights in the event of default.

- Look to support a general education of the wider stakeholder community in making high PMV approaches 'mainstream' and acceptable based on clear benefits case analysis.

- Look at more use of project bank accounts and new methods of project level insurance policy to re-aggregate the natural fragmentation that may exist around transactional and legal liability interfaces that often stand in the way of innovative procurement and product assembly models. This should also extend to digitisation of the payment process all the way down the supply chain and a move away from a culture of using other peoples' money to make money. These measures need to be supported by appropriate contractual mechanisms.

- Look specifically at ways in which the rate at which initial fixed costs in manufacturing plant have to be written down against revenues can be supported through focused fiscal measures, subsidized loans or other policy measures. A factory overhead burden is an extremely sensitive cost and viability parameter for a pre-manufactured product, so an ability to help new businesses smooth this overhead allocation would support the comparative analysis against traditional construction and avoid a 'chicken and egg' barrier to investment and market entry.

- Definition, targets and measures - There is a need for ongoing measurement and reporting of progress against the targets (work on the definitions and targets has already started) so as to check if more radical interventions are needed to drive transformational change (see recommendation 10).

- Quantify and connect with the export opportunity - This workstream should seek to understand the potential for export markets to create an additional layer of demand for pre-manufactured housing solutions and inform support in relation to government trade missions and promotion.

- Influencing Client Integration Agenda - In conjunction with the CLC's *Business Models* workstream, there is a critical need to disseminate outputs to provide the data and insights which can ultimately be shared with clients to help understand the business case for embracing innovation.

In connection with Recommendation 2, it will be necessary for a reformed CITB to link into the programme of activity detailed above. It will also need to design its grant system to reflect the relevant R&D and Innovation priorities. It is suggested a refreshed grant system should encompass:

- Use of BIM level 2 and above.
- Use of collaborative procurement and contract forms.
- Use of DfMA / 'lean' principles as part of client brief setting.
- Use of minimum levels of pre-manufactured value (PMV).
- Funding / contribution to project or programme led R&D.
- Delivery of customer choice as part of design & construction solutions.
- Use of site based automation techniques – robotics, drones, etc.
- General applications from parties for technology & innovation related initiatives underpinned by collaboration.
- Strategic activities with wider industry impact attracting much higher levels of grant to be paid including direct or indirect investment in a pre-manufacturing capacity base that will serve the wider market.

Recommendation 4: Industry, government and clients, supported by academic expertise and leveraging CLC's current Innovation workstream activity, should organise to deliver a comprehensive innovation programme. This should be fully aligned to market, benefits case led and generate a new shape of demand across industry (with a priority on residential construction). It should quickly define key measures of progress and report regularly against these as a check on the possible need for more radical measures. It should in turn also help shape CITB reform proposals in relation to technology and innovation grant funding initiatives.

Skills & Training Priorities

This review has noted that the extreme cyclicality of the industry leads to a number of de-risking behaviours that impact on the incentives and ability of the supply chain to invest in skills. There is a more general need for industry to work more closely with its supply chains and fully understand how its clients can bring greater confidence to ensure greater skills investment. Longer-term contracts and shared framework contracts have had a visibly positive impact in some construction subsectors and this is the desired outcome across some of the more short-term, cycle led, markets if at all possible, such as real estate.

As part of a CITB reform programme, the desired skills and training priorities need to be identified and used to design an appropriate grant funding scheme. This would run alongside the R&D / Innovation programme highlighed in recommendation 4 to combine to an integrated innovation and skills programme of grant funded activity. In relation to skills and training, it is recommended that CITB grant should be focused on:

- **Maintaining the principle of the existing CITB grant support for traditional apprenticeships and expand this to non-traditional, accelerated training arrangements that focus on long-term employment outcomes and measures to incentivise employment continuity. The current proposed CITB levy simplification measures are useful but concentrate on payment not grant recovery. Ease of application and support for SMEs needs to step-change.**

