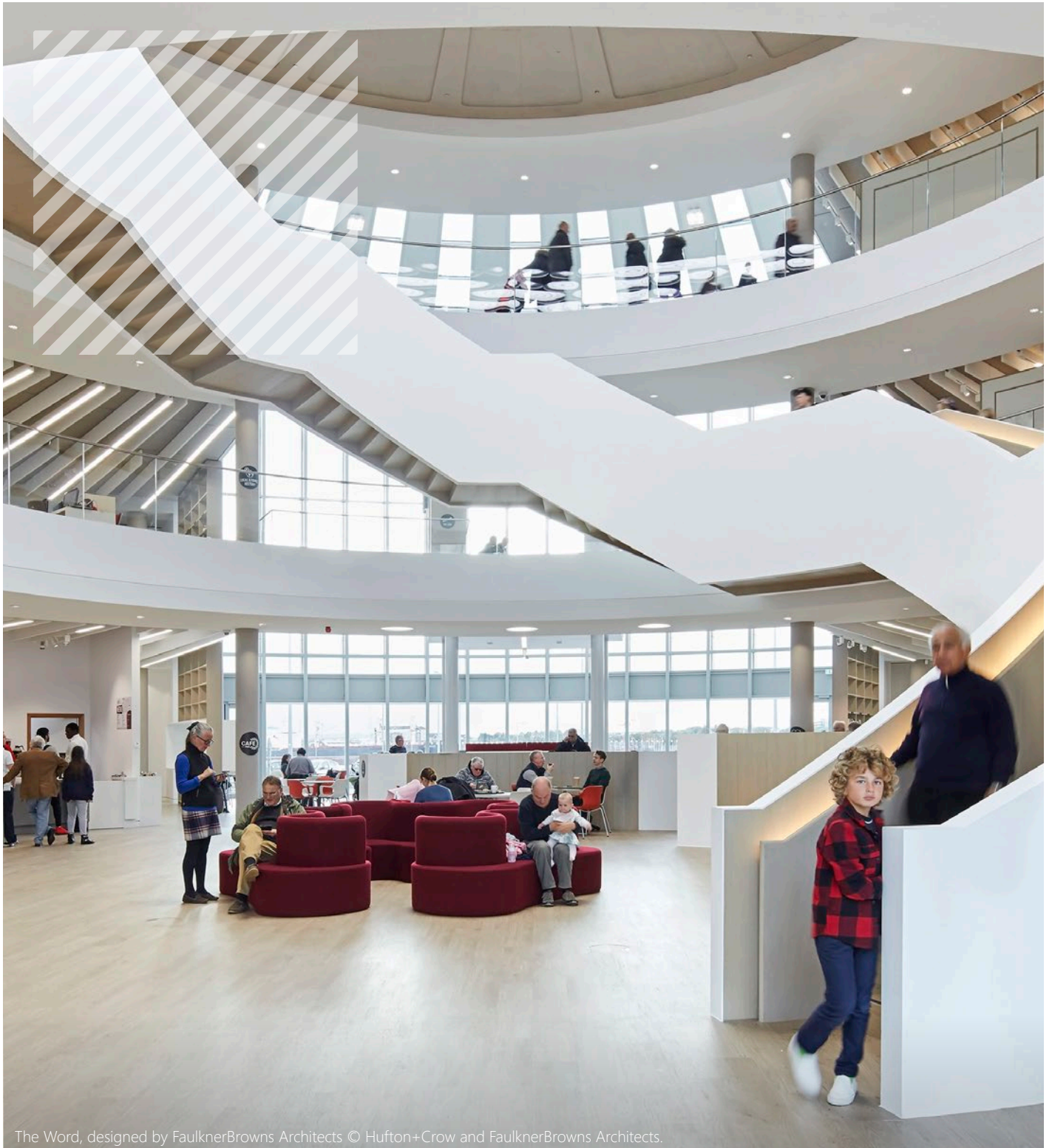# Digital
Transformation
in Architecture

The Word, designed by FaulknerBrowns Architects © Hufton+Crow and FaulknerBrowns Architects.

Cover image
The National Automotive Innovation Centre – architect and
interior design: Cullinan Studio; image © Cullinan Studio.

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01
Foreword

RIBA Royal Gold Medallist (2017) Paulo Mendes da Rocha. © 2018 Microsoft Corporation.

The RIBA, in partnership with Microsoft, is pleased to report these findings from its research into digital transformation in architecture.

The RIBA supports the adoption of transformational technology that enables our members to deliver better buildings and places, stronger communities and a sustainable environment. Helping our members to engage with the challenges of a rapidly changing world, such as greater urbanisation and an ageing population, and to embrace digital opportunities is fundamental to developing and maintaining a strong profession.

Throughout the history of British architecture, technology has repeatedly transformed what architects can create, and how they do so. But since the digital revolution, the profession has experienced a period of rapid change – starting with the adoption of 2D, then 3D computer-aided design, moving to Building Information Modelling (BIM) and, in the near future, the Internet of Things (IoT). As this report shows, there has already been some adoption of IoT, and this will grow. Digital transformation allows us to create what could not be created before, to design new kinds of buildings, to transform towns and cities to meet the challenges of urbanisation and sustainability.

Architects are uniquely placed to meet those challenges. The UK is already a world leader in the digitisation of the design process, and the examples in this report, from UK practices large and small, demonstrate the UK's world-leading techniques and approaches which are bringing real benefits to clients and architects alike.

UK architects, and their innovative design skills, are valued globally. The RIBA is known and respected well beyond these shores. This position of pre-eminence relies on our innovation, the continued transformation of the work we do and how we do it. The results of this survey are encouraging: they show how open UK architects are to continued change, and to leading that change.

In the coming years, we expect to see greater opportunities for digital collaborative design. Part of this drive for change has come from the UK Government's commitment to a 'Digital Built Britain' which will realise reductions in project costs, timescales, whole life costs and carbon emissions. BIM has realised the benefits of digitisation to the design process. Soon those benefits will move beyond the design and construction stages into 'soft landings', and to the whole building life cycle. It will not be long before we can expect digitisation to break the confines of the building envelope, transforming the design and operation of whole towns, cities and even countries through integration with the Internet of Things.

Along this journey, we expect to see increasing demonstrable benefits for clients. The client experience has already improved, with the availability of 3D models at the design stages. Using mixed reality to fully engage with holographic representations of proposed buildings and refine design as if in the completed building is already happening, with over a third of respondents now using some form of immersive technology. And more respondents to our survey expect to adopt these technologies – within five years we anticipate use of them growing to 64%.
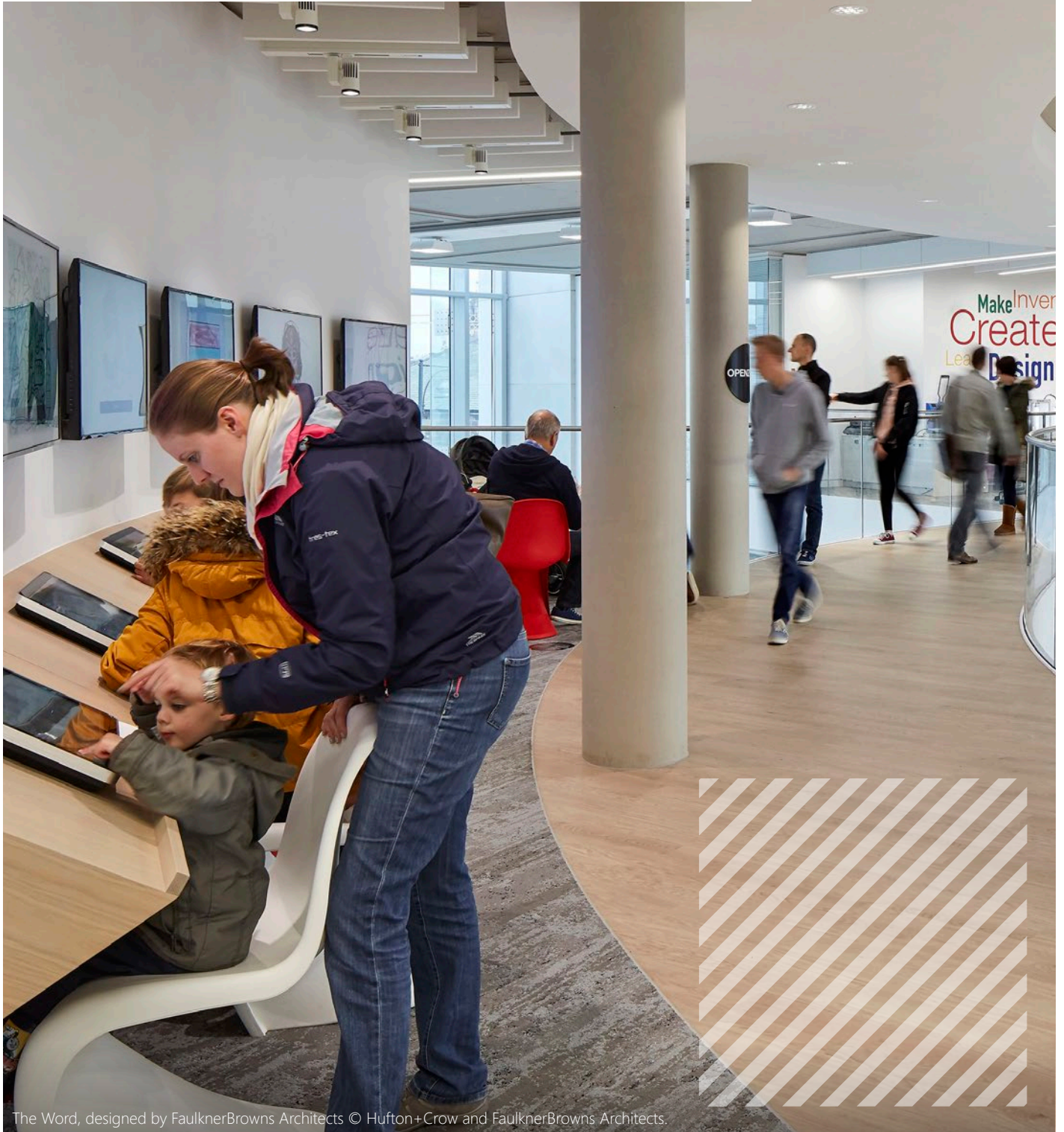
The digital transformation of the architectural profession is not without risks. In the past, we have seen technological innovation come hand in hand with de-skilling, a rise in wealth inequality, degradation of personal privacy and older generations being left behind. The RIBA has an ongoing role to play in shaping and promoting the use of digital technology by the architectural profession in ways that are trusted, responsible and inclusive; our use of digital technology must deliver benefits for the communities that we serve.

The RIBA will continue to support our members through the journey of digital transformation, and we hope that this report forms part of that process.

02
Executive summary

The Word, designed by FaulknerBrowns Architects © Hufton+Crow and FaulknerBrowns Architects.

This report captures a moment in time in the architectural profession's 'digital transformation journey'. It explores what digital transformation looks like in architecture, and what it means for the profession.

We highlight the technologies being adopted – how these are changing the way that projects are run and the internal workings of architectural practices. We look at which technologies are likely to be significant as the industry continues to go through rapid change. We uncover the benefits that this change brings to practices, and also the challenges that need to be overcome. We provide examples of how digital technologies can improve client outcomes and create better buildings, and we try to give a sense of the potential effects of digital transformation on wider society.

The RIBA and Microsoft have worked together to conduct the study that underpins this report. We carried out an online survey, and in-depth interviews of over 300 professionals working in architectural practices and other built environment organisations. Participants were architects, as well as other designers and technology specialists, working at a range of levels in their organisations. Organisations of all sizes, working across all sectors and locations of the UK, were represented. Free text responses made by survey respondents are shown throughout the report, as well as quotes from opinion leaders and influential organisations and documents.

In the report, we also include opinion pieces and case studies from architectural practices, large and small, who have described what they are seeing or doing in terms of digital transformation. Their examples cover new build, refurbishment and conservation projects in a range of

'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'.

The Farmer Review

sectors. These bring to life how adopting new technologies can improve how practices work and what they deliver, as well as highlighting what digital transformation could mean for the industry. We are enormously grateful to these practices for their contributions.

