WORK FOUNDATION

City & Guilds Group

Constructing the future:

How the skills needed for success in the workplace are changing

September 2018

Contents

Foreword

I want to start with a hypothetical but a very common and realistic situation.

Mike has been a builder all his life. He joined the industry at 18 after completing a City & Guilds qualification and now his daughter has followed him into the industry and is working for the same organisation.

Mike knows that he is going to have to work until he is at least 67 and his daughter is probably going to still be working at 70. Both of them are very competent builders but are conscious that the industry is changing and new ways of working are emerging which may automate some of the work they do now. They know their skills will become outdated and their employer is also aware that they are going to have to invest in upskilling and reskilling them in order to remain competitive.

Mike, his daughter and their employer could be in any industry in the UK. But the important underlying message is that the evolution of the UK's workforce and the growth and success of its businesses hinges on the ability of the UK's skills system to adapt and develop to prepare for the jobs of the future.

The majority of people in the workforce now will still be in the workforce in 30 years' time. As the world of work continues to evolve, so too should the way in which lifelong learning is incorporated into career paths, and the role played by businesses in upskilling and reskilling their workforce. And we must equip people, such as Mike and his daughter, with the important transferable skills as well as the technical skills which will allow them to better adapt to change when it happens.

Many of the proposals in the Government's Industrial Strategy which focus on tackling the UK's skills challenges do so with an emphasis on getting young people into the workforce. Whilst this is of importance, if the Government is serious about solving the current productivity challenge whilst building a workforce with the capacity and capability to meet the skills challenges of the future, it needs to act urgently on the UK's current 33 million workforce.

It is with this perspective, with a focus on the construction industry, that this report is centred. Though concentrated on the skills challenges of one sector, which permitted us to hone in on key issues such a skills drain from Brexit, it provides valuable insights for other industries.

The report highlights the importance of the construction industry to the UK as the fourth largest sector by turnover and the fifth largest by employment. The UK is also expected to overtake Germany and become Europe's largest construction market and the sixth biggest in the world. Clearly there are huge opportunities to be grasped. But the report also indicates that with a current estimated workforce of 1,892,427 and one in twenty construction companies reporting their trades people did not have the range and level of skills needed now, there is much to be done to realise that opportunity.

So, the skills sector must respond to this challenge and opportunity. We are accustomed to change, especially in the area of technical skills and apprenticeships, but the change we really need to see is sustainable reform which facilitates progression, embeds lifelong learning and equips people with important transferable, future proof skills and also the technical skills that are needed now. We need to ensure that initiatives launched with the intention of supporting upskilling and reskilling, such as the Government's National Retraining Scheme, actually realise their intended benefits by ensuring all businesses in the sector are on-board and understanding of the ambition and the opportunity.

Finally, we provide a number of recommendations at the end of the report, noting what we believe needs to happen from the perspective of the Government, the construction industry and those in the skills sector such as: more collaboration, building leadership and management skills, ensuring new initiatives support all areas of the industry and developing the existing workforce. They are deliberately high level. We want this report to spark debate and formulate action and the City & Guilds Group in partnership with employers and other stakeholders will continue to facilitate debate and action from hereon

We look forward to working with you on realising that ambition.

Chris Jones,
Chief Executive Officer,
City & Guilds Group

1 in 20
construction companies report their trades people do not have the range and level of skills needed now

The current estimated construction workforce is
1,892,427

About The Work Foundation

The Work Foundation is a leading provider of analysis, evaluation, policy advice and know-how around developments in work, targeting organisations, cities, regions and economies, now and for the future. Our mission is to improve working practices to make the best of people and create more Good Work.

As a charity owned by Lancaster University we advance Good Work in all its forms from a truly objective position, getting under the skin of problems, developing actionable solutions and practical tools, and networking, to share ideas and learning with leading thinkers and practitioners who have first-hand experience of what works. Good Work for all by necessity encapsulates the importance of productivity and skills needs, the consequences of technological innovation, tackling inequality and creating a work environment to support a healthy, happy and productive workforce.

For further details, please visit **www.theworkfoundation.com**.

About the City & Guilds Group

The City & Guilds Group is a leader in global skills development. We work with education providers, employers and governments in over 100 countries across the world to help people, businesses and economies grow by shaping skills systems and supporting skills development.

The Group is made up of City & Guilds, ILM, Kineo, The Oxford Group, Digitalme and Gen2. Together, we set the standard for professional and technical education and corporate learning and development around the world.

Each of our businesses has its own distinct focus. As a Group, its combined products and services provide a comprehensive range of work-relevant qualifications, assessment, training, and learning support services.

The products and services we offer across the Group are globally recognised and respected.

Acknowledgements

The research was conducted by a team at the Work Foundation including: Nigel Hudson and Lesley Giles. It was overseen by Clare Fraser and Caroline Roberts at the City & Guilds Group.

The authors would like to thank the City & Guilds Group for funding and supporting the research presented in this report.

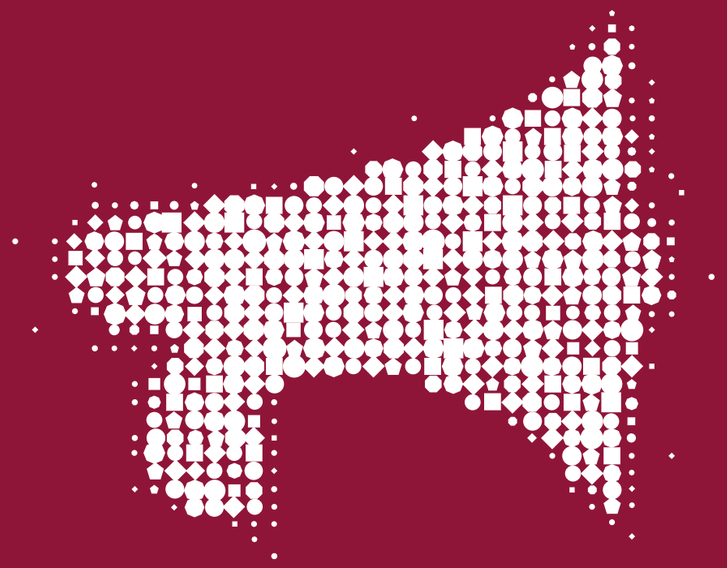
This paper represents a distillation of findings from a rapid review of the relevant literature. A copy of this paper is available on request. The findings from this were summarised and discussed at a workshop of industry experts held in London in March 2018. The workshop discussions were particularly important in framing the recommendations made in the concluding chapter.

We would also like to thank all the workshop participants for their invaluable insights.

We are grateful to Construction Robotics for permission to use their image of the SAM 100 bricklaying robot.

Summary

The Work Foundation and the City & Guilds Group share a common interest in understanding the evolution of the workforce and how the skills needed for effective performance in the workplace are changing. Ongoing developments in the world of work put an onus on lifelong learning but are businesses doing enough to upskill their workers and to ensure their effective development and skills utilisation? This paper looks to address these issues through the lens of a particular industry: construction.



Many commentators have spoken of a new industrial revolution. It is easy to see early shoots of this emerging in construction, particularly in relation to digital technologies.

Building Information Modelling has the potential to act as the cornerstone for digital information to facilitate optimal performance over the life-cycle of a building. Equipment such as drones, autonomous vehicles, 3D printers and robotic bricklaying machines, a similarly wide range of new materials, more extensive use of off-site construction and technology such as embedded sensors are already available but their more extensive and integrated use has the potential to transform the industry.

Such a transformation offers the opportunity for a radical improvement in levels of productivity and profitability within the UK industry and for it to acquire global leadership in a market that is expected to triple in the years to 2030.