- **Looking at options for a larger scale version of the current CITB-funded 'Shared Apprenticeship Scheme' (SAS) where payroll burden is held by regional employment vehicles. This might offer an opportunity for a centralised labour force to be developed, trained and then held post qualification, taking payroll burden off the SME sector and enabling a direct workforce to be flexibly deployed. This might also help professionalise the current private umbrella / payroll intermediary sector.**

- **Directly supporting the establishment of appropriate training course development & industry alignment, not just for apprentices - including BIM and digitisation (in tandem with SFA / HEFA).**

- **Creating new open data enabled tools to increase visibility of demand and initiatives that drive skills development and R&D investment.**

- **General applications from parties for skills development & training related initiatives, including support for funding of employment.**

- **Work in helping develop, fund and accredit new industry training programmes with a focus on BIM and digitally enabled professional and trades qualifications in conjunction with HEFE sector.**

There is also a need to recognise where organisations and bodies that sit outside of levy paying scope will also be required to influence a skills and training agenda fit for a modernised industry. Some examples include:

- **Industry bodies and professional institutions should liaise with the Quality Assurance Agency for Higher Education and the Higher Education Funding Agency to ensure degree course accreditations reflect industry's changing needs, including digital engineering.**

- **Professional services organisations should individually or in multi-disciplinary collaboration, establish a new offer to market which integrates pre-manufactured solutions into a final on-site solution. This differs from normal contracting methodologies and should be more about logistics management, haulage coordination, on site assembly and traditional trade integration in a de-risked environment. The commercial model for this means less risk for the 'integrator' and should be recognised as such by funders, supported by lawyers, and use standard forms of contract that reflect an integrator approach alongside a large pre-manufactured element.**

- In association with the above, there is a need for the legal profession to further develop and promote a wider range of user friendly collaborative, multi-party contracts that embrace BIM and a different mix of participants between designers and supply chain, including specialist provisions for the integration of pre-manufactured solutions and frameworks sitting across multi-project opportunities.

Recommendation 5: A reformed CITB should look to reorganise its grant funding model for skills and training aligned to what a future modernised industry will need. Industry bodies and professional institutions should also take a more active role in ensuring that training courses are producing talent which is appropriate for a digitally enabled world, making sure that the right business models are evolved with appropriate contractual frameworks.

Industry Image & Outreach Priorities

There remains a key role for a central body, building on CITB's current work, to have an influence beyond smarter grant funding for skills and innovation. This could encompass:

- Driving a major outreach programme into schools at 11+ level, embedding the likes of Design – Engineer – Construct (DEC) curriculum options into chosen schools that position the digital agenda in a built environment context. There is good work in progress here through the Go-Construct initiative, and through the development of career pathways announced in the recent Skills Plan, but this needs to be sustained and extended.

- Look to create a holistic marketing and messaging campaign that embraces 'Built Environment' not just 'Construction' It should bring in all ancillary professions and trades and link better the idea of physical assets created to excitement of being involved. This needs to move beyond major projects and engineering infrastructure and illustrate how the apparently mundane is exciting in construction process.

- Avoid use of stereotypes in how the industry is presented – for example a bricklayer with a trowel, an architect's blueprint, etc. There needs to be a more balanced approach to go hand in hand with a modernisation agenda.

In many ways, and going back to the chain reaction analogy used for these recommendations, the industry's image is a by-product of addressing all the other factors highlighted in this review. The task of attracting motivated and appropriate new entrants into the industry will be very much easier if we have modernised its basic delivery model.

Recommendation 6: A reformed CITB or stand-alone body should be challenged and empowered to deliver a more powerful public facing story and image for the holistic 'built environment' process, of which construction forms part. This responsibility should include an outreach programme to schools and should draw on existing industry exemplars and the vision for the industry's future state rather than just 'business as usual'.

THE INITIATOR –

The Role of Government in Pump Priming Change

While changes to industry practices can help support investment in skills, government also has a clear role in ensuring that the skills system, supports a healthy construction sector. Action should include:

- Making sure the funding priorities for FE and Apprenticeships align to industry needs and that courses are fit for purpose for a modernising industry. The current 'margin creation' process of trying to deliver courses for less than the SFA grant is acting against construction courses and needs to be addressed. It is hoped that the Apprenticeship Levy and employer routed funding will assist and actually have a positive impact on college behaviours.

