

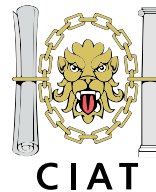


DIGITAL 2023 CONSTRUCTION REPORT

IN ASSOCIATION WITH

G Glenigan

Thank you to all 723 people who took the time to complete the survey, and to the organizations shown below that supported NBS by promoting it to their members and networks. We are extremely grateful.



We are particularly grateful to our sister company Glenigan for supporting the survey and contributing to this report.



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Foreword



Dr. Stephen Hamil,
Innovation Director



David Bain,
Research Manager

This is the second 'Digital Construction Report', as opposed to our 'BIM Report'. There is a range of digital technologies and processes that have the potential to support the creation of a better built environment. We aim to put this report forward as a platform for discussion about their development. It also represents a snapshot of the adoption of such technologies in 2023 – highlighting how things have changed, and also what might be coming. BIM remains a key part of this, as you'll see in the results. So, while the discussion around BIM has also evolved, we continue to track trends relating to BIM.

It's hard to have a discussion about digital tech in 2023 without mentioning artificial intelligence (AI). While there has been plenty of talk about AI and machine learning over the years, it has really gained momentum over the last year or so. We've therefore covered AI in this survey, along with cloud computing, off-site construction, virtual reality and digital twins.

We continue to measure attitudes relating to digital tech's ability to help us build better. After all, what's it all for if it doesn't help us create better, more sustainable and safer buildings? This feels particularly relevant now, following the recent publication of secondary legislation for the Building Safety Act.

The construction industry has been accused of being slow to innovate and adopt new ways of working. However, in recent years, there seems to have been a huge amount of innovation, technology adoption and new tools for professionals to use. In reflection of this, we felt that it was a good time to ask built environment professionals whether they think the industry has caught up – or whether construction still lags behind other sectors. Read on to find out, and to better understand what construction professionals think – and how they are using digital technology to meet the challenges that they face.

We thank all those who took the time to share their views, and all those that supported the survey by promoting it on our behalf.

01

Introduction

We conducted the survey between July and September this year. 723 construction professionals took part. They represent the main project roles: client, constructor, consultant and supplier. As in previous surveys, around two thirds of respondents work in consultant roles, but clients, constructors and suppliers are all also well represented. This allows us to compare views on digital construction by project role.

Breaking the main project roles down, the survey represents views from architects, engineers and other consultants and design professionals. It also includes people working for main contractors, subcontractors and specialists. These include BIM specialists, as well as project managers, quantity surveyors and other consultants. There are similar professionals from client organizations, which include local authorities, developers and education providers, among others. And we have responses from marketing and technical product specialists from suppliers and manufacturers. Organizations range in size from sole practitioners and micro businesses to multinationals with thousands of employees. And there are responses from individuals just beginning their careers alongside those with many years of experience.

The survey continues to present a picture of the views of UK professionals but, in addition, includes perspectives from around the world. 72% of respondents are based in the UK, meaning that 28% are in other countries – particularly those in Europe (outside the UK) and Asia. Compared with our 2021 survey, that's a slight drop in the proportion of international respondents, which was over a third of respondents, but is still higher than in surveys before 2021. In fact, respondents were from over 60 countries in six continents. This range of represented geographies continues to give us insight into digital construction in different parts of the world, and is perhaps an indicator of the interest that people in other parts of the world take in what's happening in the UK.

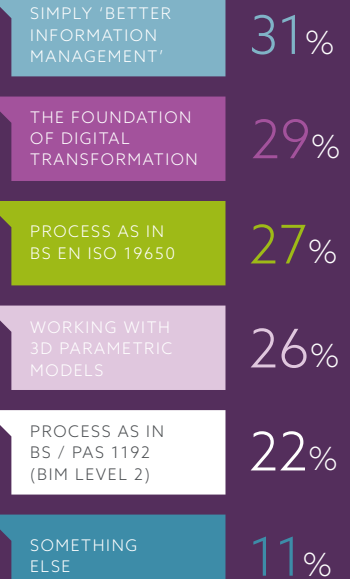
See section 06 to read the profile of respondents and survey methodology in more detail.