At the same time the current performance, organisation and practices of the industry are likely to inhibit change. It is highly cyclical and profit margins and levels of investment, both in equipment and people, are comparatively low. The industry is highly fragmented, with a very large proportion of the workforce accounted for by micro businesses, sole traders and the self-employed. Relationships with clients and along the extended supply chains are typically adversarial.

The industry struggles to recruit and train sufficient young people, experiences difficulties filling the vacancies already available and skill gaps amongst the existing workforce are a further problem. The workforce is ageing and this is likely to be exacerbated by Brexit, particularly in London. Working practices associated with high performance are relatively rare, as is engagement with lean approaches to maximising efficiency.

At the same time, there are questions about the quality of management and leadership within the sector and how sufficiently it invests in and makes full use of its workers' talents. Surveys have repeatedly found that little more than half of construction employers provided training to their workforce, which is below national levels. Further, most of this training seeks to cover statutory minimum requirements for health and safety and/or induction. Furthermore, only 4% of construction businesses adopt the full blend of high performance management practices known to be associated with creating a competent and motivated workforce to deliver high levels of personal and business performance.

Realising the better prospects for the industry will require strategic leadership that engages the whole of the industry and similarly coherent support from Government.

Major workforce and skills challenges will include:

- developing leadership and management skills and behaviours appropriate for a high performing, collaborative and digitally-enabled industry
- attracting more, and a wider range of, young people into the industry and ensuring they develop the skills required
- continually developing the skills of the existing workforce, having appropriate incentives and provision to engage the smallest businesses and self-employed and creating industry-wide arrangements for recognising bite-size learning achievement.

We hope this report contributes to helping the industry and stakeholders tackle these challenges and more generally achieve positive transformational change.

1

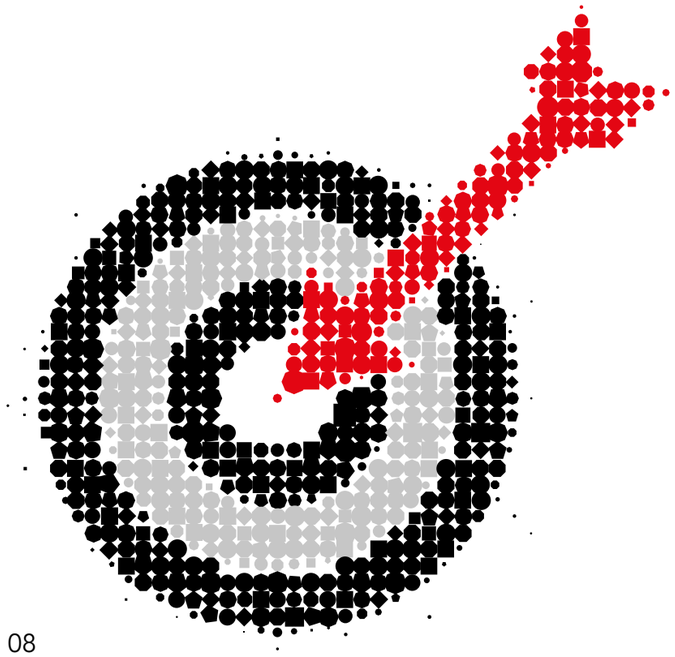
The scope and aim of this paper

The Work Foundation and the City & Guilds Group have a common interest in understanding the evolution of the workforce and how the skills needed for effective performance in the workplace are changing alongside ongoing innovation and technological advances. The UK is experiencing economic challenges as evidenced by the long running productivity problem. Whilst there is no consensus over the cause of the problem, the skills of managers, and the workforce as a whole, have a vital role to play. Too few businesses across the economy are adopting high performance working practices, which support the conditions for continuous improvement at work, especially through people, and their effective skills development and use. This places an increasing importance on lifelong learning that is both responsive to, and enhances, changing working practices. Lifelong learning can therefore help to unlock the productivity problem.

This paper seeks to consider how these issues might be addressed through the lens of a particular industry: construction.

Many commentators have spoken of a new industrial revolution. It is easy to see early shoots of this emerging in construction, particularly in relation to digital technologies. At the same time there are strong arguments for seeing the current performance, organisation and practices of the industry as likely to inhibit transformational change. The Government is pushing forward an ambitious programme of reforms in the Industrial Strategy to support change and modernisation. In particular this offers much potential to strengthen investments in areas such as skills. But there are questions as to whether the scale of ambition and investment lives up to the challenge. The paper briefly reviews aspects of the motors for, and inhibitors of, change and the potential for the industry and Government to make positive choices to enhance its future trajectory.

Subject to those choices, we make recommendations related to the workforce, skills and training.[1]



2

The importance of the industry today

Construction is a crucial industry.

Globally it accounts for 6% of total gross domestic product (GDP), with annual revenues of almost $10 trillion. The market is predicted to grow to $30 trillion by 2030 and constitute 14.7% of global GDP. China, United States of America and India will account for more than half (57%) of that growth.[2]

Growing share of the market by 2030

57%
China, United States of America and India

43%
Rest of the world

In the United Kingdom (UK), construction accounts for about 8% of the economy, whether judged by turnover or employment.[3] This makes it the fourth largest sector by turnover and the fifth largest by employment. The UK is expected to overtake Germany and become Europe's largest construction market and the sixth biggest in the world. The growth will be driven in no small part by investment in major infrastructure projects (such as HS2, a second Crossrail project, expansion of Heathrow and power plant construction), with the Industrial Strategy valuing the National Infrastructure and Construction Pipeline at £600bn.[4]

The sector plays a crucial role strengthening and maintaining our infrastructure and built environment and is critical to aspirations for sustainability and supporting greener, "cleaner" practices and in turn growth. The industry is the largest consumer of raw materials and other resources, including about half of global steel production. Buildings are responsible for about a third of all energy consumption and the industry is a major producer of waste. For example, in the United States about 40% of all solid waste comes from demolition and construction.

[2] World Economic Forum (2016) Shaping the Future of Construction: A Breakthrough in Mindset and Technology, World Economic Forum, Geneva. Available at http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Construction_full_report__.pdf (Accessed 5 December 2017).

[3] Analysis of Business Population Estimates for the UK and Regions 2017. Data available from https://www.gov.uk/government/statistics/business-population-estimates-2017, downloaded 15 December 2017. Note figures are not available for turnover in the Financial and Insurance Activities sector.

[4] BEIS (2017) Industrial Strategy. https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

Given the importance of the industry it is not surprising that it has been prominent in Government policy. Most recently the industry has featured strongly in the Industrial Strategy as a key contributor to driving productivity growth in future, and earning power through the UK economy.

In particular, the Government aims to work strategically with the industry through a Sector Deal to increase productivity in construction and achieve efficiency savings of £1.7 billion. A core aim is to build on previous Government targets which included:

- a reduction of a third in initial and whole life costs of building
- halving delivery time for new builds and refurbishment
- halving greenhouse gas emissions from the built environment
- halving the trade gap in construction products and materials.

Working to achieve efficiency savings of

£1.7bn

The Sector Deal aims to meet these goals, by encouraging a more long term, partnership between Government and the industry. This seeks to support a more collaborative approach to procurement and investment. In turn, it has also been important to recognise and exploit the opportunities offered by the modern economy, and advances in technology and innovation associated with the so called Fourth Industrial Revolution.

As such, there is also an increasing emphasis on incentivising greater innovation in construction methods, and focussing on a "whole-life assessment" of construction methods to reduce costs and enhance operational efficiency and environmental impact, as well as supporting greater productivity. Relatedly, the intention is that this will enable greater investment in skills and ways of working, supporting the take up and use of new technologies (e.g. using Building Information Modelling, digital, automated and off-site technologies).