- Maximising the impact of re-training and re-skilling programmes, including by not artificially constraining the supply of older trainees through funding rules. There should be particular focus on declining industries (such as steelmaking) and ex armed forces, which would serve wider social objectives. Age-related restrictions or gearing on funding and training schemes should be abolished.

- Driving effective dialogue with all levels of the sector on a new landscape for industry skills training. This should include input to the Area Review being undertaken by DfE & SFA via the Joint Area Review Delivery Unit. The Area Review needs to ultimately be influenced by better tools to align demand and supply of skills.

- The development in conjunction with the private sector or via the CITB reform programme of open data based supply and demand skills and training alignment tools that are informed by total visibility of private and public sector workload and the type of current and future skills needed. This requires a new data platform, building on tools already used in the major infrastructure projects sector (including the work for the National Infrastructure Pipeline (NIP) for skills) linking ultimately to a low cost, brokerage solution.

- A stable commitment to carbon reduction in new-build residential. This will influence the skills and methods of construction required to deliver energy efficiency standards and inherently promotes innovation.

- Change Section 106 planning condition obligations at local authority level on employment and training so that they can cover a wider, more sustainable geographic area. Many Section 106 obligations are fulfilled through limited term Apprenticeship Training Agencies contracts without analysis of geographical demand and sustainable long-term employment.

- Assess how CIS may be modified to further disincentivise 'false' self-employment, perhaps through a larger levy differential applied between directly employed labour and CIS sub-contractors, or through the expansion of direct employment in public sector delivery organisations and shared apprenticeship schemes.

Recommendation 7: Government has recently reaffirmed its commitment to having a strong industrial strategy. The government should recognise the value of the construction sector and be willing to intervene by way of appropriate further education, planning and tax / employment policies to help establish and maintain appropriate skills capacity.

In addition to those areas where government has a vital role to play in influencing the skills and education agenda there is a more strategic role that it can play in setting the right conditions for a construction sector National System of Innovation (NSI). Government has the ability to facilitate the right institutional arrangements and economic conditions to establish and make a success of the tripartite covenant referenced above, both as an enlightened client of the industry and through the application of intelligent pro-innovation policies. It is the conclusion of this review that there is untapped potential to use government initiatives to drive industry modernisation particularly in the housing sector where the industry's problems are most acute and which will have consequential benefits for social welfare, the economy and the construction industry.

By playing an active role, government will get a healthier instrument of economic and social policy, a stronger basis for an economic multiplier and a potential stronger export base. When it comes to building new homes, influencing the way we deliver, as well as the end numbers of units delivered, will create a longer-term sustainable house building industry and will have quantifiable benefits in terms of productivity, quality and cost efficiency.

The development of the National Infrastructure Delivery Plan has had a positive effect on confidence in investment in UK infrastructure. It has helped to stimulate innovation and the deployment of new technology. However, as described, housing remains particularly exposed to short-term cyclicality and is unhealthily reliant on traditional low tech skills.

Demand predictability is a key component in generating the confidence necessary to expand the UK's housebuilding capabilities. The importance of this has been heightened further in light of the uncertainty arising from the UK's recent decision to leave the EU.

Government now has an opportunity to act strategically by using its interventions in the housing sector as a means of promoting new business models and innovation. It is suggested that there are three main routes to achieving this:

- **encouraging institutional investment in the private rented sector (PRS) through the 'Build to Rent' model but specifically linked to influencing the use of innovation and pre-manufacture led construction.**

- **working with Registered Providers to deliver and co-invest in a reinvigorated National Affordable Housing Programme (NAHP) more specifically linked to influencing the use of innovation and pre-manufacture led construction.**

- **implementing a strategic level direct investment and / or building programme of pre-manufacture led homes directly commissioned by government / Local Government.**