Key findings from this research show that the way organisations operate has changed significantly in the last few years, and 87% agree that digital technologies are transforming the way that they work now. Indeed, most architectural practices have embarked on their digital transformation journey. In particular, the embedding of BIM into the culture and processes of many practices is reducing project costs and improving certainty for clients.

'Every company is a software company. You have to start thinking and operating like a digital company. It's no longer just about procuring one solution and deploying one. It's not about one simple software solution. It's really you yourself thinking of your own future as a digital company'.

Satya Nadella, CEO, Microsoft

The way that architects present designs to clients is changing, and this will continue as mixed, augmented and virtual reality bring buildings to life before they have been built. We see in this research that many practices are using digital technologies to create a **better experience for clients** – putting them at the heart of the design process. And, as well as using BIM and visualisation tools to improve collaboration externally with clients, contractors and other consultants, architects are also using technology to work more effectively *within* their organisations. Clearly, the way that projects are delivered is changing, but so are the ways that architectural practices are run.

In addition to improved collaboration and a better client experience, the participants in this research recognise many benefits of digital transformation: in particular, productivity and efficiency gains, with 79% of survey respondents saying that adopting digital technologies leads to improved project efficiencies.

With any new opportunity, there come challenges. For architectural practices, cost stands out as the most significant barrier to achieving the potential that digital transformation can bring; in particular, finding the funds to invest in new technology and to up-skill staff. This and some of the other challenges cited in the research relate to culture. We have already seen a positive culture change that has developed alongside digital transformation. However, some aspects of organisational culture, such as **weak leadership, a lack of willingness to change and slow decision-making, are impeding progress.**

Despite the challenges that do exist, the findings of this research are extremely positive for UK architecture and construction. For the RIBA, the adoption of transformative technology goes beyond bringing efficiency to architectural services. It is also about continuous improvement in project outcomes – **creating buildings fit for the challenges that we face now and in future,** and which have a positive impact on users, communities and the environment. On this point, the findings are tentatively positive, with just over half (56%) of practices telling us that digital technologies help to design better buildings and places, and improve client outcomes. It's early days, but digital transformation will touch all areas of professional practice.

Many architectural practices see themselves as being ahead of others in construction, although they also believe that digital technologies are transforming the whole industry. For most, **there is no going back**: 83% expect the way that architects operate to be different in 2030 compared to now. However, there are those who don't see the adoption of digital technologies as critical to staying in business. For them, the benefits of digital transformation are not clear and/or the challenges appear to be too great. Furthermore, at least half of practices don't believe that the construction industry will be significantly disrupted by new business models in the next two years.

Thinking beyond architecture, many of those taking part in this study do strike a note of caution about the wider, societal effects of digital transformation. There are likely to be concerns about privacy and security, and also that some parts of society may get left behind.

The report is structured around a series of themes that emerged from the research, and that also reflect construction industry and societal opportunities and challenges. They are integral to ongoing digital transformation and are interrelated:

Digital transformation

We look at what this means in architecture and where practices are on their 'journey', including the key benefits and challenges of digital transformation.

Innovation

The technologies that are transforming architecture now and those that are likely to continue the evolution in the next few years.

Productivity

How the adoption of digital ways of working, like BIM, is improving the productivity and efficiency of projects and architectural practices.

Collaboration

As well as BIM, how mixed, augmented and virtual reality technologies are improving the client experience, and aiding collaboration across projects and within organisations.

Culture

The importance of having the right culture to enable digital transformation and some of those characteristics.

Looking ahead

Implications for the next wave of digital transformation, the technologies that will be important, the opportunities for architectural practices and the challenges to overcome.
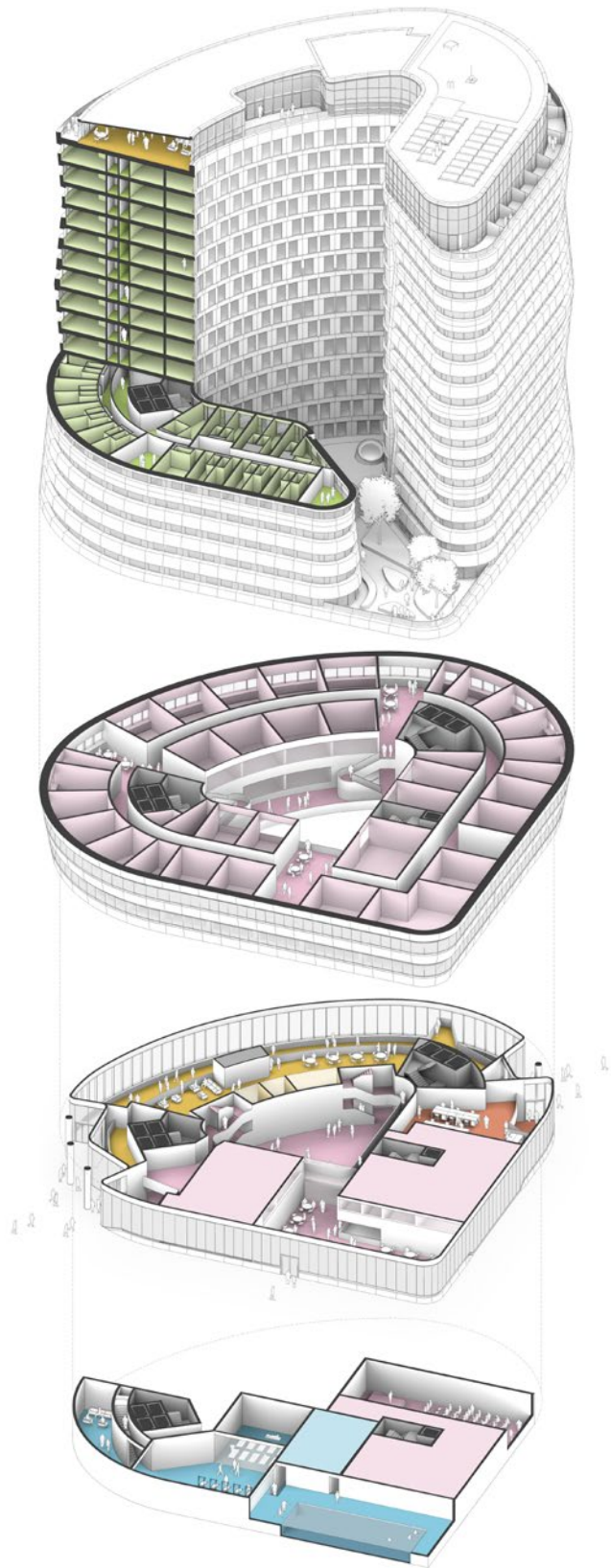
Westminster Bridge Road.
© Allford Hall Monaghan Morris Ltd
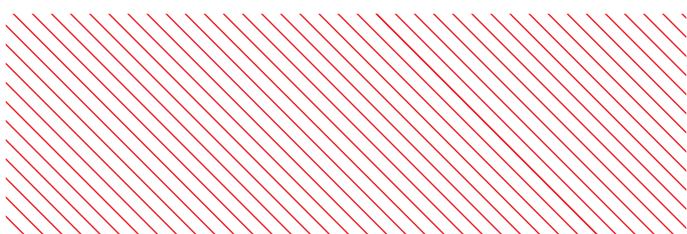
03
Digital Transformation in Architecture

What is digital transformation?

Digital transformation is global. It is changing how we work, how we communicate and how we create and form relationships. It is transforming every aspect of our lives.

A digitally transformative culture enables collaboration and innovation. These, in turn, have the potential to radically improve productivity and efficiency.

We found that 'digital transformation' isn't a familiar term to architects and built environment professionals. However, whether they recognise the terminology or not, we see below that the architectural and design community is, by and large, embracing digital transformation and the opportunities that it brings.

Digital transformation is about reimagining how you bring together people, data and processes to create value for your customers and maintain a competitive advantage in a digital-first world.

> 'It's a different way of working, a new process model and more agile, where data is produced once, and is used many times for more tasks'.
>
> **Survey respondent**

Digital transformation and Architecture

British architecture is at the forefront of digital transformation. **Digital transformation is not just the adoption of a set of technologies. Rather, it is a fundamental shift in culture, supported and facilitated by technology.** The ultimate goal is for digital transformation to help create better buildings and places, and improve client outcomes; 56% of our survey respondents recognise this as a benefit of adopting digital technologies.

Our research shows that many architects see the great potential of digital transformation, and how it can bring great improvements in efficiency in particular.

UK architects and designers are already digitally transforming both their profession and the wider construction industry. We see this in new ways of designing, in new forms of buildings, the use of new materials and new collaborative working practices; all supported by digital working.

Digital technology adoption is not optional: 55% link it to business survival, but as we see on page 13, the majority have only just started their digital transformation journeys, have not started at all, or aren't sure.

Nevertheless, the way that practices operate has changed in the last five years – almost half of survey respondents say this has changed a lot, or completely. In particular, the way that projects are delivered is being transformed, with 56% telling us that digital ways of working have changed this a lot, or completely. Fewer, 41%, said they have changed the way that their organisation is run a lot, or completely. Almost 90% say that digital technologies are transforming the way that they work now.

Most people who took part in our research believe that their organisation has embarked on some kind of digital transformation journey. Thirty-nine percent told us that they were near the beginning of the journey, and 37% have been on the journey for some time (Figure 1).

Ten percent told us that they have not begun the journey. They may need to get on board soon: the digital revolution is happening, and those not part of it risk being left behind.

Few think that they have almost completed the journey, and no one believes that they have reached their destination. This makes sense: digital transformation is an ongoing process of change and renewal, rather than a road to a set destination.

Ten percent are not sure where they are on their journey. This isn't ignorance: with the pace of societal, organisational and technological change, direction is not always clear.

These findings align with the 'S-curve model' of continual, iterative improvement that can be applied to digital transformation (Figure 2). This model describes how old ways of doing things mature, but are then superseded by new ways. Those leading transformation are already looking to the next iteration, to the next way of doing things, *before* making the transition to new ways of working. So, many architects have made the transition from CAD to BIM. Rather than waiting to complete this transition, leading innovators are already experimenting with immersive visualisation technologies that build on the foundation BIM has created. This creates a culture of continuous innovation, rather than a one-off project to find time for in addition to 'normal' work. Innovation becomes part of the everyday operation of the organisation, with time, budget and resources allocated to it.

What is mixed reality?

Sometimes referred to as 'hybrid reality', mixed reality merges real and virtual worlds. This produces new environments and visualisations where physical and digital objects co-exist. The digital and physical objects can interact, in real time.

Paul Milgram and Fumio Kishino introduced the notion of mixed reality as a virtuality continuum, encompassing the completely real through to the completely virtual – with augmented reality and virtuality in-between.

See: *P. Milgram and A. F. Kishino (1994). 'Taxonomy of Mixed Reality Visual Displays', IEICE Transactions on Information and Systems, pp. 1321–1329.*

Figure 1. Most architectural practices have begun their 'digital transformation journey'

If digital transformation was a journey, where is your practice on that journey?