Specific commitments in the Industrial Strategy include:

- allocating £170m to reduce costs, make buildings more energy efficient and increase exports as part of the Clean Growth element of the Industrial Strategy Challenge Fund
- making construction skills one of two initial targets in the £30m National Retraining Scheme to develop and test innovative educational technology
- providing £34m to expand innovative construction training programmes
- a presumption in favour of offsite construction on suitable programmes by 2019

3

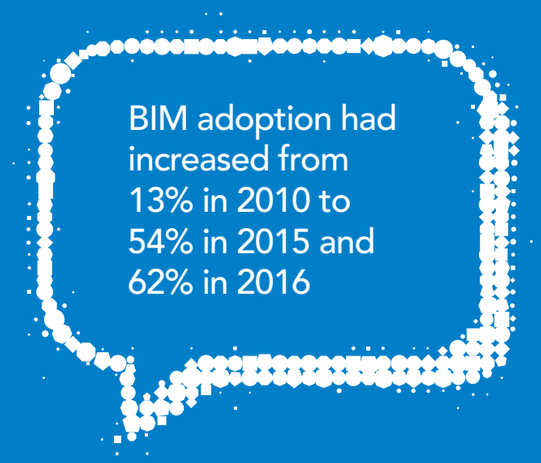
Prospects for change – the opportunity

As the UK economy witnesses substantial ongoing changes in technology and ways of working, this offers significant opportunities too for Construction. With advances in technologies, new materials and modern construction methods, this creates the potential for quite a transformational change. So what is this opportunity?

3.1 Digital optimisation and wider technology

One of the key technologies that offers significant improvements in operating efficiencies and productivity is Building Information Modelling (BIM). This is why it is so central to the Industrial Strategy proposals. BIM provides three-dimensional (3D) models of buildings and information for the management of their construction over time and with regard to cost.

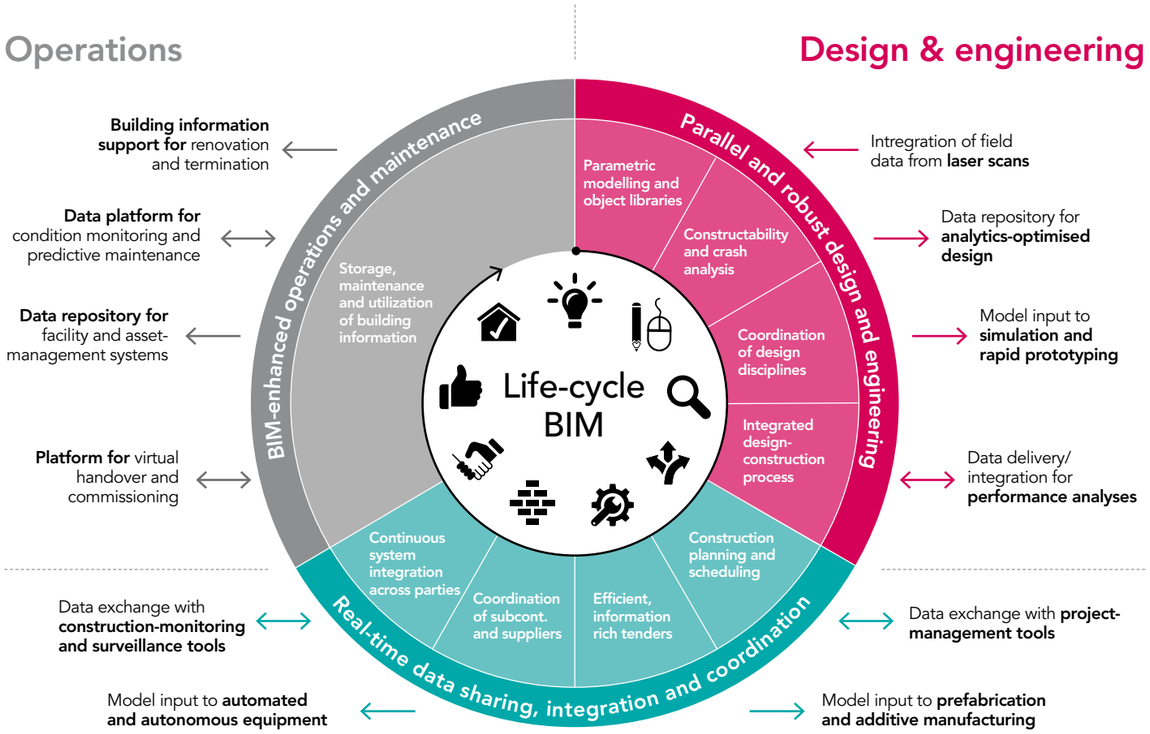
The UK government has required the use of this technology on all its projects since 2016. According to a Royal Institute of British Architects (RIBA) survey BIM adoption had increased from 13% in 2010 to 54% in 2015 and 62% in 2016.



BIM can underpin virtual testing of designs and iron out practical problems before the build begins. Its full potential can be realised by linking to other technologies. Even more powerfully, it creates the opportunity for life cycle optimisation by, for example, utilising feedback from sensors and the Internet of Things, enabling real-time management and monitoring of progress, and extending to end of life decommissioning. This could improve environmental sustainability by reducing waste, increasing re-use and recycling and shifting the focus from initial build cost to life-time value. The World Economic Forum (WEF) provide a visual representation for this life-cycle.

But, the power of digital can extend even further, from marketing and procurement through to after sales service and support. Digital technologies have the potential to transform every aspect of a construction business.

Application of BIM along the E&C Value Chain[50]



Construction

Life-cycle BIM

Concept → Design → Analysis → Scheduling → Fabrication → Construction → Handover → O&M → Renovation

Source: World Economic Forum (2016) Shaping the Future of Construction: A Breakthrough in Mindset and Technology, World Economic Forum, Geneva.

More generally, there are wider radical breakthroughs in technology and productive equipment. These present further opportunities for improvements within construction processes as in the construction of Google's new corporate headquarters. This involved the use of new robotic cranes and machines to tie together steel reinforcement bars in concrete structures, potentially saving huge amounts of time and requiring far fewer workers. These wider technological developments include:

- **3D printing**. The printer repeatedly lays down material, such as steel or concrete, in thin layers to build up the three-dimensional product. It allows the construction of objects that simply cannot be produced by traditional methods. Other potential benefits include substantial weight reductions and use of far less material. The technology has already created a bridge in Madrid, a house in Russia and an office in Dubai. The Emirate now expects to build the world's first skyscraper and have a quarter of its buildings constructed using this technology by 2030.
- **Drones**. They are increasingly used to survey sites and inspect existing structures in ways that are quicker, cheaper and reduce the risk to workers when compared to traditional methods. For example, a new system for surveying rail infrastructure uses high resolution cameras on drones to produce overlapping images that are combined to create a range of plans and visuals to an accuracy of less that 5mm, better than current laser scanning systems. Innovate UK are supporting a project with architectural practice Foster + Partners and software developer Be Tomorrow UK to use drones to detect real-time errors on major construction projects.
- **Robots and automated vehicles**. Construction Robotics in the USA have developed SAM 100, a brick laying machine. Users suggest it can lay bricks five-times faster than a bricklayer and without the risk of strains and other injuries. Komatsu's new Smart Construction service combines its autonomous dump trucks, bulldozers, and excavators with drones to provide three-dimensional mapping of the work area and updates the data in real time.