These options are not mutually exclusive, but a choice can be made about which to emphasise. Several different combinations of measures are possible, but it is recommended that the ultimate aim should be to foster in the medium term the creation of a sustainable domestic pre-manufactured housing industry capable of delivering 50,000 homes per annum in addition to current 'traditional' new-build output of circa 160,000. It also needs to be complementary to current private for sale housebuilding rather than crowding it out which is why the above options immediately suggest tenure diversity. A further benefit of Build to Rent and the wider Private Rented Sector, social housing and direct government interventions is that these are acyclical or indeed can be timed to be counter-cyclical in their nature.

All three routes have some common requirements: land must be available and investment in manufacture led construction capacity must be supported (at national or local level) to enable capacity to grow in front of demand being 'turned on'. This will require direct government investment or the private sector having confidence in the demand pipeline which must be visible and certain enough for investment to be committed and sustainable. This in reality could be achieved via a government demand guarantee model.

The PRS route could be encouraged for instance by favourable land release by central and local government which would be conditional on using pre-manufactured solutions. In addition, tax incentives, such as a rebate on the recently introduced SDLT surcharge, could be offered to institutional investors and their development vehicles in PRS where new housing was being created with high levels of pre-manufactured value (PMV).

PRS-led innovation could also be stimulated by allocating a portion of a refreshed Build to Rent Fund prospectus with preferential financing terms to schemes which use pre-manufacturing. This could include covenant and security support or dispensation for lower capitalised pre-manufacturing businesses. This incentive could also be shared with long-term investors who dictate to developers that they require pre-manufactured product by offering preferential asset financing allocation as part of a modified Private Rented Housing Guarantee Scheme.

Working with Registered Providers to develop a programme of pre-manufactured social housing would also be an alternative or preferably, a complementary option to promoting Build to Rent. This review has noted examples where Registered Providers are already either individually or by aggregating demand, looking to adopt manufacture led techniques as part of their current plans and this must be viewed as a positive move which government could further support.

Finally, government could make firm decisions as part of its prospective programme of directly commissioned housing and allocate a significant proportion to pre-manufactured housing which it may choose to deliver independently of, or link, to the policy options stated above as a land donor.

It is also possible, on a wider basis, for planning policy to be brought to bear in incentivising innovation. In the same way that centrally issued supplementary planning guidance supports the National Planning Policy Framework (NPPF), government could consider how the promotion of high levels of customer choice, supported by a pre-manufactured solution, could be beneficially recognised in the application of local planning policy. Regional government can also mirror this approach independently through their own local plans and SPG's. Options might include exploring ways to replicate an approach to planning based on a Permission in Principle (PiP) system for pre-approved housing products with a standard typology, unit mix and sizing (similar to the NHBC 'type approval' approach to Building Control) This could be used for self-build / custom build, where clients purchase from a catalogue with automatic planning permission. There should also be consideration of relaxing planning led mix constraints to enable better standardisation and stacking of unit types, enabled by a more consistent mix of different types of units. Finally consideration should be given to how changing schemes from traditional to manufacture led designs that have an acceptable level of visual impact can be deemed to be 'minor' or 'non material' amendments in planning terms.

Recommendation 8: Government should act to provide an 'initiation' stimulus to innovation in the housing sector by promoting the use of pre-manufactured solutions through policy measures. This should be prioritised either through the conditional incentivisation of institutional development and investment in the private rented sector; the promotion of more pre-manufactured social housebuilding through Registered Providers; direct commissioning of pre-manufactured housing; or a combination of any of the above. It should also consider planning breaks for pre-manufactured approaches.