02

BIM: Different things to different people?

We begin with BIM. Given the development of different standards, the amount of terminology associated with it and even debates about what it is actually called, we wanted to ask respondents how they would describe it. Is it the process of following the BS EN ISO 19650 suite of standards? Is it 'Level 2' BIM or working with 3D models? Is it the foundation of digital transformation in the sector? Or is it simply 'better information management'? The survey results suggest that, to some extent, it's all of these things. And in a way, that's not surprising.

HOW PEOPLE VIEW BIM



In part, it's likely to be a reflection of where people are on their BIM adoption journey. Perhaps they began a few years ago and followed the PAS 1192 standards; now that there are new standards, it can take time to read and learn how to apply them (e.g. the ISO 19650 suite). Having said that, focus has moved away from the BIM Levels, and the number of people relating BIM to PAS 1192 does seem to be falling (22%).

For others, it may be important – and a project requirement – to adopt the latest international standards outlined in BS EN ISO 19650: 27% describe BIM in this way. We do find that smaller organizations, of 25 staff or fewer (17%), are less likely to see BIM as following this set of standards. In terms of professional discipline, unsurprisingly it's the BIM specialists who are most likely to see BIM in terms of the BS EN ISO 19650 process (55%). They are also most likely to view it as better information management (38%) and the foundation of digital transformation (41%).

n = 674. All respondents who gave an answer (excluding 'don't know').
Q: How would you describe BIM in 2023?
Percentages don't add up to 100% as respondents could select multiple answers.

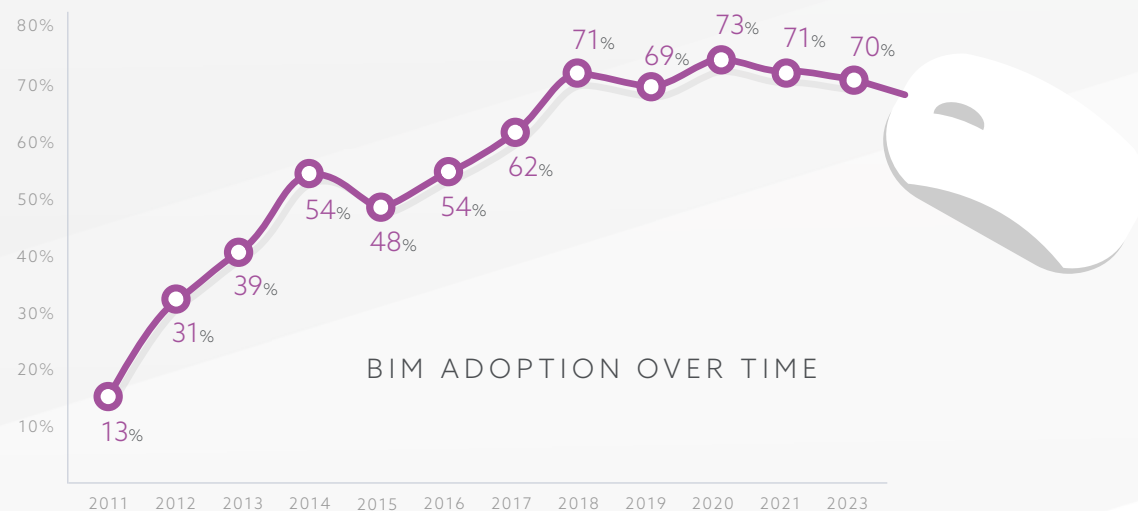
At its core, the ethos of BIM is to manage information better. Getting back to this in an attempt to limit the use of jargon may appeal to many (31% described it as this); perhaps those working on smaller, simpler projects in particular. And the requirement to create structured data – that can be accessed and ‘understood’ by machines and shared between different platforms – can make it a foundation of transformation, enabling the use of digital twins, AI and other forms of digital technology: 29% of respondents view BIM in this way. This increases to 37% among people in large organizations with more than 250 staff.