3.2 New materials

A wide range of advanced materials are becoming available for the industry. They offer the prospect of longer life, improved energy efficiency, full recyclability and other forms of improved performance. Examples include:

- ***different concretes***
  - self-healing
  - fast-setting
  - made with sulphur in place of water
  - absorb and emit light
- ***bricks***
  - made partly from cigarette butts to make them lighter and more efficient
  - filter out pollution
- completely ***recyclable flooring and latent-heat storage material***
- ***hydroceramics*** containing bubbles that retain four hundred times their volume of water and release it for cooling on hot days
- ***translucent wood***
- ***new reinforcements*** to make buildings more resistant to earthquakes

3.3 Off-site construction

A major potential source of productivity improvements in construction could come from different forms of pre-fabrication. This can range from component systems, such as pre-cast beams, floor cassettes and kitchen pods, through to modules and complete buildings. The place of production may vary from the site, to temporary and local 'flying factories', through to permanent factories.

Moves toward a manufacturing approach offer benefits such as work unaffected by weather conditions. They also offer opportunities to implement lean approaches and aid on-time delivery. Off-site construction in the UK is estimated to be worth £1.5bn, with the potential for this to rise to £6bn and form 7% of total sector output.

The Farmer Review cites several case studies of standardisation, factory-based pre-fabrication and modular construction with the GSK 'Factory in a Box', Laing O'Rouke's Volumetric Factory and 'hoUSe' by Urban Splash. The property developer Pocket Living is using standardised designs, factory production and modular build to offer one-bedroom apartments at 20% below market rates.

Laing O'Rouke Design for Manufacture and Assembly (DfMA)

Laing O'Rourke have invested in digital engineering and manufacturing facilities to support DfMA. The aim is to produce complex sets of building system components in a controlled factory environment in Explore Industrial Park (EIP), Nottinghamshire. DfMA is a component of Lean Manufacturing.

DfMA redefines the traditional phases of project delivery to identify, quantify and eliminate waste or inefficiency in a product design. Substantial efficiencies are achieved by agreeing and locking down the design much earlier to allow the manufacturing, assembly, testing and commissioning to be run in parallel, rather than in one long linear sequence.

DfMA has been used on projects including Elephant Road, London and Two Fifty One, Southwark. A further new Advanced Manufacturing Facility is planned to deliver a new range of automated residential solutions that could revolutionise house-building in the UK.

Off-site construction in the UK is estimated to be worth

£1.5bn

Other examples include:

- The China National Building Material Company (CNBM) has formed a joint venture with Your Housing Group and renewable energy specialist WElink, and is developing six offsite factories around the UK, with a target of 25,000 homes per year by 2022.
- Legal & General's modular housing factory near Leeds is to roll out its first units next summer, and will be capable of supplying 3,000 homes a year.
- Mace is building two residential towers 30 and 26 storeys tall in Stratford, east London, using a "jump" factory, where offsite-manufactured components are assembled on site under a giant "marquee".
- Vision Modular and its partner Tide Construction have submitted plans for the world's tallest volumetric building, a 42-storey scheme in Croydon.
- Aecom is working with The Silvertown Partnership to deliver up to 3,000 homes at the Royal Docks in east London using a modular factory.
- Ilke Homes is a new modular housing business, formed by housing contractor Keepmoat and modular specialist Elliott Group, which aims to deliver 750 homes a year.
- Essential Living has appointed modular specialist Elements Europe to deliver a 23-storey residential block in Greenwich.

Source: Mann (2017) Has offsite's time finally arrived?

3.4 Organisation

These radical technological changes could form the basis in construction of the Fourth Industrial Revolution that has been "*characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres*".[5] It is associated with fully integrated physical and digital elements that are largely self-managed thanks to real-time data monitoring, analysis and machine learning.

This has huge implications for work organisation and workforce skills. One example is the adoption of 'lean' approaches that systematically identify and eliminate waste, including activities that do not add value for the customer. The WEF[6] foresees

- reductions in time of up to 30%
- reductions in costs of up to 15%
- reductions in waste
- improved safety.

The ***Implementing Lean in Construction project*** from the Construction Industry Research and Information Association produced a set of six guides for the industry. However Farmer judged that to date ***"there is a peripheral awareness of 'Lean' and … there is no mainstream shift towards embracing such thinking..".***

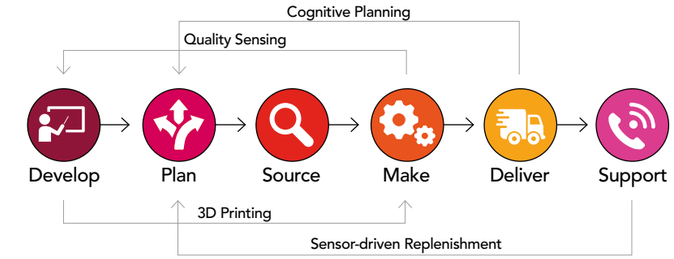
Digital technologies have the potential to provide radical improvements in efficiency through the reconfiguration of the extended supply chains that are such a feature of the industry. Supply chains no longer need to be based on a linear sequence of activities but can be now configured as a flexible network.

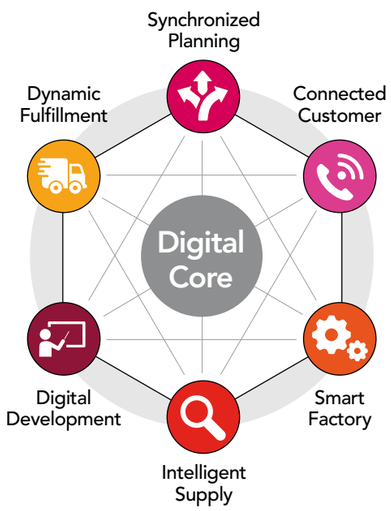
Digital supply chain networks

This creates conditions for a more collaborative approach. The WEF[7] called on the industry to:

- involve all stakeholders in developing global standards for key areas of work
- share data, benchmarking and best practice and set common targets for the implementation of technological advances
- work with other businesses along the value chain.

The launch of the Infrastructure Industry Innovation Platform (i3P) in October 2016 can be seen as a practical example of this. I3P is an independent innovation community created from and for clients (currently major infrastructure projects and construction programmes) and their supply chains (Tier 1 contractors and consultants) across the infrastructure industry. The Platform therefore immediately tackles the critical divide between client and contractor identified by the Farmer Review. The aim is to foster a collaborative culture by providing a space where members can safely share ideas and resources and make contact with one another. To this can be added the work that the Construction Leadership Council has already started through its Business Models work stream.





Digital supply chain networks

Source: Deloitte, https://www2.deloitte.com/us/en/pages/operations/solutions/digital-supply-networks.html

According to the Organisation for Economic Co-operation and Development (OECD)[8], trade and international investment can improve productivity, and hence business performance, through:

- tougher product market competition
- enhanced knowledge flows
- increasing the effective market size

The WEF identifies internationalisation as a key component in transforming the construction industry.

3.5 Contested change

These radical technological changes could form the basis in construction of the Fourth Industrial Revolution that has been "characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres". It is associated with fully integrated physical and digital elements that are largely self-managed thanks to real-time data monitoring, analysis and machine learning.

[5] Made Smarter Review (2017).

[6] World Economic Forum (2016) Shaping the Future of Construction: A Breakthrough in Mindset and Technology, World Economic Forum, Geneva.

[7] World Economic Forum (2016) Shaping the Future of Construction: A Breakthrough in Mindset and Technology, World Economic Forum, Geneva. Available at http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Construction_full_report__.pdf (Accessed 5 December 2017)

[8] McGowan,M.A., Andrews,D., Criscuolo,C. and Nicoletti,G. (2015) The Future of Productivity, OECD, Paris. Available at https://www.oecd.org/eco/OECD-2015-The-future-of-productivity-book.pdf (Accessed 19 December 2017).