More generally, the housing sector would benefit from a greater visibility and confidence in levels of future demand for new public housing. To promote this government and industry should work with local and regional authorities (including Local Housing Companies) and Registered Providers to understand their plans to grow direct delivery output in housing and the timing of that relative to projected private market activity (i.e. to try to promote a counter-cyclical element of activity). This should capture both temporary and permanent housing and the potential for both traditional and off-site manufacture options. This forward planning can be directly and indirectly influenced by government as stated above through the phasing and allocation of HCA grant from the central or devolved National Affordable Homes Programme (NAHP) or through the introduction of intelligent, incentivised measures linked to regional devolution and perhaps elements of associated fiscal autonomy. In addition, plans for real estate development associated with the NIP and the plans of institutional investors in PRS should be drawn in to the picture as much as possible. The ultimate aim would be to create a credible and comprehensive picture of plans for residential development and levels of likely demand for skills and high PMV output in an easily accessible digital form that can de-risk investment in innovation and training.

Recommendation 9: **Government, as part of its housing policy planning, should work with industry to assemble and publish a comprehensive pipeline of demand in the new-build housing sector. This should be along the same lines as the National Infrastructure Pipeline, seeking to bring private developers and investors into this as far as possible to assist with longer term innovation and skills investment planning.**

THE CATALYST –

An Option for Accelerating Behavioural Change

Despite the logical plan of action being proposed in the preceding recommendations, a realistic view should be taken as to how the systemic change inertia which besets the construction industry may act to inhibit or prevent some of the desired outcomes defined in this review.

One of the largest barriers to be overcome is the behavioural resistance to change amongst many clients as well as industry. The working premise is that change will be not happen in the construction industry unless it is instigated by clients changing their construction commissioning behaviours. This means by implication that there may be a need, subject to the rate of progress observed by implementing the ideas presented, to more radically influence client behaviour if the ultimate goal of transformational change is not achieved through voluntary means or by any of the 'initiator' policy suggestions identified above.

The key here will be an appropriate carrot and stick framework within which to influence how clients engage with the construction industry. Some of the recommendations already set out have identified various 'carrot' characteristics but there remains a more drastic option to use a 'stick' as a behavioural change mechanism. Comparisons can be drawn to the so-called 'carrier bag tax' which has been very successful in dissuading consumers from making what is considered to be an undesirable purchase by the levying of a relatively small charge. The same principle could be applied to clients who procure construction work in a short-termist or irresponsible manner which harms the future sustainability of the industry and in reality, clients' own ability to rely on the construction industry in the future.

Ultimately, a modernised construction industry will need greater investment, more collaboration and better alignment of industry and client interests. The potential need to introduce a statutory contribution from clients is not one taken lightly but it could have two purposes:

- **To act as a behavioural deterrent for clients who may not naturally believe they need to assist with the modernisation of industry through reformed construction commissioning.**

- **Assuming some clients will accept the charge and continue 'business as usual', to build a supplementary fund in addition to the CITB levy or its equivalent that can then be scaled up to better to fund and implement large scale technological advancement, major manufacturing capacity investments or strategic skills development.**

The intention would be to allow clients to avoid paying such a charge by defining specific qualifying activities or behaviours which would be seen to be benefical for industry's modernisation. It would therefore be a 'pay or play' charge mechanism. The type of qualifying activities defined should perhaps be changed over time to make it initially easily viable for clients to avoid paying by doing simple but important things that are not perceived as 'too difficult'. The compliance bar can then be raised over time to drive a progressive level of industry improvement that does not create a viability shock for clients and is in tandem with a gradual cultural change in procurement trends, collaboration or the embracing of pre-manufactured approaches. Any such charge should not duplicate liabilities that clients have under any Section 106 training obligation.

A timescale for a decision on whether to introduce a client charge should be set out clearly in advance and should in any event be decided within the next five years. The decision should be made by reference to progress against key targets for the industry: for example the *Construction 2025* targets for a 33% reduction in costs and a 50% increase in speed of development, supplemented by additional targets for improving industry productivity and output (specifically housing output). If a client charge proves necessary, it should be calculated in relation to the *total value of construction work* undertaken and should be no more than 0.5% of this total value. It is suggested that this charge would not apply to the domestic public consumer, only business consumers of the industry.