10% — We've not started

We've started but we're at the beginning/early stages — 39%

37% — We've been on the journey for some time but it's not complete

We're well on the way to completing the journey — 5%

10% — Not sure

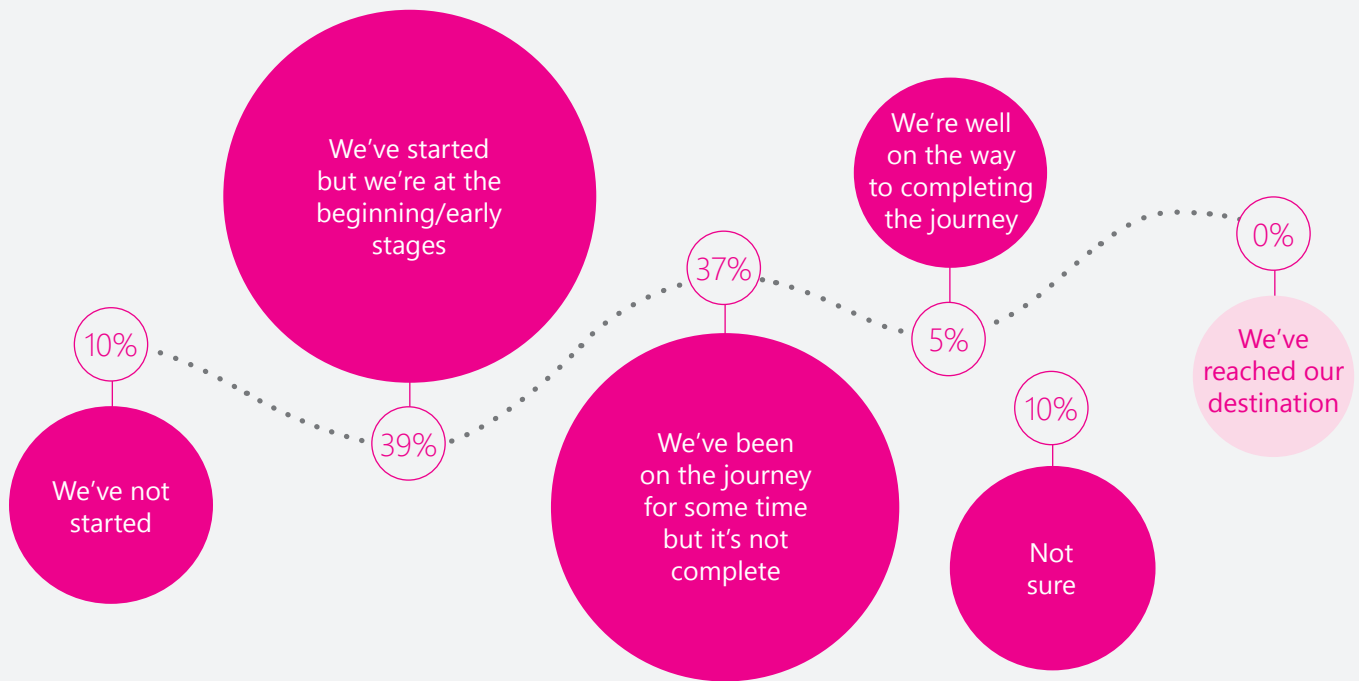0% — We've reached our destination

Figure 2. S-curve model of iterative improvement

S-curve model

The S-curve describes the growth of one variable in terms of another variable over time. In the case of digital transformation, it shows the progress of organisations that quickly adopt new technologies. In particular, it demonstrates how they avoid any potential slow-down or tail-off during the transition phase by focusing on the next step of the journey before the previous step is complete.

Growth

Path of high performers

Transition

Compete

Scale

Start-up

Time
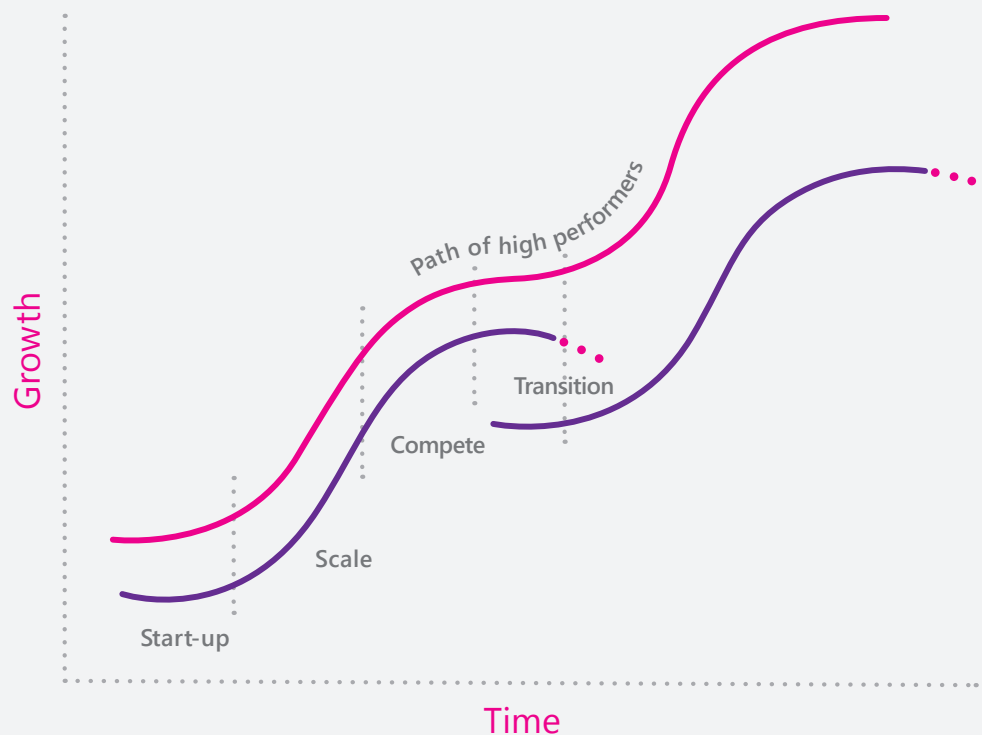
What are the benefits of digital transformation?

Why be a part of this digital transformation? **Digital technologies are making projects more efficient**: over three quarters of respondents recognise this.

Looking beyond current screen-based models, mixed, augmented and virtual reality can bring a design to life, enabling the client to really experience the building before it is built. All members of the construction team, clients, consultants and contractors work as virtual teams, together exploring, assessing and agreeing on design choices, putting the client at the heart of design. This will save time and money – minimising on-site changes and post-construction remedial work.

In the accompanying case study, Tomas Millar describes using virtual reality to digitally transform how he works with clients. His practice is now taking a lead in breaking down the barriers of understanding between a client and architect. He presents virtual reality as a 'time machine' for the client to see what will be built, bringing early stage design alive to deliver better buildings.

He is not alone, as adoption of these technologies is set to grow: **thirty-five percent of architects are using at least one form of mixed, augmented or virtual reality now.** Some of those plan to expand their use of immersive technology and use other variants in the near future. In addition, 29% plan to use mixed, augmented or virtual reality within the next five years.

Challenges of digital transformation

Transformation isn't easy: it takes significant effort and investment to become, and remain, digital-first. In architectural practice, margins are often tight, workloads heavy and the need to continually develop new business ever-present. Staying afloat today while investing in the future is a balancing act.

Cost is the primary challenge in adopting new technologies, cited by 69% of architects. In addition to the cost of purchasing new software, time and investment is needed to get staff up to speed. Indeed, almost **half highlight a lack of company-wide digital skills as a challenge.** And just over half (52%) find it difficult to know which digital trends or opportunities to respond to. In the next section we discuss just some of the digital innovations that architects and designers can adopt and are adopting: from digital forms of marketing and social media to the thousands of apps available to support businesses, the advances in mobile working and cloud computing, as well as those already mentioned, like BIM, immersive tech and IoT.

These challenges are real and can seem insurmountable, particularly for the very small practices. However, as we explore later in this report, having the right organisational culture is essential to enabling digital transformation in the architecture and design profession.

Immersive technologies powering a revolution in customer experience.
Tomas Millar, Millar + Howard Workshop

Over the past 30 years, technology has changed the way that architects work. However, the manner in which we interact with our clients has remained remarkably constant. This is about to change. A new generation of technological innovation, such as virtual reality, is offering opportunities for architects to connect more directly with their clients. Those practices that embrace this opportunity will change the industry for the better.

Virtual reality offers clients a way to experience their building before it is built. Clients often struggle to fully understand abstract forms of representation – especially for inside spaces. A rendered perspective or model can help, but only to an extent – there is no substitute for actually being in a space. Virtual reality is starting to change this. Paired with a detailed 3D model of the building, the high-end headsets give such a powerful illusion of inhabiting a real space that people find themselves trying to lean on virtual tables, or to reach out and touch virtual columns.

We have been using virtual reality at all stages of projects for over two years now, and have found that it actually speeds up the design process. Clients are able to grasp the nuances of spaces which were previously difficult to communicate, and it is helping them to make quicker decisions. We are also using it as a design tool to test our designs day to day. So powerful is this technology that we often describe the headsets as 'time machines' that transport you into the future to experience a building before it is actually built.

04

Innovation: beyond Building Information Modelling

© Getty Images/iStockphoto

UK architecture is renowned for innovation, and the profession is a leading global voice in the transformation of the design process. BIM has been the biggest technological and cultural innovation of the architectural community in the last few years.

In the future, it is clear that innovation will come in many different forms, but we will take a deep dive into BIM as the main driver for transformation right now.

BIM is the first truly global digital construction technology and will soon be deployed in every country in the world. It is a 'game-changer'.

The BIM process is an exemplar of UK, architect-led, digital transformation. It improves efficiency and demonstrates how digital transformation can quickly and radically change existing ways of working.

Figure 3 shows how, over a period of seven years, BIM has gone from a niche specialism to the de facto norm for design practice. Results from this digital technology survey show that this trend is continuing, with 70% of architectural practices using BIM (Figure 4).

BIM requires **culture change** of the sort described in the **Culture** section of this report, where practices are ready and empowered to adopt new ways of working.

BIM is **collaborative**; it provides a shared digital data environment where stakeholders share and agree requirements and inputs, as appropriate for each stage of the RIBA Plan of Work. It makes it clear *what* should happen *when*, and *who* is responsible.

Many architects and designers have led the way on BIM. Others, too, have been keen to get on-board. Large clients, contractors, construction product manufacturers and asset managers are adopting BIM – with many learning from the design community. BIM has already transformed design, and will collaboratively transform the whole construction life cycle in the near future.

What is BIM?

BIM (Building Information Modelling) is a process for creating and managing information on a construction project across the project life cycle. One of the key outputs of this process is the Building Information Model: the digital description of every aspect of the built asset.

This model draws on information assembled collaboratively and updated at key stages of a project. Creating a digital Building Information Model enables those who interact with the building during design, construction and use to make better informed decisions, resulting in a greater whole life value for the asset.

BIM is **technically innovative**. It relies on 3D modelling tools of a power and sophistication that have only become available in the last few years. It also relies on innovation in the structuring and standardisation of construction information, the 'I' in 'BIM'.

It **improves efficiency**; a 3D, data-rich model can be shared, accessed and developed by different members of the project team. The collaborative nature of BIM means that clashes between the inputs of design disciplines are picked up early on, and that time is not wasted on-site. It also provides the much-needed framework to move away from a fragmented and adversarial approach to construction.

BIM adoption is driving lower costs (in the design, construction and whole life costs of built assets) and increasing productivity (creating efficiencies to reduce time from inception to completion). Better collaboration and information coordination is transforming the delivery of architectural services and outcomes.

The UK Government is alive to the transformative potential of BIM, backing it through its BIM mandate. This is not surprising: the annual publication of UK Government construction cost reductions show the savings to which BIM has contributed.[1]

'Visualisations and BIM are in my opinion the greatest software advances we have experienced'.