4

Current challenges to overcome

4.1 Performance, investment and organisation

Construction is a notoriously cyclical industry. The Farmer Review[9] referred to "a continuing boom and bust cycle of overheating followed by permanently damaging attrition in a downturn." This introduces challenges unlocking the long term investment to support productivity enhancing improvements required.

Profit margins are low. The Construction News survey of the top one hundred construction contractors found margins fell steadily from 2.4% in 2014 to 1.5% in 2017.[10]

Perhaps unsurprisingly given these financial challenges, the levels of research and development (R&D) investment and innovation in construction are comparatively low. In 2015 total R&D spending in construction was £146 million; only agriculture, hunting, forestry and fishing had lower expenditure at £139 million.

Competitive tendering is ubiquitous. It is seen as fostering a focus on cost rather than on quality, with an all-too-common inability to deliver projects on time and on budget. All this encourages adversarial relationships between the parties. Risks are passed down the supply chain and changes to client requirements are used to renegotiate terms to boost profitability.

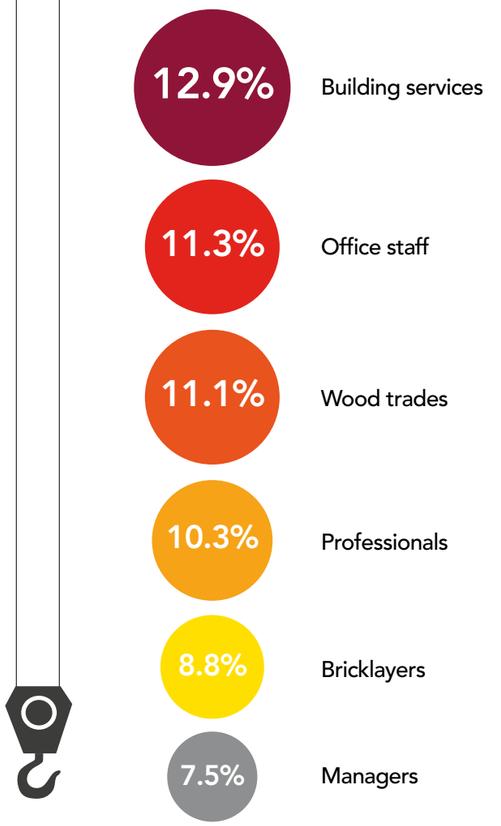
The industry is highly fragmented. High proportions of sole traders and other micro businesses contribute to extended supply chains and reinforce sub-sectoral specialisation. This risks further impeding efforts to steer widespread change.

4.2 Workforce and skills

The construction workforce is substantial, although estimates of its size vary. The latest survey for the Construction Industry Training Board (CITB) put the number at 1,892,427, compared to a Labour Force Survey estimate of 2,386,305 at roughly the same time in 2015.[11] The CITB survey also provided the following breakdown of the workforce by occupation and by gender, showing the construction workforce remains disproportionately male, especially in manual occupations.

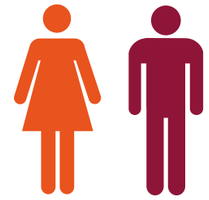
Workforce composition

Occupation / Share of total workforce (%)



Source: CITB 2016

Gender breakdown of the construction workforce



Gender	Manual (%)	Non-manual (%)	Total (%)
Men	99.5	65.5	87.4
Women	0.5	34.5	12.6
Total	100.0	100.0	100.0
Base	**37,548**	**4,558**	**42,007**

Source: CITB 2016

Pressures on skills investment clearly also affect the industry's ability to respond to skills priorities and resolve skills deficiencies. The UK Employer Skills Survey found that current skill shortages were most prevalent in the skilled trades. This affected the majority of employers in construction (54%), even more than in manufacturing (49%) and more than double that for the economy as a whole (25%).

[9] Farmer,M. (2016) The Farmer Review of the UK Construction Labour Model, Construction Leadership Council, London. Available at http://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2016/10/Farmer-Review.pdf (Accessed 5 December 2017).

[10] See http://www.theconstructionindex.co.uk/market-data/top-100-construction-companies/2017

[11] Lepanjuuri,K. and Humphrey,A. (2016) Survey of Employment by Occupation in the Construction Industry, NatCen Social Research, London. Available at https://www.citb.co.uk/documents/research/survey%20of%20employment%20by%20occupation%202011_tcm17-32805.pdf

[12] UKCES (2015) UK Employers Skills Survey.

Proportion of construction employers reporting loss of business due to skills shortages

Size	% of organisations	Base
2-4	61	87
5-24	51	267
25-49	46	52
50-99	59	31
100-249	**	7
250+	**	2

Source: UKCES UK Employers Skills Survey 2015

As a consequence, over half of the affected companies had lost business to competitors. The above table reports the percentage of organisations losing business or orders to competitors as a result of skill shortages and shows how this is something that was affecting businesses of all sizes (for which reliable results were available).

There are also substantial problems, referred to as skill gaps, amongst those already working in the industry. One in twenty construction companies reported their trades people did not have the range and level of skills needed.

The workforce is an ageing one, with about a fifth of current workers expected to retire in the next decade. Brexit could make this even worse as the age profile of the UK-born workforce is significantly older than for those born in the rest of the European Union (EU). The problem will be particularly marked in London because one in three construction workers in the capital were born outside of the UK.

At the same time the industry has concerns about its ability to attract young people. The number of first year construction trainees rose slightly to 15,800 in 2016/17 from 14,900 the previous year.

However, this initial training remains at a very low level and roughly a third of the level reported in 2005. Over three-quarters of the latest trainees are targeting qualifications at levels 1 or 2 and less than two-thirds (61%) of those on the main level 1 qualifications are expected to progress on to a level 2 qualification. In 2016/17 there were only 774 trainees pursing a level 3 apprenticeship and 2,247 following a level 2 apprenticeship.

Over the last decade or so the UK has witnessed an explosion in the number of people working for themselves, accounting for about one in seven of those in work. Construction has the second highest proportion of such businesses (41.1%) and a far higher share than in comparable industries such as manufacturing (7.6%), wholesale & retail (6.8%) and transport & storage (20.9%). Just over one in five of the workforce (20.1%) are self-employed. This also presents difficulties co-ordinating industry-wide responses to skills priorities.

These issues are exacerbated by the extent of training and development activity provided by construction businesses for the existing workforce. Surveys have repeatedly found that little more than half of construction employers provided training to their workforce. Agriculture was the only sector with a lower level of training. The most common type of training was in health & safety (81% of employers providing training) and for over two-thirds (69%) it was basic induction training. This suggests that a substantial proportion of training may have been at a relatively low level or required by regulations.

4.1 Management practices

People are at the heart of every business. Getting the best people and the best out of them is a crucial component of business performance.