While many stress that BIM is much more than 3D modelling, it is still part of the process, so it’s not surprising that some people focus on this aspect (26%). In fact, among architects, this is the most common response (32%). Only 18% see it as the foundation of digital transformation, although 31% of architects do view BIM as better information management.

When we look at these responses by people’s adoption of BIM, we find that those who have not adopted BIM are less likely to describe it as following the processes in the standards: 18% see it in relation to BS EN ISO 19650, compared with 31% of those who use BIM. Those not using BIM are most likely to see it as better information management (30%), and more of this group describe it in another way (15% compared with 9% of BIM adopters).

BIM adoption

A solid majority of construction professionals, 70%, say that they have adopted BIM. This means that for the last five years, since 2018, the proportion adopting BIM has remained virtually unchanged. There are some differences between roles, with adoption rising to 73% among consultants and, perhaps unsurprisingly, it’s lower (53%) for clients.



BIM adoption among architecture and landscape practices is higher, at 77%. It's higher again among multidisciplinary practices, especially in the UK (88%). UK-based engineering organizations are also more likely to be using BIM (83%). Some professions did point out the importance of ensuring that BIM processes, and the tools that support them, are applicable to landscape and infrastructure works – not just to buildings.

“ BIM data within natural [objects/ materials] (trees, plants, grass etc.) lags far behind [man-made] materials and therefore makes BIM within landscape [works] tougher to implement accurately... with the importance for producing environmentally friendly designs increasing, it will become necessary to close this gap so that designs can be [realized] within BIM [software] ”

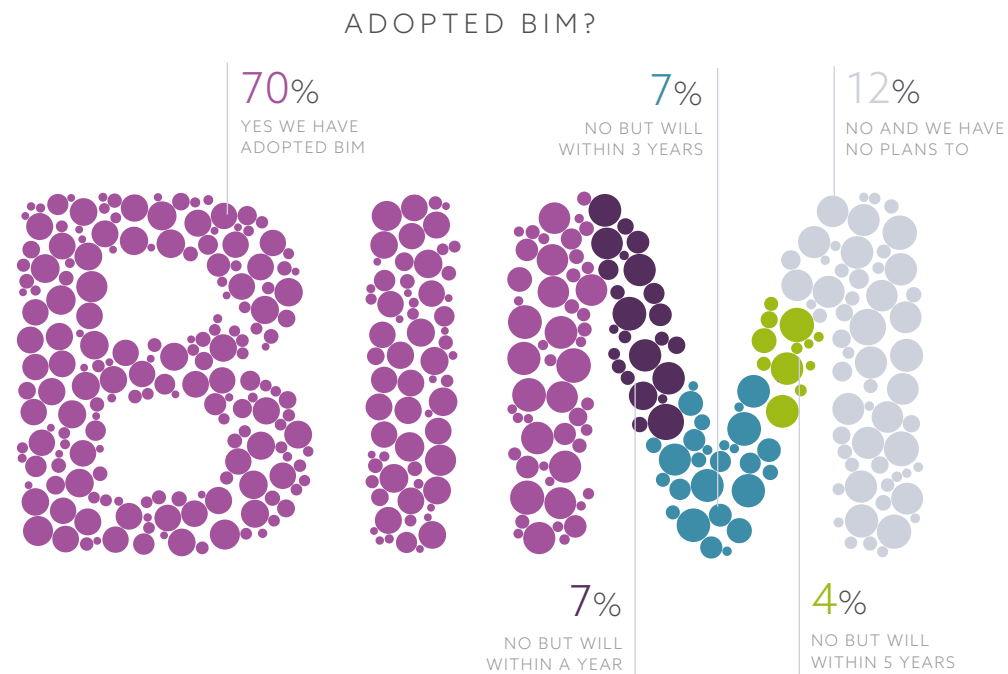
Architectural technician, medium-sized environmental consultancy

There remain large differences relating to organization size, with BIM adoption dropping to 60% among organizations with 25 or fewer staff, and 56% for those with 15 staff or less. Age can have an effect too, with those over 55 less likely to have adopted BIM (59%), and more likely to have no plans to (22%).