Survey respondent

1 *Government Construction: Construction Cost Reductions, Cost Benchmarks, & Cost Reduction Trajectories to March 2015* (2015) Cabinet Office

Figure 3. A majority of designers now use BIM (Source: NBS BIM Report 2018)

BIM adoption over time

Aware and currently using
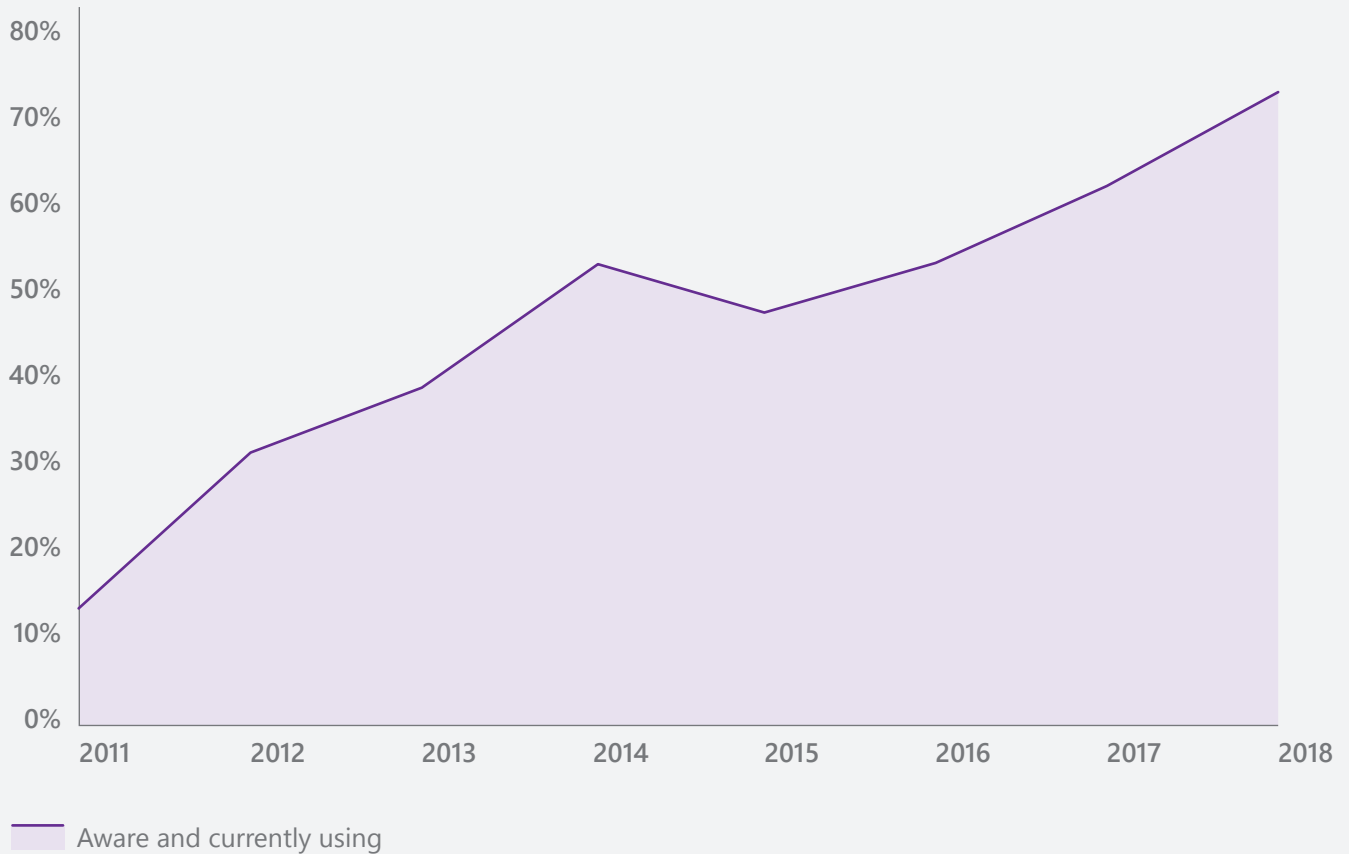
BIM improves **client outcomes** too through lower costs, fewer delays and greater certainty of outputs.

In the future, BIM may allow design choices on projects in development to be assessed through the capture of real-time performance information from buildings in use. This technology will enable a *continuous evolution* of design, based on data-driven learning and best practice. This transformative capability will require cross-industry engagement, but will create significant improvement in client outcomes, as well as benefits for society and the environment.

Creativity is the lifeblood of UK architecture. As well as enabling more efficient design, BIM and digitisation open up new **creative** possibilities. Digital practice allows designers to create buildings that wouldn't have been possible just a few years ago, from the futuristic forms of Zaha Hadid to Future Systems' Lord's Media Centre.

BIM exemplifies the key attributes of digital transformation in action, namely:

- Culture change
- Collaboration
- Technical innovation
- Improving efficiency
- Improving client outcomes
- Supporting creativity

When looking to the next stage of digital transformation in architecture, these attributes of BIM serve as a useful checklist of what we should be seeking to achieve, and what we need to do to get there.

BIM has been, and will increasingly be, transformative. As it becomes business as usual, the path of high performers will turn to new areas of digitisation.

Over the past century, the approach to design and constructional techniques has moved increasingly away from the use of indigenous materials and traditional forms of building as exemplified in this image of 20 Fenchurch Street the 'Walkie-Talkie' designed by architect Rafael Viñoly. © Ingval Maxwell

Figure 4. The technologies helping to transform UK architecture

What digital technologies are you using or planning to invest in?

Using now — **Plan to use within 5 years** — **Not sure if will use in 5 years**
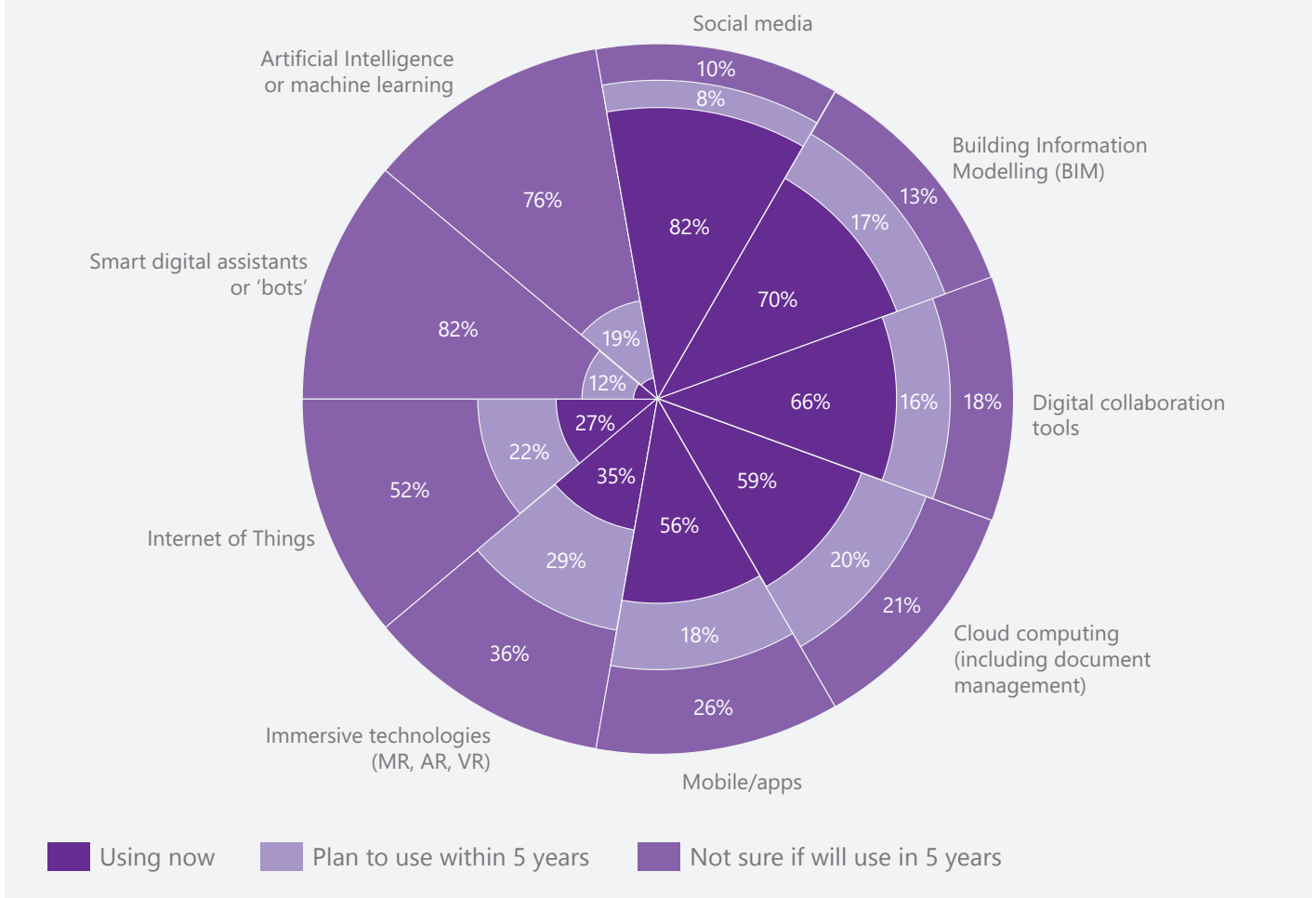
In such times of rapid change, new ways of working often flourish, and go on to displace old methods. We can see the emergence of other technologies that allow architects to work in different ways, to collaborate, to work on-site or on the move.

Beyond BIM, the next wave of digital adoption sees architects harnessing the Internet of Things, with a total of 48% anticipating using this in the next five years. Use of mixed, augmented and virtual reality is also on track to become much more common over the same period, with 35% already using at least one of these technologies and a further 29% planning to within five years. Adoption of AI and smart bots will take a little longer, as architects learn more about the opportunities associated with these emerging technologies. Also on the horizon are real-time co-authoring (where people collaborate on electronic documents) and

digital inking. Use of these innovations is currently limited to a minority of early adopters in a small number of organisations, or is being piloted by a handful of practices.

These advances will increasingly be supported by the cloud (already used by almost 60%), freeing practices from the maintenance of their own servers, and allowing reliable anytime, anyplace access to project files. This is valuable for an increasingly globalised profession, working between offices and sites around the world. The majority of practices are using social media (82%), digital collaboration tools (66%) and mobile/apps (56%). These technologies will radically alter the practice of architecture. They will complement each other, perhaps in ways that we don't foresee, but companies that have a culture of innovation will be ready to adapt and reap the rewards.

While BIM is becoming the norm for new build projects, there is a different set of challenges and opportunities for work to existing buildings. In order to work with a 3D model of an existing building, you need to scan it first. The cost associated with digital surveys can be perceived as a barrier to BIM on refurbishment projects. However, advances in digital surveying techniques, including the use of unmanned aerial vehicles, are making it easier. Work to existing assets is a significant part of UK construction output: in the health sector, for instance, and for those managing large estates like universities, churches and other historic buildings. In 2017, repair and maintenance accounted for 34% of construction output.[2] The construction industry is looking to digital transformation to address the challenges inherent in work to existing buildings and architectural conservation. In the article below, architectural conservation consultant Ingvar Maxwell helps us to understand those opportunities and challenges in the context of what he refers to as 'Historic BIM'.

2 Office for National Statistics

Bringing the benefits of digital tech to conservation architecture: Historic Building Information Modelling, by international architectural conservation consultant Ingval Maxwell OBE.

Applying BIM to existing built heritage creates a different set of problems that have not yet been considered in any detail. Historic Building Information Modelling (HBIM) requirements call for a different (and more informed) professional expertise and understanding than new build BIM applications.

To a large extent, addressing this difference lies in how well trained and experienced practitioners are in their retrospective appreciation and understanding of the ways in which historic buildings were constructed in the past. At the same time, they need to be alert and CPD-informed of how emerging technological influences and developments might be adopted, adjusted and beneficial.

If we reflect on current promulgations in the BSI PAS 1192 document series, these HBIM challenges might be highlighted with regard to the future repair, maintenance, rehabilitation, restoration and conservation work to the existing built heritage:

• Will clients become adequately informed in order to effectively provide the anticipated role that the HBIM (BIM) process requires of them? What information needs to be amassed to create the 'Employer's Information Requirement (EIR)'? And who will need to be involved in producing it?

• Will the cost of any 'detailed surveying' required to underpin the creation of an HBIM EIR be prohibitive?

With regard to preparedness in the adoption and use of new initiatives:

• Are the education and training establishments properly and fully prepared to address the 'challenges of understanding BIM and its HBIM derivative'?

• How might growth in the 'Internet of Things' be translated into work-a-day conservation practice?

• Will developments in 'wireless electricity' hold potential for servicing heritage structures?

• Will the use of large-scale '3D printing and milling' become inevitable in the replacement of historic parts?

• How might the potential adoption of 'Smart Personal Protection Equipment' and Virtual Reality be of assistance?

Inevitably, these issues and opportunities will be addressed and resolved over time. But in caring for the built heritage, the responsibility of deliberating on them could readily challenge well-established conservation philosophy, principles and practice.

In the pending debates, practitioners might reflect that, at any point in time, they are the 'temporary custodians' of what has been handed down from previous generations. Inevitably, in carrying out that obligation, decisions taken today will be reflected upon for their relevance in future. Accordingly, the need to be fully informed, valid and justifiable in effective decision-making will be critical.