In relation to a government contribution to such a system and to avoid any possibility of a greater tax payer burden, it could be considered whether a limited land value tax is imposed to fund a contribution to such an enhanced fund. This might be linked to taxing a relatively small element of 'windfall' real estate price rises driven by tax payer funded major infrastructure projects such as HS2 or Crossrail 2. Such receipts would be ring fenced and re-invested in construction innovation and skills development so allowing construction to benefit from the wider 'non-earned value' economic benefits that its end products directly generate.

It is recognised that not all clients of the industry may react well to a proposition seeking investment from them. They may feel that they are being unfairly driven to support the construction industry's inability to sort its own problems out. However, this is the nub of the issue. The lack of industry's capacity to pay, its inability to see an alternative client-led demand profile and the lack of external stimuli to change, all combined with a reluctance by all parties to take collective responsibility means that unless clients stand back and see the bigger picture, strategic change will not happen and that is ultimately to their own detriment. If change does happen, clients of the industry will get more predictable outcomes in terms of cost, time and quality with long-term productivity gains improving their returns / competitiveness. The appropriate integration of technology should offer end users of built assets, including new homes, much more choice in product design, intelligent / smart buildings & assets and drive more end value for the real estate and infrastructure investment markets and occupiers / users. There should also be less volatility in capacity levels, pricing and the quality of outcomes if this funding builds extra capacity through new and traditional skills and new methods of delivery.

Recommendation 10: **In the medium to longer-term, and in particular if a voluntary approach does not achieve the step-change necessary, government should consider introducing a charge on business clients of the construction industry to further influence commissioning behaviour and to supplement funding for skills and innovation at a level commensurate with the size of the industry. If such a charge is introduced, it should be set at no more than 0.5% of construction value, with a clear implementation timetable. Clients should be able to avoid paying this by demonstrating how they are contributing to industry capacity building and modernisation by directly or indirectly supporting skills development, pre-manufacturing facilities, or other forms of innovation and R&D.**

5 KEEPING THE INDUSTRY UNDER OBSERVATION – SUCCESS FACTORS

Rather than set out a series of headline, metric based targets by which to measure the success of the recommendations in this report, it is felt more appropriate to set out some wider key characteristics which you would see, feel and hear in relation to the industry's future state. Some of these have quantifiable elements, but success will be implicit if many of the more subjective outcomes below are observed.

- More widespread use of the terms 'Built Environment', 'Built Asset Creation' 'Construction Integrated Manufacturing' 'Construction Engineering' rather than simply 'Building' or 'Construction'.
- Higher levels of industry attraction from Generation Z and a more diverse make up underpinned by a more modern image and wide ranging career routes and prospects mapping.
- Clients seeing the built asset creation phase as being as valuable to them as land assembly & securing planning – a driver of returns rather than a necessary evil.
- Clients, government and the supply chain talking with one voice with regards to strategic direction and outcome-led thinking.
- Large improvement in predictability of outcomes in terms of cost, time and quality.
- Average PMV showing a clear upward direction of travel across industry and with a particular step-change in residential products.
- Volatility of supply chain demand reduced through the overlay of measures to promote a-cyclical and counter-cyclical demand profile.
- A wholesale step-change in the take up of R&D tax credits by industry – moving towards benchmarks set by manufacturing.
- Number of large players in pre-manufacture market increased to 10-20 who can deliver at least 2,000 residential units plus per annum with a spectrum of providers below this output level.
- Flexible collaboration hubs being used by supply chain outside of formal alliances or corporate joint venture relationships.

- Tangible improvement in links between academia and industry (all levels) in relation to R&D that fundamentally redefine products being offered to end users.
- Large parts of programmatic built asset delivery across all asset sectors being linked to high levels of PMV.
- Costs per unit of production starting to fall on long-term trended basis as supply chain capacity and productivity improves.
- Less use of traditional split design & construction contracts and a move to more collaborative integrated contracts.
- BIM embraced by industry – private sector moving to BIM adoption as a business norm.
- Structural margins improved across clients, consultants, supply chain (when corrected for economic cycles).
- Wholesale but positive disruption to established lines of businesses – surveying profession, lump sum contracting, traditional trades, etc – new solutions and service lines being innovated on the back of a 'change or die' ethos.
- HEFE training courses for Built Environment related subjects fully validated by industry, integrated in terms of different types of trainee placement formats and closer links to permanent career opportunities.
- Increase in proportion of PAYE employees across supply chain.
- On project training not being promoted in isolation from wider strategic regional opportunities – greater transferability of skills during development and at maturity.
- Wide-scale adoption of open data platforms to inform and link supply and demand planning.