“ A significant sector of the construction field is sole practitioner architectural consultants like myself working on small to [medium-sized] projects of mainly domestic refurb and alterations for which BIM is an irrelevance ”

Architectural technologist, small architectural technologist practice

18% of respondents say that they plan to adopt BIM: 7% within the year; while 12% have no plans to adopt it. Given that almost a fifth intend to use BIM, one would think that adoption would continue to increase, especially as previous surveys have also shown this intent. The fact that it hasn't suggests there are still barriers to some professionals, which are making it difficult for them to adopt BIM. The proportion with no plans rises to 19% among organizations with 25 or fewer staff, and 23% among those with 15 staff or less. These figures show that some of the challenges to BIM adoption which particularly affect smaller organizations, and were raised years ago, are likely to remain: factors like lack of client demand, the additional time and cost, and projects perceived to be too small to warrant its use.



n = 678. All respondents who gave an answer (excluding 'don't know').
Q: Based on your answer to the previous question, have you adopted BIM?
Percentages may not add up to 100% due to rounding.



“ *Clients need to be educated that design costs will increase significantly and [on-site] costs will reduce as less error and variations will be made... decisions are needed much sooner with economic commitments made. This shift in budget [utilization] is a huge barrier to digital progress* ”

Quantity surveyor, small quantity surveying practice

“ *I think there is generally a knowledge gap between senior construction professionals and junior staff using BIM software full time, making it harder to calculate the level of resource required to deliver a certain level of [detail/ information]. If BIM as a process was more inclusive of all team members, especially in small to [medium-sized] businesses, everyone might better understand what they're signing up to when they take on contracts with BIM as a deliverable* ”

Architectural assistant, medium-sized architectural practice

BIM tasks

In order to comply with the processes set out in the ISO 19650 suite, there are a number of tasks that should be carried out, or documents that should be produced. The task that respondents are most likely to be involved with is model design reviews (68% of those who have adopted BIM, and 56% of all respondents). 64%, of those using BIM, had some involvement in using common data environments (CDEs), which is slightly higher than the 60% in 2021, but lower than the 67% in 2020. However, there has been a fall in the number of those citing BIM Execution Plans: from 67% in 2020 to 63% in 2021, and 58% this year. Conversely, more respondents (46%) mentioned being involved with a detailed responsibility matrix (39% in 2021).

So, this is a mixed picture. Digging deeper, we do find differences. Contractors (41% of which are main contractors) are the group most likely to have been involved with these tasks or platforms, especially CDEs (80%). This may be expected, as main contractors will often have their preferred CDE and manage much of the information sharing on a project. They are also more likely to be involved in BIM Execution Plans (73%) and detailed responsibility matrices (DRMs), 60%. This could involve receiving these, as well as developing them. The figures for consultants are lower: 65% for involvement with CDEs, 61% for BEPs, and 48% for DRMs. 50% of architects practices are involved with DRMs. Engineering and multidisciplinary organizations are more likely to be involved with several of these tasks; model design reviews for instance (both 81%). In general, these tasks and tools are less likely to be cited by smaller organizations.