05
Increased productivity through new skills and new tools

Drones are one of the digital tools transforming the design process. © AECOM

Image of a live, rendered model: no post processing required. © Allford Hall Monaghan Morris Ltd

The UK has a problem with productivity: only one country in the G7 has lower productivity levels per hour worked. The construction industry has struggled to become more productive, though its productivity increased by 2.6% from 2014–2016.

It is easy to fall into the trap of thinking that increasing productivity is just a matter of the people within an organisation working harder and 'smarter'. This is too simplistic. Higher productivity depends as much on the skills of the person doing the work as on the tools that a person has at their disposal when producing goods or delivering services.

Skills result from education and training levels. Architecture qualifications are the result of years of study and practice-based learning. But skills levels are also influenced by how well a company or group of professionals share their learning and best practices. This is part of the reason why the RIBA is committed to Continuing Professional Development, including the core curriculum topic of Design, Construction and Technology.

Equipping those within a practice with the skills that they need to own and further transform ways of doing things is core to digital transformation. Our survey confirms that investment in skills is required for digital transformation – lack of digital skills was the third biggest challenge, cited by 48% of respondents (Figure 5).

Aligned to new skills are new tools. Taking advantage of new technology means that skilled employees can do more, more quickly, and to a higher standard. The new tools that architects now have, or will soon have, at their disposal open up a range of possibilities. In BIM, we have seen data and geometry come together, through collaboration, to transform design practice. Architects are already seeing that adopting digital technologies optimises project, and internal business, efficiency. Architects AHMM have invested in a 'back of house' set-up which includes a dedicated digital design team to support project teams. All their projects are

> 'I think the [augmented reality] technologies will have a big impact on how a project develops and is run. Better collaboration will speed up efficiency on projects, live modelling will give better clash detection and reduce project programmes'.
>
> **Survey respondent**

23

For the Here East Broadcast Centre Hawkins\Brown developed a unique 'dazzle pattern' facade, which was achieved by printing a ceramic frit onto curtain wall glazing. By using generative design software Hawkins\Brown were able to optioneer for the client, the pattern at building, human and micro scales. Here, the client and design team could accurately preview the aesthetic outcome but also, ensure that the frit performs technically.
© Hawkins\Brown Architects; CGI artists The Neighbourhood; photographer GG Archard

now delivered using a digital authoring tool, meaning that AHMM is in a strong position to deliver BIM requirements as increasing numbers of clients now request them. In his article on the next page, Aaron Perry from AHMM highlights the potential for increasing productivity using live render visualisation tools, cloud-based algorithmic tools and recycling of knowledge from previous projects – saving time and producing better outputs for clients.

Productivity and efficiency benefits have been felt most at the project level, with 79% recognising that digital technologies optimise project efficiency, but 63% also say that digital technology is helping them to be more efficient internally (Figure 6). The difference that BIM has made is clear.

Within organisations, though, the adoption of practice management software is helping architects to plan project delivery and resourcing better. More readily available financial data can lead to practices bidding for work from

clients that is more likely to make a profit. Forty-five percent of survey respondents said that digital technology was changing practice management, and 54% said that internal IT systems were changing.

Further transformative technology is to come. With mixed reality, AI, big data and cloud computing, we can begin to imagine a dispersed construction team collaborating on information-rich models that can be rendered in immersive 3D visualisations. Real-time, person-to-person collaboration can take place virtually, with AI swiftly running through the 'what ifs' of design.

Generative design software develops thousands of possible design permutations based on a set of design goals and parameters. It produces far more alternatives than a designer could create manually for them to consider. Generative design software was used by Hawkins\Brown Architects on the Here East Broadcast Centre (above).

Figure 5. The skills challenge

What would you say are the biggest challenges for architectural practices/ organisations wanting to transform into a digital business?

48%
Lack of digital skills
company-wide

Figure 6. Digital technologies bring improved efficiencies

What would you say are the main benefits of adopting digital technologies in your organisation?

79%
To optimise
project efficiency

63%
To optimise our
internal business
efficiency

More efficient and automated design – improving client outcomes.
Aaron Perry from Allford Hall Monaghan Morris Ltd. shares how he sees new technologies benefitting the design process.

Looking ahead, we hope to see new technological capabilities encouraging or even compelling architects to complement traditional methods for designing, visualising and previewing the spaces we design. Here are three examples of where this will benefit the design process.

1. In the last decade, architects have become all too familiar with the idea of 'pressing the render button' and going out for lunch or home for the evening; however, I see this approach disappearing, or at least evolving. With the recent increase of live render visualisation tools, moving through a pre-rendered model and simply saving images (renders) in real time is becoming more common. While the use of static digital imagery will certainly continue, there is an increasing call from clients, stakeholders and even local authorities and planners for animated or virtual reality experiences. No post process: just the live rendered model.

2. Where a range of design options may need to be produced relatively quickly, we've been using cloud-based algorithmic tools to find and filter to our 'favourite' results. This has delivered the ability to produce a much greater number of options of an equal, or even improved, graphic/visual quality, in the same time that it would previously have taken to explore only a couple of options using traditional methods.

3. One final example that digitisation has already realised is the ability to recycle previous design research and development from across a multitude of preceding projects. This has quickly led to the development of 'standard' parts of schemes for use at early stages.

Collaboration and the client experience

It is well documented that construction has a problem with collaboration. From Latham to Egan, and then on to the current Government Construction Strategy: 2016-2020, the need for greater collaboration through the construction timeline has been well identified and described.

A lack of collaboration has made for an inefficient industry, prone to an adversarial approach to work, to disputes, to design intent not being realised, to costly re-work and delays, and ultimately to inferior client outcomes.

Digital transformation has given us new ways to address these old problems.

So why collaborate? Collaboration offers a number of advantages:

- Information is standardised.

- Information is shared, and is therefore actionable.

- Knowledge and innovative techniques are shared and passed on.

- The process is transparent, so risk and accountability can be appropriately allocated.

- Solutions to construction problems are sourced from a wide range of expertise.

- There's greater opportunity for the whole construction life cycle to be considered.

- Better client outcomes.

'Expecting construction site workers to carry hand held models with them while they are brick laying or installing pipework is not practical. If any digital technology is to succeed it needs to be used throughout the construction stages not just in the design stage'
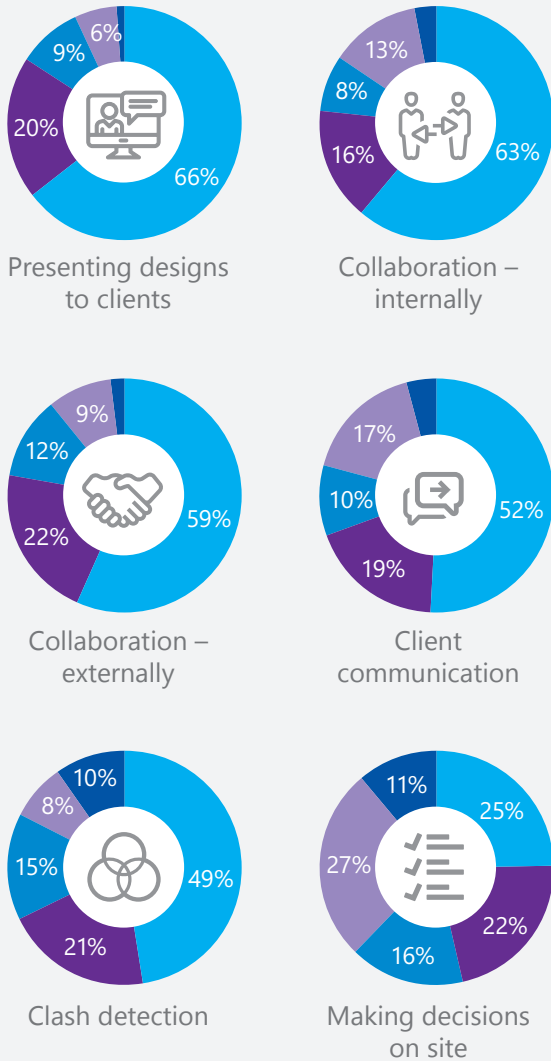
Survey respondent

Digital transformation has opened up new ways of working together, so together we can create, aggregate, analyse and share design and construction information.

Fifty-nine per cent told us that digital technologies have changed how they collaborate externally (Figure 7). This means working more effectively with other design disciplines and with contractors. Clash detection has improved (49% say digital technology has changed this) as federated models bring together architectural, structural and M&E designs.

Figure 7. Improved collaboration through digital transformation

Which aspects of your work are being changed, or are likely to change, by adopting digital technologies?

Presenting designs to clients
6% · 9% · 20% · 66%

Collaboration – internally
13% · 8% · 16% · 63%

Collaboration – externally
9% · 12% · 22% · 59%

Client communication
17% · 10% · 19% · 52%

Clash detection
10% · 8% · 15% · 49% · 21%

Making decisions on site
11% · 25% · 22% · 16% · 27%

- Changed/changing now
- Likely to change in next 1 – 2 years
- Likely to change in next 3 to 5 years
- Not changed, and not likely to change
- Not sure

True collaboration requires a cultural change, a culture where responsibility, risk and reward are proportionately shared and collectively owned. Where collaboration takes root (as, for example, in the 2012 Olympics construction), it is a better way to deliver client requirements, increase efficiency and reduce disputes.

To be successful, the move to collaboration needs to happen within organisations, and so we find that digital technologies are helping 63% of practices to collaborate internally (Figure 7). Many architectural practices (59%) are taking the opportunity that digital technologies and ways of working bring to improve employee collaboration and productivity (Figure 8).

Another significant change is the way that architects are collaborating with clients. Almost two thirds (66%) of architects have changed how they present designs to clients, and just over half (52%) how they communicate with clients. More realistic rendering of designs through computer-generated imagery and through mixed, augmented and

Figure 8. Architectural practices are using digital technologies to improve employee collaboration and the customer experience

What are you/your organisation doing to take advantage of digital technologies or digital ways of working?

59%
Improving employee collaboration and productivity

45%
Creating new/ better customer experiences using digital technologies
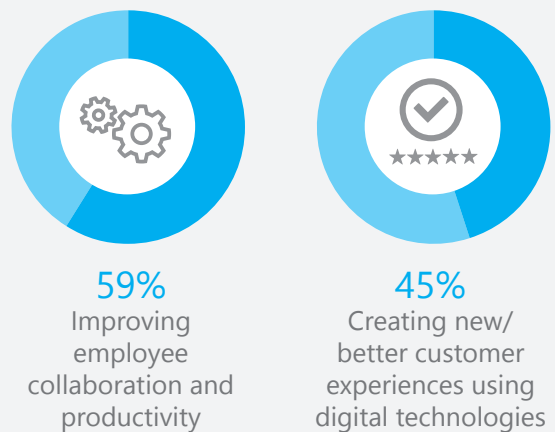
virtual reality allows clients to experience their building before it is built. These changes mean that the client is, and will increasingly become, better positioned to make sure that the design delivers to their needs (see below how Ackroyd Lowrie are putting their clients at the heart of the design process).

As we have already noted, architects identify cost as the most significant barrier to adoption of the digital technology and protocols that lead to improved collaboration.

Challenges for the wider industry include the need to extend collaboration to all stakeholders. While designers and main contractors are adopting and driving BIM, it is not always filtering through to sub-contractors and those working on-site: only 25% said that the way decisions on-site are being made is changing (Figure 7). We still hear of preferences from contractors for 2D printed drawings, and there are practical challenges with accessing and using digital models on a busy construction site.

'*Pre*-Occupancy Evaluation': Oliver Lowrie explains how Ackroyd Lowrie uses virtual reality to make sure that clients get the building they asked for.

We have been developing a visualisation methodology that allows us to test multiple design iterations and gain feedback from users to create meaningful design changes. We find that doing this very early on in a project gets huge buy-in from the client, and by the end of our second meeting, we usually have the skeleton of a final design which the client is happy with. The immersive experience that they get allows them, at a basic level, to see how the light comes in, how the views out will work, how the space might be occupied and how the spaces relate to each other. From a purely commercial point of view, we find it more profitable to use VR on projects than to not use it, as we no longer end up making emergency changes when the project is on-site and the client realises exactly what they are getting.