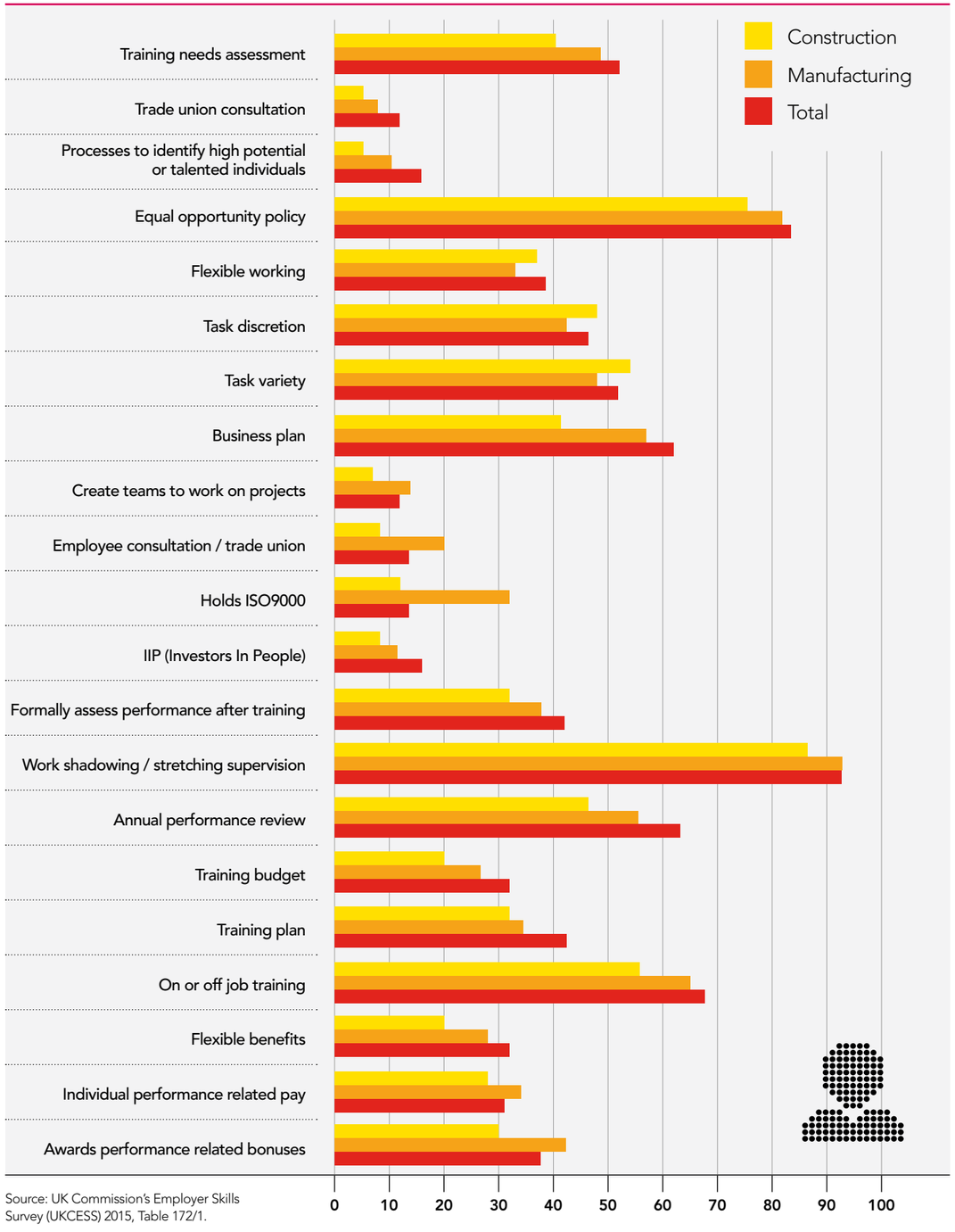
A wide range of management practices are known to be associated with creating a competent and motivated workforce to deliver high levels of personal performance. Collectively these are known as High Performance Working Practices. Whilst the precise practices can vary, the management approach seeks to unlock the discretionary effort of employees, to create a culture for learning, innovation and continuous improvement.

The UK Employer Skills Survey asked whether businesses were adopting twenty-one of these practices. Those adopting at fourteen or more were classified as high performance working. Construction had only 4% of such businesses. Only agriculture (2%) was lower and the results were substantially worse than for transport, storage & communications (8%), manufacturing (10%) and utilities (16%), let alone public administration (40%). The chart on the next page shows the results for the individual practices, comparing construction with manufacturing and the economy as a whole. In eighteen of the twenty-one practices construction had the lowest score. This provides a further indication behind the performance challenges the industry faces.

A key challenge for the industry is to drive up the ambition and quality of management and leadership sector-wide and to create a more strategic vision for the future. To be effective that will need to truly engage with all the sub-sectors and the army of self-employed workers, sole traders and micro businesses within the industry. It will require action to help develop a more collaborative approach: business to business; between business and Government; and with clients. This is essential to shift the focus from short-term cost cutting to longer term investment, and making the necessary changes in technology, ways of working and how people are developed and utilised to ensure quality. Unlocking this potential however relies heavily on understanding future implications for the workforce, its skills and hence acting appropriately to support ongoing learning and development.

In 2015 R&D spending in construction was

£146m



Source: UK Commission's Employer Skills Survey (UKCESS) 2015, Table 172/1.

5

Future workforce, skills and learning

Various studies have sought to investigate the impact of changes in technology and working practices on skills requirements to support future preparations and change

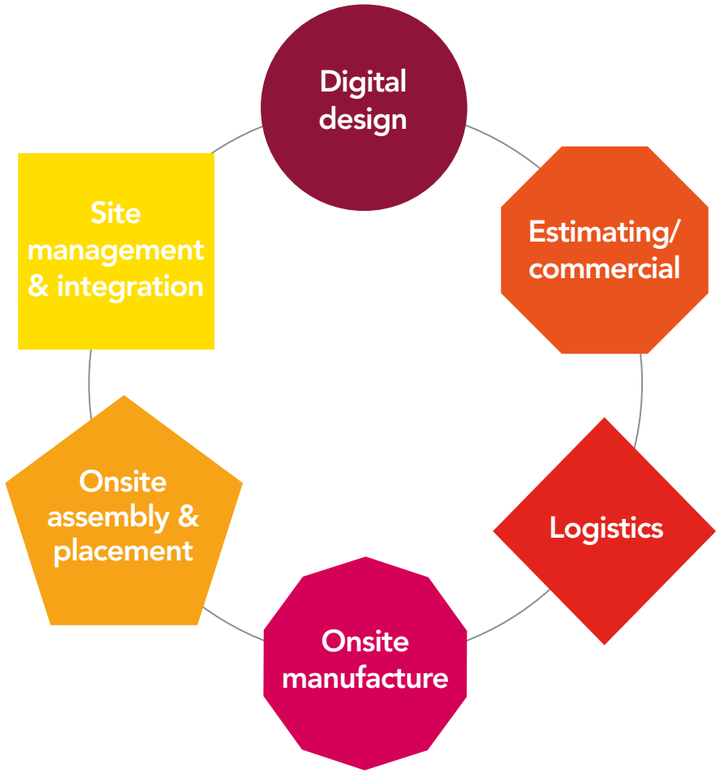
5.1 Changing occupations

Technological and organisational developments in the industry will modify the occupational composition and mix of skills needed in the future. The CITB has researched such developments.

For instance, a study on the skills needed in offsite construction identified six key functions that would affect a wide range of job roles.

Future skills needs required

The skill sets required create a need for new standards, training, trainers and qualifications. The technical education reforms provide the channels to make such changes.



Source: Brennan,J., Vokes,C., Tanner,A. and Lever,B. (2017) Faster, Smarter, More Efficient: Building Skills for Offsite Construction, Construction Industry Training Board, Bircham Newton, Norfolk.

5.2 Changing skills

Alongside a changed occupational mix will be a shift in the skills required within all jobs, including the traditional trades.

Generic digital, analytical, interpersonal, team working and communication skills will be required, alongside those of the technical specialism.

All this will create a substantial need to further improve and update management and leadership skills in the industry. This will not be limited to technical issues associated with off-site construction and digital infrastructure, for example. It will require changes in culture, human resources management, through to the time horizons for investments and financial management.