6

NEXT STEPS

The premise of this review was that it would report back to the Construction Leadership Council (CLC), and if accepted, the findings would be adopted as a basis for action.

The recommendations from this review are ambitious and strategic and it is clear that there can be no 'big bang'. However, there are short, medium and long-term activities and priorities that can be used as an immediate menu for action.

It is important to note that the impact of this review's recommendations will only be maximised if adopted holistically. 'Cherry picking' will dilute effectiveness and in some instances may have negative impacts unless coordinated with other recommended measures being adopted.

This plan should be integrated into the current CLC road mapping aligned to relevant workstreams of Skills, New Business Models, and Innovation.

FARMER REVIEW: ORIGINAL TERMS OF REFERENCE

The construction industry is essential to the delivery of the government's ambitions to increase levels of house building and to improving the UK's economic and social Infrastructure. However the sector is characterised by recurrent skills pressures, associated with its widespread reliance on extensive sub-contracting and recruiting skilled labour project-by-project.

Nick Boles, Minister for Skills, and Brandon Lewis, Minister for Housing and Planning, have asked the Construction Leadership Council to work with Mark Farmer to identify actions which will address this, focusing on what measures will help lead house-building and other construction firms to ensure they have the skills, and the skills pipelines, that they need. They will take recent work, including his own report (with Simon Rawlinson) People and Money, as a starting point. The work will also examine the barriers and enablers to the greater use of off-site construction, specifically in housing.

The work will engage with construction stakeholders and take account of current practices in the sector, including what factors affect the use of and reliance on native and migrant labour, and of existing arrangements in place to support skills in construction including college and FE training, Levy systems and apprenticeships.

The Construction Leadership Council will report to Nick Boles and Brandon Lewis in the spring of 2016.

January 2016

ABBREVIATIONS AND ACRONYMS

BEIS – Department for Business, Energy & Industrial Strategy
BIM – Building Information Modelling
BTR – Build to Rent
CIS – Construction Industry Scheme
CLG – Department for Communities and Local Government
CSCS – Construction Skills Certification Scheme
DfE – Department for Education
DfMA – Design for Manufacture & Assembly
FE – Further Education
HCA – Home & Communities Agency
HE – Higher Education
IoT – Internet of Things
IP – Intellectual Property
KPI – Key Performance Indicator
NAHP – National Affordable Housing Programme
NHBC – National House Building Council
NPPF – National Planning Policy Framework
NSI – National System of Innovation
NVQ – National Vocational Qualification
PAYE – Pay as you Earn
PiP – Permission in Principle
PMV – Pre-manufactured Value
PRS – Private Rented Sector
RIBA – Royal Institute of British Architects
RICS – Royal Institution of Chartered Surveyors
RTPI – Royal Town Planning Institute
SFA – Skills Funding Agency
SME – Small and Medium Sized Enterprises
SPG – Supplementary Planning Guidance
UKCES – UK Commission for Employers and Skills

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Thank you to all those who contributed their views, whether through informal discussions, interviews, roundtables or written submissions. Each piece of oral and written evidence was carefully analysed and has helped to develop my thinking but all views expressed in the report are my own. – Mark Farmer.

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NOTES

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"The evidence reviewed indicates that the construction industry and its labour model is at a critical crossroads in terms of its long-term health. Whilst the diagnosis points to a deep-seated market failure, there are certain industry trends and wider societal changes happening now that represent both unprecedented risk and opportunity for the industry and its clients. If the opportunities are not harnessed, the risks may become overwhelming."

Mark Farmer

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