We have formulated this into a five-stage process that we are currently trademarking as a **'*Pre*-Occupancy Evaluation'**. We are currently working with a software developer called Constructive Labs to enhance the functionality of the experience.

Crucially, it is also multi-user, so we as architects can stand alongside our client, seeing what they see. It strengthens our partnership as we go on a shared design journey, making adjustments at every stage

with the sole intention of guaranteeing the building's effectiveness in the real world and improving the end product before it is built. This also works for other members of the project team, and helps different specialists to better understand each other's roles and challenges, in turn leading to better teamwork and collaboration. We have already done coordination workshops with sub-contractors using the VR technology. This will eventually reduce the inevitable on-site clashes that cause huge expense, delay and wastage on-site.

In the future, we see this technology transforming the industry further. The current process of using 2D information to communicate with clients is already being phased out, and the next step will be phasing out 2D communication with builders. BIM is just the beginning. We see a future where builders use Augmented Reality to set out buildings and see where duct runs will go.

If we test what we're building before we build it, we not only eliminate error but also ensure higher quality construction, improved performance in the long term, and a better outcome and experience for the end-user. Through technology, our clients are positioned at the heart of the process where they belong.

Another challenge is making sure that the benefits brought by collaborative working and BIM are felt by the users of a building. To date, relatively few fully updated BIM models make their way through all RIBA Plan of Work stages, from the design team, to the construction teams, to facilities managers. And, whilst this is improving, the voice of facilities managers isn't heard early enough to have an influence on the design of the building that they will have to manage.

So, as with the adoption of anything new, there are challenges to embedding digital technology into all parts of the construction industry and phases of the project life cycle. However, the transformative potential is significant and the benefits from the technologies available now are already being felt. Modern business practices and workplace environments are already changing. Improved communications infrastructure and wireless connectivity mean that it's easier to create flexible office spaces, to enable homeworking and for people to work together in different locations. Meetings can increasingly take place using video conferencing and documents shared and collaborated on in the cloud. Physically dispersed project teams can work together in a virtual space, sharing models in a common data environment. Immersive technologies are being embraced by architectural practices to show clients how the building will look – and to change the design in response to client feedback, before construction starts.

In the piece on page 29, Ackroyd Lowrie show how they have embedded virtual reality into their way of working. They find that this reduces the need for last-minute changes on site, improving efficiencies and the bottom line. It's a win-win situation – better for them commercially and leading to better outcomes for their clients.
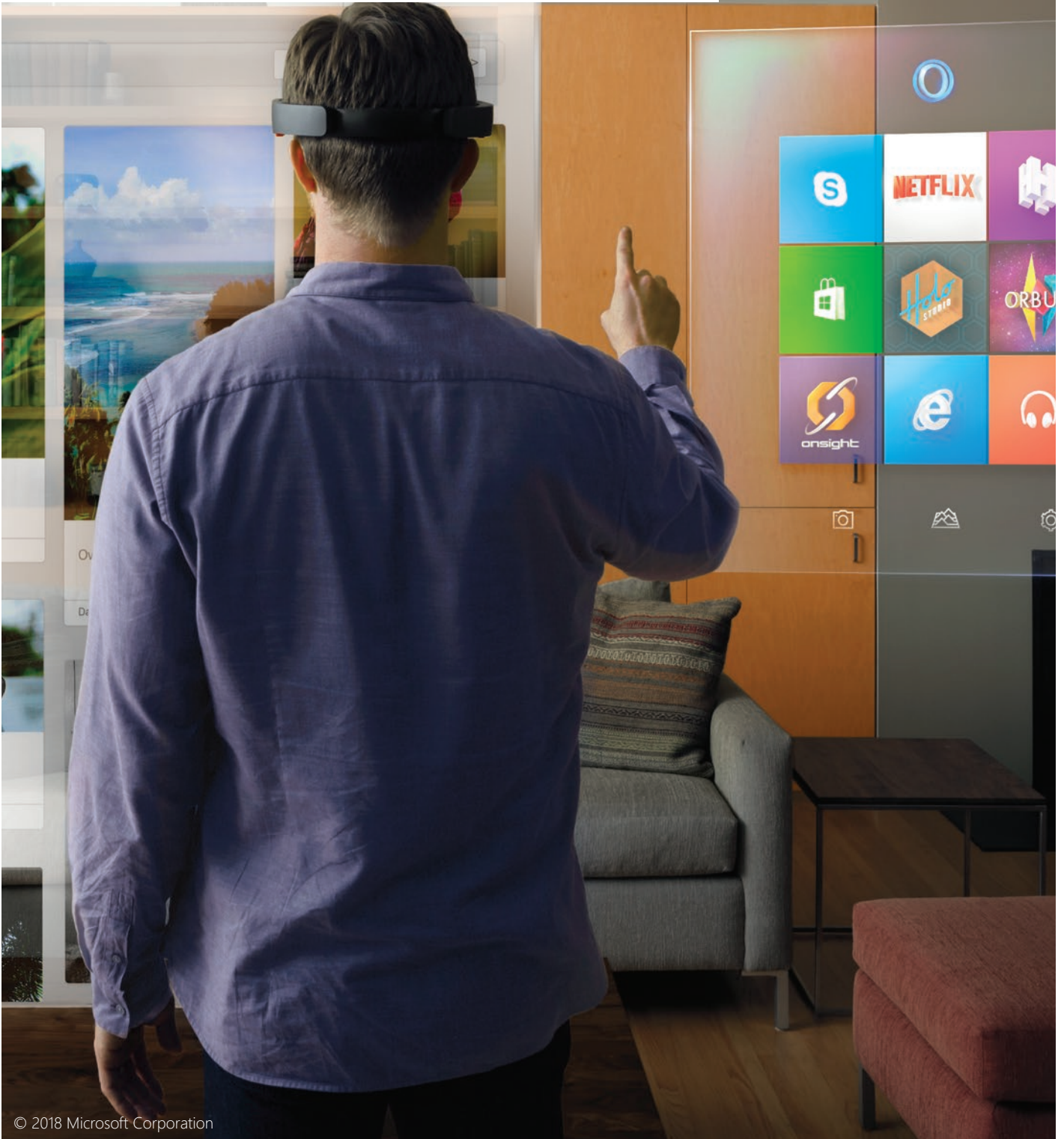
07
Culture for change

Digital transformation is not just a willingness to adopt new technology. It is a shared engagement and belief among those setting the strategic direction of a practice and those carrying out the day-to-day architectural work.

A culture of transformation is one where professionals are empowered to explore new ways of doing things, given the autonomy to initiate change, and provided with the training and tools to do so.

This is for the long term: a practice ready to adapt to, and exploit, the technological innovations coming now and in the future.

Naturally, a culture isn't just created by instruction from senior management. A digitally literate and engaged leadership sets the course, but everyone within the practice generates the momentum to swiftly and effectively adapt to, and drive, change.

The findings of our research, however, suggest that there are some leaders who still need to embrace digital transformation. Less than half of practices (47%) assess their leadership as digitally literate (Figure 9). Only a third suggest that their practice has a clear or formal digital strategy. There is work for the leaders of the profession to do.

For the RIBA, digital transformation has meant setting the professional context in such a way that it can support and facilitate the digital journey.

In recent years, we have seen the RIBA Plan of Work being overhauled to reflect and lead digital ways of working. Throughout the nations and regions, we support the sharing and adoption of best practice. Through CPD, we help ensure that all chartered architects are equipped with the skills that they need to be competent, professional, capable and resilient as an architect.

Architecture practices have changed their offer to clients through the use of mixed reality, some using high-powered PCs and headsets, others with just a smartphone, and now BIM is making a massive difference in design coordination and specification tasks.

However, the visualisation technology mentioned in this report is yet to make much difference in the later stages of projects, particularly in technical design and exchange of information from the design team to the contractor and specialist subcontractors.

> 'Building a strong support provision at an early stage meant that new projects and teams felt more comfortable 'taking the leap'. To that end, over time we built up a dedicated digital design team to manage day to day queries, technical issues, workshops and training, project set-up, and software/hardware resources'.
>
> **Survey respondent**

Figure 9. Signs of a culture enabling digital transformation

Please state whether or not you agree with these statements

47%
Our organisation has a digitally literate senior leadership team

33%
Our organisation has a clear or formal digital transformation strategy

We can see a great value in mixed reality enabling designers to highlight health and safety risks in virtual models placed in front of the construction team at review meetings, and augmented reality headsets providing real-time health and safety overlays to site operatives during assembly and construction. Clearly, health and safety (including fire safety) is not the only construction information that would benefit from new ways of being exchanged.

Perhaps a future might exist where designers take back ground lost to specialist contractors and provide detailed construction information straight to manufacturers – using more precise modelling and visualisation technology combined with greater construction knowledge developed using advanced immersive CPD. Dale Sinclair from Aecom (see article on page 36) believes that, for architects to maintain their role as lead designer, they will need to '*drive new design to construction workflows which have not fundamentally altered over the years*'. He portrays the

transition to BIM as a step change, unlike the move from paper drawings to CAD. BIM is the foundation of future transformation, as its data-rich models open the door to VR, modular construction and robotics. For the architectural profession to fully embrace this potential requires culture change for many practices – to look forwards and to break away from some past working practices that may constrain their development.

Such a change isn't necessarily easy and, by definition, not all architecture practices are leading in digital transformation. In our research, we explored what stood in the way.

As already highlighted earlier in this report, the top reason given is cost (Figure 10). A focus on cost alone can be misleading. The risks of not investing can often be more significant. New technology, supported by a transformative culture, has the potential to increase commissions and internal efficiency, and so revenue and profit.

Figure 10. Cultural barriers to achieving digital transformation

What would you say are the biggest challenges for architectural practices/ organisations wanting to transform into a digital business?
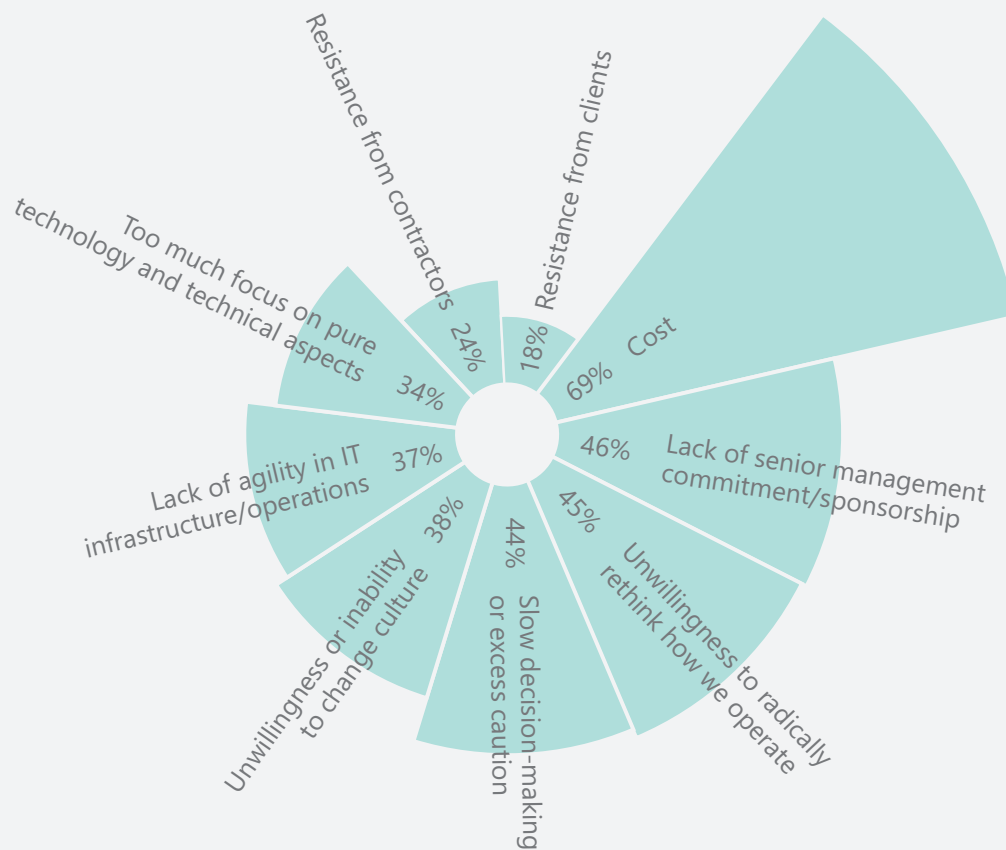
All new technology is **not** necessarily good. As well as transformative technologies such as BIM, the history of technology is littered with solutions without problems, cost overruns and a tendency of vendors to overpromise and under-deliver. These factors highlight the importance of creating teams of digitally literate professionals: teams of those skilled and empowered to assess new technology and guide its practice-specific implementation.