5.2 Size of workforce, recruitment and organisation

Studies on the longer term impact of new technologies and organisation have estimated a fall of about 50% by 2050 in traditional skilled jobs, although there will be an increase in other, digital roles.

The shift in occupational structure will create the potential to recruit people with the core skills required from other sectors. The challenge then will be to equip them with the knowledge and understanding of construction they need and provide the opportunities to develop fully rounded competence within the industry.

Building becomes less tied to the site, the more physically demanding, routine and risky tasks can be automated, and the opportunities for a more flexible workforce grow. There will be greater potential for more flexible hours, working from home, older workers and workers with physical impairments.

This can support the development of a far more diverse workforce. The increased role of digital technologies also offers the opportunity to enhance the attractiveness of the industry to a broader range of young people.

5.3 Learning and recognition

If digital technology is threatening to revolutionise aspects of the construction industry, it also has the potential to transform vocational learning and recognition of achievement, thus facilitating attempts to support effective upskilling of the workforce in future.

Digital technologies are dramatically changing the way people work, how they use their skills, interact and communicate with each other, express ideas and learn.

Workers continually learn as they are exposed to new technologies or as their work takes a new course and becomes more stretching. Changes in technology and work organisation thus present huge opportunities for productivity gains within the industry but only if they are effectively deployed.

One potentially important element in this is immersive learning, using artificial environments (virtual reality) or real environments with additional sensory information or data (augmented reality).

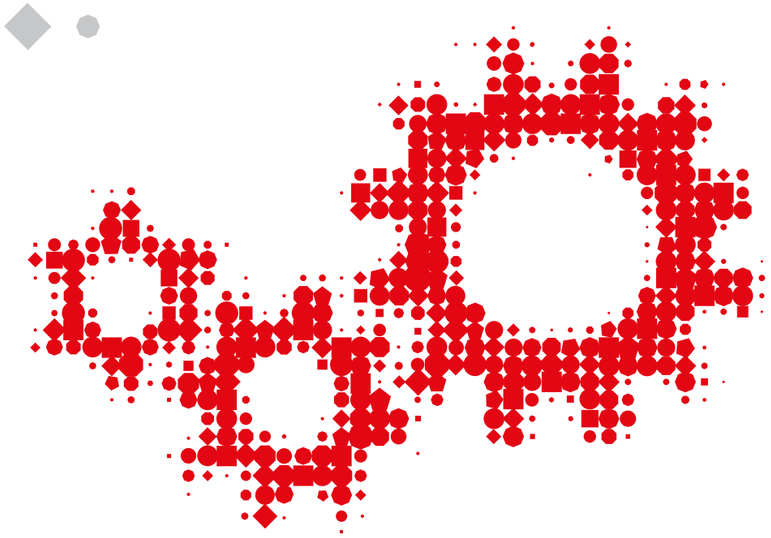
Some of the advantages of immersive learning found in a recent CITB study included:

- simulation to foster problem solving skills and experience a wider range of environments and challenges
- practicing in a safe environment
- potential for use outside the classroom and greater cost effectiveness
- improving the attractiveness of the industry to young people.

Others have predicted an increasing use of Massive Open Online Courses and free educational resources outside of existing, traditional educational institutions and/or places of work. Various sources of online information through "knowledge hubs" provided through open access sources, or for a subscription or membership fee, can support more flexible forms of self-supported learning and upskilling, accessed much more effectively, on demand, as required 24/7. In the medium term as digital tools can also be used to enhance and individualise learning, there is expected to be a greater shift toward more agile and adaptive learning based on smaller, bite-size components.

Utilising digital learning technologies has the potential to generate data that can contribute toward the evidence of learning achievement. If learning does become more personalised and bite-size there is then an issue of how that learning is recognised so that it is transferable and accepted across the industry.

One option is to use digital badges. These were originally developed over a decade ago and have begun to be taken up by education and accreditation organisations. One such example is provided by City & Guilds Group. They have developed their DigitalMe business to support the adoption of digital credentials, including general options for issuing and using digital badges and comprehensive platforms that integrate into numerous applications. Badges could, for example, be held in a personal electronic portfolio, with information accessible to current and potential employers.



Education and training systems, alongside industry, have a huge role to play to develop the right skills mix of the workforce and to help people to respond to the requirements of the ever changing nature of work. But a key future tension is how they can keep up to date with evolving skills requirements and ways of learning. In a dynamic economy lifelong learning is vital to support the right adaptations to digital transformations but in turn digitalisation in itself brings many new opportunities to learn. But the benefits are not inevitable and will only be achieved where industries exploit the opportunities through effective partnership working and co-ordinated action with key skills partners and providers. The current reforms within the education and skills system set out in the Industrial Strategy offer the potential for better partnership working with industries around skills and to strengthen the relevance and quality of training and skills provision, especially in technical areas. But given the scale of the reforms, alongside the pace of in-work change, there is an ongoing question about whether supply can match demand and support effective upskilling and lifelong learning over time. This must remain a fundamental priority and area of review.

6

Conclusions and recommendations

Construction could witness a technological and organisational transformation in the coming years. The extent and nature of that transformation will in part depend upon the ability of the industry to articulate and implement a vision of the future that is shared by every part of the industry and key stakeholders, particularly Government. That transformation has the potential to radically improve the productivity and financial performance of the industry, position it as a global leader and offer attractive career prospects for a wide range of young people in the future. But it requires a collaborative approach that can unite industry sub-sectors and the large number of small and micro businesses within the industry.

Government will also have a crucial role to play not least as:

- the major client and funder of construction
- a significant landowner and influence on planning rules
- the policy maker in relation to employment and taxation regulations
- a substantial funder and policy maker for education and training
- a supporter of innovation and exporting

The Industrial Strategy and Sector Deal commitments provide a basis to begin to support long term change and to encourage stronger partnership working, better co-investment in new technologies and skills and to encourage improvements in ways of working.

It will also necessitate fundamental changes to the workforce and skills and it is in this area that this work leads to the following recommendations.

1. Representatives of the industry, training providers, educational technology experts, equipment providers and awarding organisations need to collaborate to ensure high quality and relevant learning provision:

a. builds leadership and management skills and behaviours appropriate for a more digital, collaborative, high performance and lean industry;

b. develops changing technical, including digital, skills;

c. enhances 'soft' transferable skills and knowledge which have sustainability

d. develops the knowledge and understanding of the industry for those entering from other sectors;

e. fully utilises immersive and other emerging forms of learning;