When we look further in Figure 10, we see cultural failing, slow decision-making, a lack of radical thinking and an unwillingness or inability to change the culture. This underscores the importance of a digitally literate leadership, ready and able to create a culture of digital transformation.

On a positive note, this survey does provide evidence of practices engendering a culture that supports and nurtures digital transformation. Forty percent explicitly agreed that they were changing organisational culture. Almost half

(49%) had assigned senior staff with formal responsibility for digital technologies. Thirty-eight percent were creating a team to experiment with digital technologies, and 34% were appointing dedicated digital specialists. These are signs of a culture that promotes innovation, and also encourages experimentation and autonomy at different levels of the organisation. Indeed, over half (53%) said that employees are bringing new technologies/ways of working into their organisation – perhaps indicative of a culture that encourages innovation from the bottom as well as the top.

Facing the future: breaking from the world of 2D, by Dale Sinclair from Aecom

Nearly thirty years ago, the transition from the drawing board to CAD was underway. The process was not easy. Hardware was expensive, with a printer costing more than a house, and a large part of the transformation effort involved convincing those with the purse strings that a quick return on investment was feasible.

The transition from CAD to BIM and onwards to wholly digital environments has reached tipping point. There is no way back. However, the same ROI arguments exist and productivity gains are being stifled. To make matters complex, this transition captures more than the previous digitisation of the design team's geometry. With new digital approaches, data is increasingly being used for the life cycle of a project for new and different topics, such as helping to determine the need for a building in the first instance, or to reduce the costs of operating it once it has been constructed. Put simply, the information prepared by the design and construction teams can be used in new and previously unimagined ways.

The transition from the drawing board to CAD happened by osmosis: slowly and incrementally. Some believe that the transition from CAD to BIM will be similar. It will not. Everything points to faster and more radical changes to the way we work. Continuing to push dead mono-disciplinary 2D information out of data-rich real-time multi-disciplinary models is not the way forward.

At present, the emphasis is rightly on data. However, it won't be long before the analysis packages used by our design team engineering colleagues will plug directly into the architect's model. This will reduce the number of iterations of the design. Design management tools and techniques will need to consider new workflows in greater detail as these new design team relationships mature.

A new generation of virtual and augmented reality software points to the future. Clients are given better representations of their products. Changes will soon be feasible when the client is 'inside' the model with cost, environmental or the other factors associated with change instantly assessed. The use of robotics on-site has commenced for simple yet awkward tasks such as drilling holes for services supports in concrete soffits. With clients fawning over new 3D design review processes and the construction team leveraging new types of information driven from the model, the death of traditional 2D information is inevitable.

Core to successful digital transformation is therefore breaking away from the world of 2D and recognising that the transition to BIM needs to be more radical than the transition to CAD. The most successful practices in the future will implement digital tools by facing the future rather than the past, and by designing new workflows that will result in faster, cheaper, greener and safer projects that continue to deliver world-class designs.

08
Looking ahead

What does this research tell us?

This report shows that architects and the wider design community are taking advantage of the digital technologies available to them. They are changing how they work now, and will continue to do so in the near future. Most practices have started their digital transformation journey (even if they don't call it that), and most recognise the benefits of doing so.

It is unsurprising that BIM is affecting the way practices work more than any other technology or process. The UK Government has driven the adoption of BIM through its 2016 mandate, and many influential organisations and individuals in the construction industry have supported this drive. **BIM is more than simply one technology or approach** – it is revolutionising the industry and paving the way for the adoption of other new digital innovations.

The next wave of digital tech, being adopted now by innovators and early adopters, includes mixed, augmented and virtual reality and the Internet of Things. Alongside these technologies, architects and designers are using other tools that have been adopted throughout society that improve communication and collaboration: social media, mobile devices and apps, and cloud computing.

There are challenges to digital transformation, most prominently the cost of investing in hardware and software and the upskilling of staff. This challenge is real, but practices of all sizes have spent time gradually improving their 'back office' set-up: acquiring modelling software, training staff and giving team members responsibility for different elements of digital transformation. This long-term outlook, driven by practice leaders but taken forward by empowered staff, represents a culture that embraces change. Some practices have yet to develop their culture in this way – lacking the leadership and decision-making to take the necessary steps, or even being resistant to the very change itself.

While adopting digital technologies is challenging, the benefits are well recognised by most practices. It is making their projects more efficient, making their practices more productive and putting clients at the heart of the design process. Few would question that digital technology is helping to make this positive difference.

What is the 'Internet of Things'?

'The Internet of Things is made up of hardware and software technologies. The hardware consists of the connected devices – which range from simple sensors to smartphones and wearable devices – and the networks that link them, such as 4G Long-Term Evolution, Wi-Fi and Bluetooth.

Software components include data storage platforms and analytics programmes that present information to users. However, it is when these components are combined to provide services that real value is created for businesses, consumers and governments'.

The Internet of Things: making the most of the Second Digital Revolution (2014), UK Government Office for Science. Page 13.

So, where from here?

A number of themes emerge from this research that help us to consider the future implications of digital transformation:

Architecture is changing for good: but there is uncertainty among practices about the scale of change and where it is coming from.

The next wave: the technologies expected to disrupt architecture in the next few years.

Digital transformation needs to permeate all parts of the construction industry: all sectors and members of the project team.
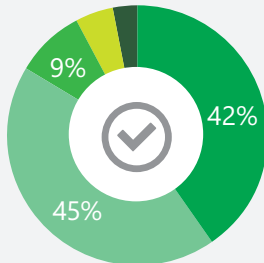
Beyond architecture: the societal and environmental impact of digital transformation.

'We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten'.
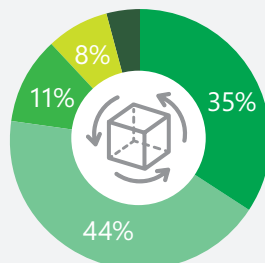
Bill Gates

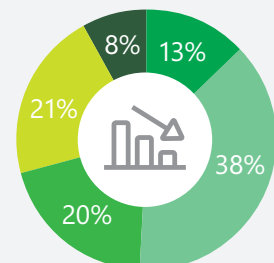**Figure 11.** No going back – Architecture is changing for good

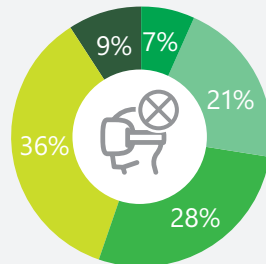## Please state whether or not you agree with these statements

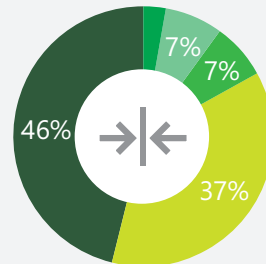Digital technologies are transforming the way we work now

- 42%
- 45%
- 9%

Digital technologies are transforming the whole construction industry

- 35%
- 44%
- 11%
- 8%

Architectural practices who do not adopt digital ways of working will go out of business

- 13%
- 38%
- 20%
- 21%
- 8%

Architects are behind other construction professionals when it comes to adopting digital technologies

- 7%
- 21%
- 28%
- 36%
- 9%

By 2030 the way that architectural practices operate won't be any different from how they operate now

- 7%
- 7%
- 37%
- 46%

Legend:
- Strongly agree
- Tend to agree
- Neither agree nor disagree
- Tend to disagree
- Strongly disagree

'Building on progress made to date, the Department for Transport, the Department of Health, the Department for Education, the Ministry of Justice, and the Ministry of Defence will adopt a presumption in favour of offsite construction by 2019 across suitable capital programmes, where it represents best value for money'.

Autumn Budget 2017

Architecture is changing for good

Almost 90% of survey respondents say **digital technologies are transforming** the way that they work now and over 80% say that, by 2030, the way architectural practices operate will be different to now (Figure 11). While some believe that architects are ahead of the curve, most practices agree that the **whole construction industry is changing**. However, the scale, pace and drivers of that change are open to debate among the architectural and design community.

Forty-two percent of survey respondents believe that the construction industry will be moderately or massively disrupted over the next two years. But a similar number (43%) **don't think that disruption will be significant**, while a few (4%) think that there will be no disruption. And most of those expecting disruption think that it will come from within the industry – from other members of the project team (66%) or from software vendors (40%). Fewer (33%) think that disruption will come from outside the industry and only 31% think that it will come from architects. Twenty-two percent see themselves as disruptors. So while some architects are keen to steer the course for their community, it feels as though the majority are anticipating the change coming from elsewhere – but they don't perceive this change totally disrupting their way of working or what they do. Twenty-nine percent disagree that practices who do not adopt digital ways of working will go out of business. This figure rises to 38% among practices with fewer than ten staff. This view could be dangerous for some UK architects: if they are not prepared for a major disruption to their industry, they may get left behind or even go out of business altogether. So what disruption can we expect?

© 2018 Microsoft Corporation

> **'Because architects are design-centric people they are not client-centric. [The] future belongs to those who are client-centric'.**
>
> **Survey respondent**

The next wave of digital transformation

We cannot see into the future, and all too often great predictions of change are inaccurate. However, the following two areas are likely to be particularly important over the next few years.

BIM Level 3 and Digital Built Britain. We expect the use of BIM (Level 2)* to thoroughly permeate the industry by the early 2020s. Then **BIM Level 3**, also known as **Digital Built Britain**** – based out of the Maxwell Centre at the University of Cambridge, promises to 'increase productivity, helping create 'high performing assets' in terms of their construction and operational efficiency, and improvement in the services that they were created to deliver, creating commercial opportunities and enhancing citizen quality of life and wellbeing. Given the investment that the UK Government and the University of Cambridge have put into this work, it is easy to be excited by these opportunities.

Advanced manufacturing and modern methods of construction: another example of technological advancements that are aiding construction are modern approaches encompassing **off-site (modular) manufacture, robotics, and additive manufacturing or 3D printing of components.** These can lead to faster, cheaper, more resource-efficient and easier-to-assemble building components that help the industry fill the continually widening skills gap by needing less skilled workers, but designers will need much improved skills to facilitate this. Closer, digital links between design, manufacture and installation are helping to make construction more accurate, efficient and collaborative. The Government agrees and is, as with BIM, using its purchasing power to drive adoption as announced in its Autumn Budget last year (see insert). Survey respondents also expect to see further advances in this area.

For the Here East gantry project by Hawkins\Brown, a series of 23 artist studios will be built using the Wikihouse design and construction toolkit. This toolkit allows the delivery of modular plywood buildings within set parameters, with each structure precision manufactured using a CNC milling machine. The challenge for the design team was in developing computational design software, specifically for this project, to push the limits of the modular system ready to be digitally fabricated.

Image courtesy of Hawkins\Brown, Pixelflakes and photographer GG Archard.

In 2003, as the Centre for Mathematical Sciences at the University of Cambridge was completed, the Director of Estates, David Adamson, and Mark Way of the Darwin Consultancy had members of the original design team work from the completed building for a while so that they could help the facilities team and academics make the most of their new asset. This process was later formalised as Soft Landings: www.bsria.co.uk/services/design/soft-landings/

Digital transformation – reaching all sectors and all professions

We have seen in this report that new technologies, and BIM in particular, have permeated many parts of the industry. To realise its full potential, though, it needs to be truly inclusive. Three areas where digital technology and the benefits of BIM have yet to be fully felt are: handover of new buildings to facilities managers, on-site construction by subcontractors and work to existing buildings.

The disjoint between the design and construction teams and facilities management is often highlighted as an issue, but we are seeing examples of this changing. Soft Landings (now managed by BSRIA) is gaining momentum in the industry. This is the idea that **facilities management thinking is**

applied in the briefing and design process, and the designers stay involved in the project for three years after it has been built (see insert showing how the University of Cambridge approached this). As monitoring kit becomes less expensive, smaller and easier to install, we can start to treat a building similarly to how Formula 1 engineers treat their cars when out on the track, continually optimising them for the highest possible performance while managing the efficiency of the fuel resource.

Perhaps the most significant part of the industry where digital transformation has not been as strongly felt is among **small-to-medium contractors and sub-contractors**. Along with the design community, main contractors are driving the adoption of BIM and other technologies.

However, 3D models are still often output to 2D for the benefit of the specialist contractors and installers who are actually constructing the building. Interrogation of the model and the use of mobile technologies to inform decision-making on-site is still limited. This is a key area where advances in digital technology could make a difference.

Work to existing buildings presents its own set of unique challenges and opportunities, as highlighted by Ingval Maxwell earlier in this report. We have already seen major advances with the development photogrammetry and the use of unmanned aerial vehicles to scan buildings. Perhaps in the future, wireless technologies will present more opportunities to modernise protected buildings sensitively, and mixed reality may enable better visualisation of building alternations and extensions in situ to make sure that new developments complement their surroundings.

'I think the [augmented reality] technologies will have a big impact on how a project develops and is run. Better collaboration will speed up efficiency on projects, live modelling will give better clash detection and reduce project programmes.'
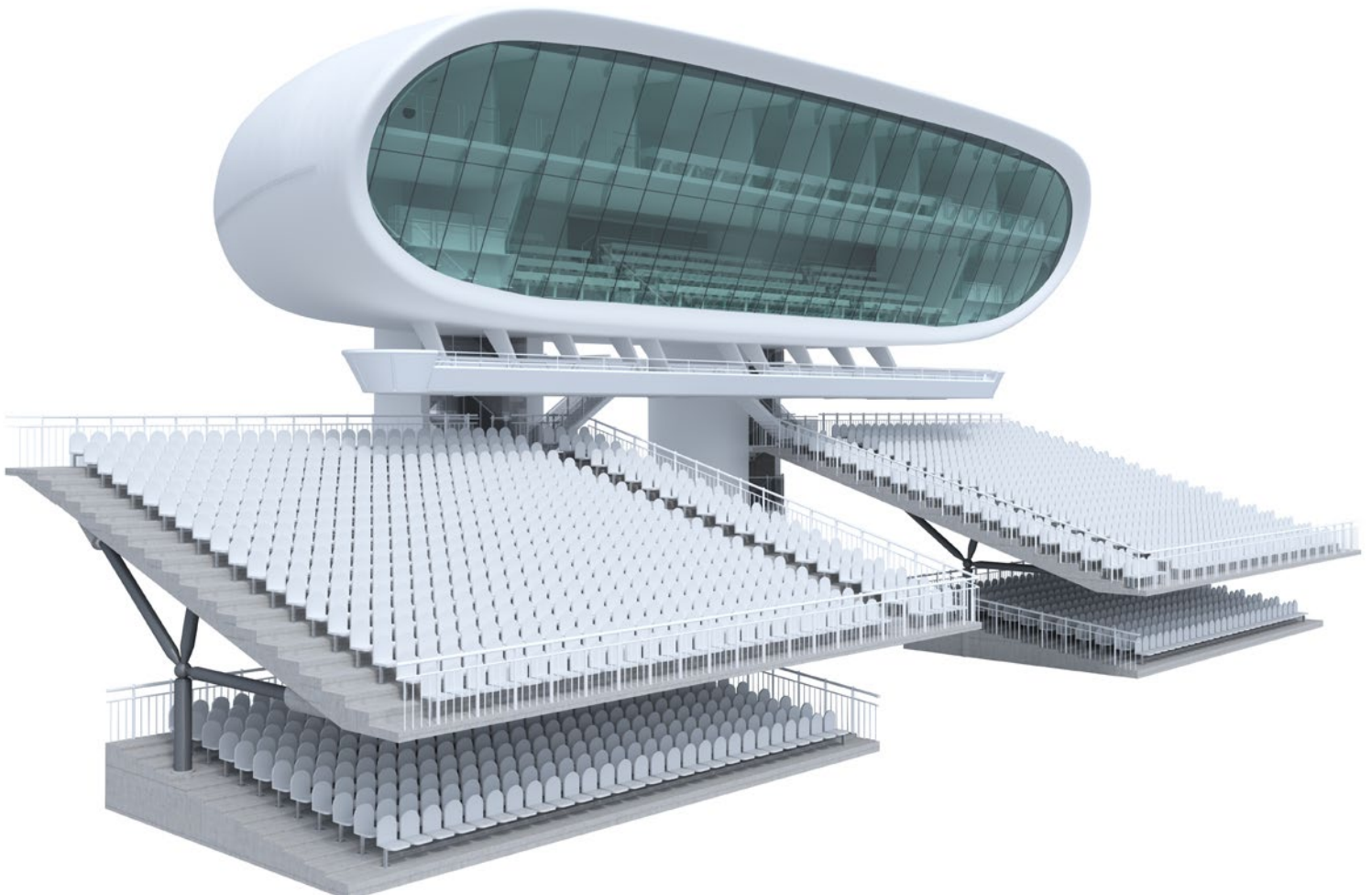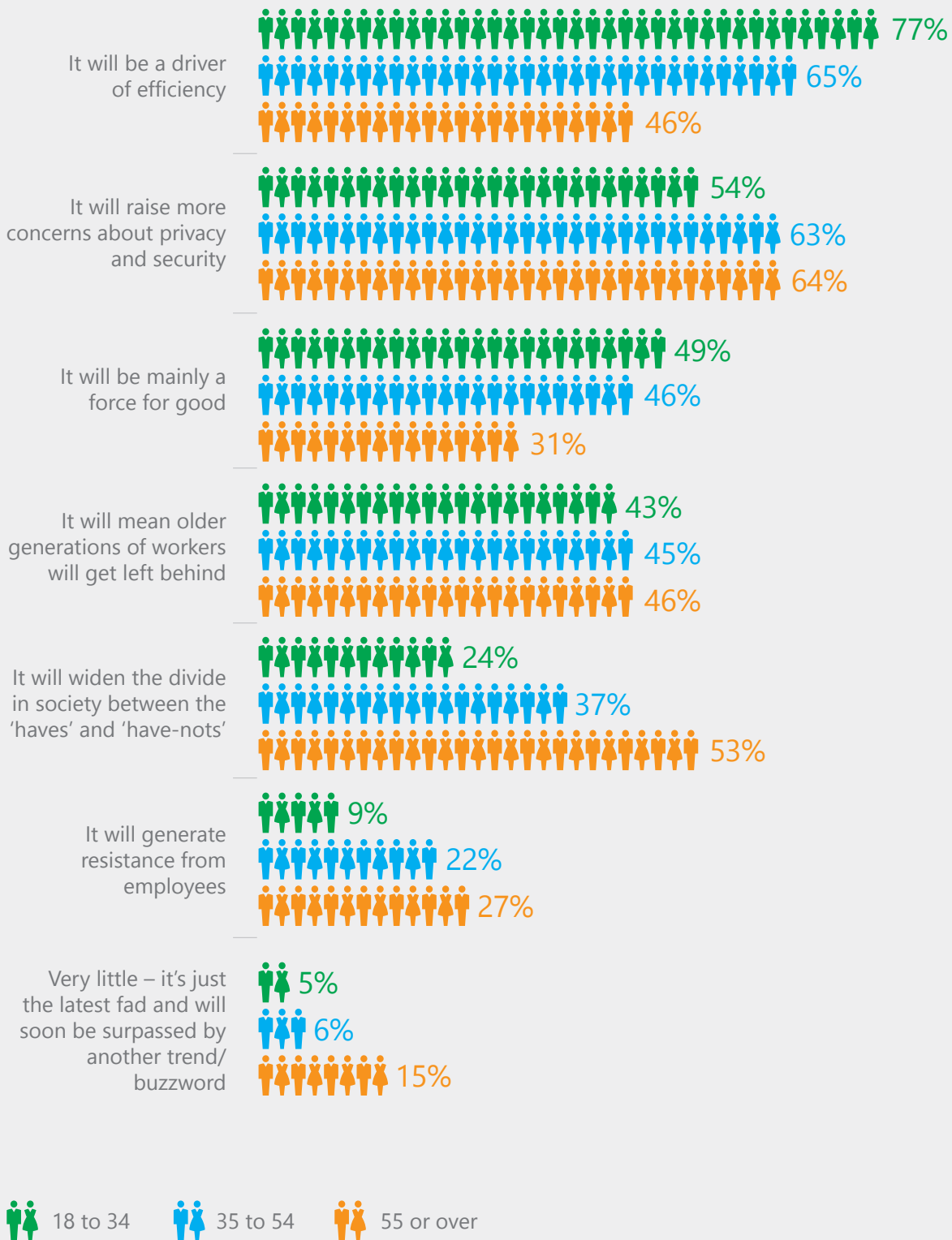
Survey respondent

The JP Morgan Media Centre, Lord's Cricket Ground, London © David Miller Architects

Figure 12. Younger professionals more likely to see the benefits of digital transformation

Impact on society by age

It will be a driver of efficiency
77%
65%
46%

It will raise more concerns about privacy and security
54%
63%
64%

It will be mainly a force for good
49%
46%
31%

It will mean older generations of workers will get left behind
43%
45%
46%

It will widen the divide in society between the 'haves' and 'have-nots'
24%
37%
53%

It will generate resistance from employees
9%
22%
27%

Very little – it's just the latest fad and will soon be surpassed by another trend/ buzzword
5%
6%
15%

18 to 34   35 to 54   55 or over

Beyond architecture

The RIBA *'serves our members and society in order to deliver better buildings and places, stronger communities and a sustainable environment. Being inclusive, ethical, environmentally aware and collaborative underpins all that we do'.* For digital transformation to be truly beneficial, in the eyes of architects and the RIBA, it needs to help achieve outcomes that align with this purpose.

A little over half of the respondents to this survey (56%) say that digital technologies help to design better buildings and places, and improve client outcomes. In terms of its impact on wider society, almost two thirds (64%) think that it will be a driver for efficiency – echoing the benefits to architecture already highlighted in this survey. Forty-three percent believe that digital transformation will mainly be a force for good.

But there are concerns. Sixty percent believe that digital transformation will raise more concerns about privacy and security. Some think that it might make society less equal, with 45% concerned that older generations will get left behind and 37% saying that it will widen the divide between the 'haves and the have-nots'.

Age is an important factor. Figure 12 shows that younger design professionals are more likely to see the benefits of digital transformation and less likely to see a downside.

However, 43% of survey respondents under the age of 35 still think that older generations will get left behind. Digital transformation should benefit all in society, so this does represent a challenge that should be discussed and debated, including within the architectural community.

Enabling conversation at all levels of our membership is key. From architects gathering at grass roots local level, discussing the smallest changes that software and hardware have enabled, through to leadership development courses involving digital innovators and RIBA council discussions on the future of our profession. All these set a challenge to the RIBA to keep its members on the path of high performers, of digital change, improvement and transformation.

So far the architectural profession has been leading digital transformation, not least through BIM. But when we look across at other industries we can see that even those who were once leading in the digital economy can be caught off guard by the unforeseen disruptor. We don't think that the true disruptor has arrived yet. But it may, and soon. It is the nature of disruptors that they tend to come out of the blue.

Architecture and design practices need to prepare for the future now. They need to consider and discuss the trends, opportunities and challenges that digital transformation may bring so they are ready to adapt when the time comes. We hope that this report helps provide a catalyst to that thinking and preparation for the future.

Preparing for the future – what practices can do to take advantage of digital technologies

Take a business-focused approach
Practices that plan for change, document goals and strategies, and review progress have been shown to successfully adopt new technologies.

Include and empower staff
Staff often have skills and ideas that can drive a business forward. Giving them responsibility also encourages them to stay and apply the knowledge and skills that they have learnt.

Look for opportunities to innovate
Hardware and software require investment. Some clients may support or require the use of tech in their project, which could help to fund such investment.

Bring in the right skills
Partnering with organisations who have experience using digital tech or recruiting staff with specialist skills may increase productivity.

For more information, please visit
https://enterprise.microsoft.com/en-gb/

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