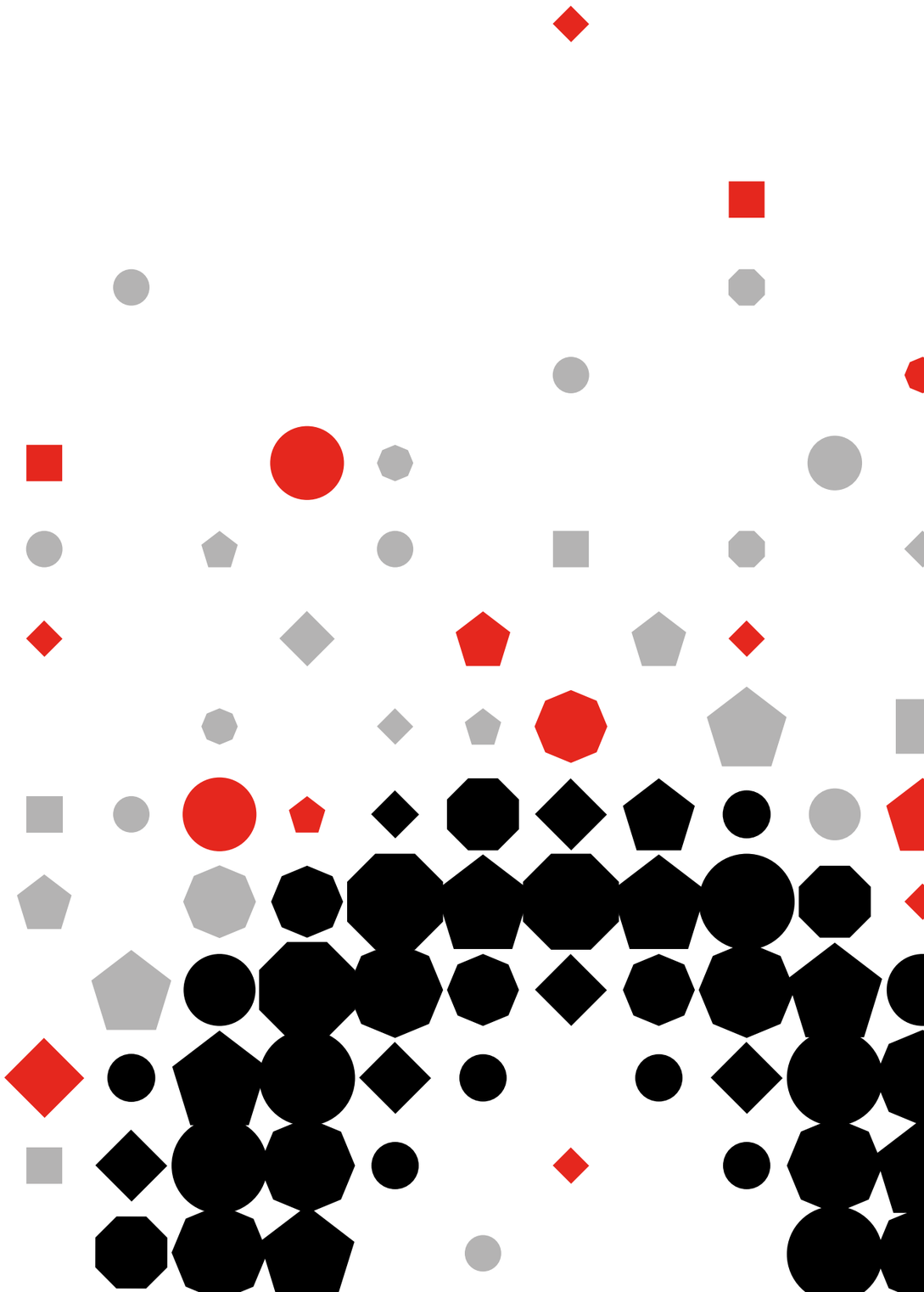
f. can capture innovative skills recognition methods across the industry, including for bite-size learning that does not lead to a qualification.

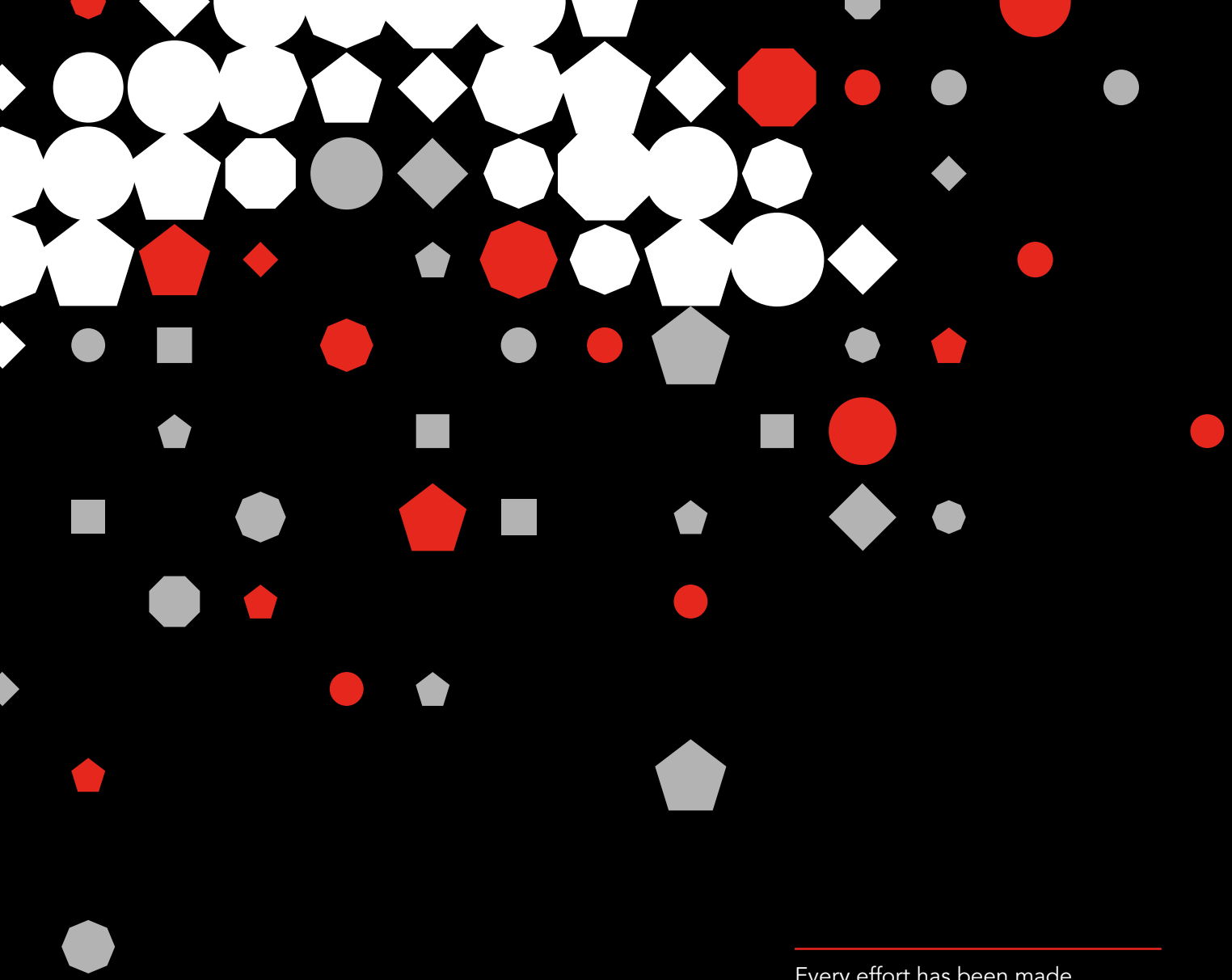
2. The industry and apprenticeship levies need to be aligned and, where necessary, revised to ensure they are complementary and sufficiently flexible to support all the forms of learning and development that will be necessary as the industry experiences technological and organisational change.

3. Initiatives to support learning and development amongst the existing workforce, such as the National Retraining Scheme, and the flexible learning fund, need to ensure they meet the needs of all sub-sectors within the industry and all parts of the workforce, especially the self-employed, sole traders or those within micro-businesses. This includes ensuring all parts of the industry are represented in the design of provision (its content, delivery and assessment) and that the infrastructure is in place to facilitate its take-up.

4. The current HM Treasury/HM Revenue & Customs consultation on the extension of tax relief for training should ensure that the self-employed are incentivised to participate in appropriate learning by recognising the full costs of such activities and offering simple schemes, such as those already in place for costs of travel and working from home, to offset these costs against income.

5. Careers materials and activities need to reflect the diversity of activities within, and changing nature of, the industry and the opportunities this is creating. The industry needs to provide far more opportunities for young people to experience the industry, including via digital platform.





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