“Contracts have picked up the key points, i.e. we need a BEP and a CDE, etc. but they do not necessarily appreciate what these add to the process in terms of skill, time, cost... There is also a huge impact on the skill building of very precious apprentice, graduate and early years design engineers”

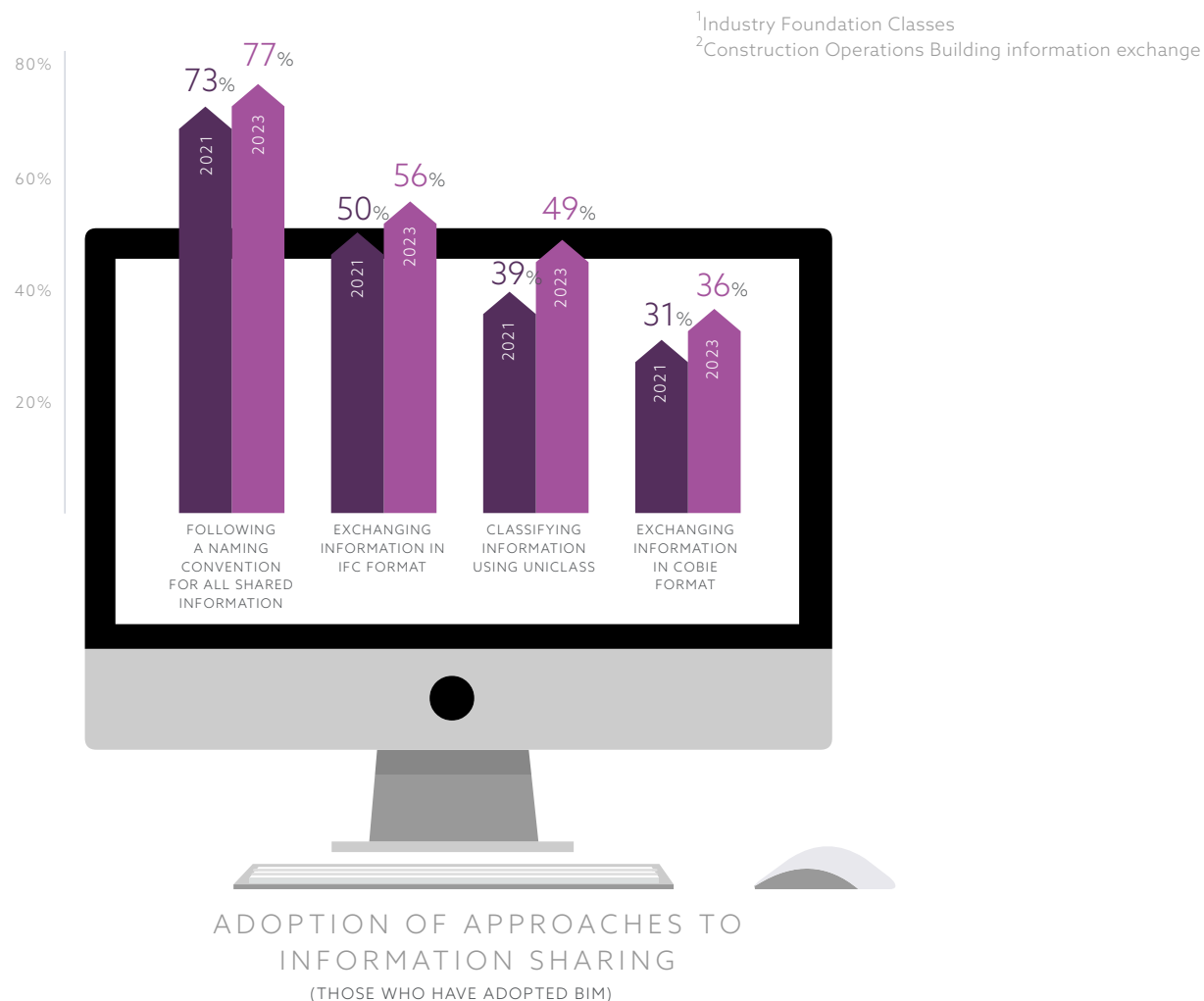
Building services engineer,
large building services
engineers practice



n = 467. All those who have adopted BIM and gave an answer (excluding 'don't know').
Q: Thinking in more detail about BIM, in the last 12 months, which of the following things have you been involved with, in some way, on projects you have worked on?
Percentages don't add up to 100% as respondents could select multiple answers.

Information sharing

While the adoption of BIM-related tasks as shown on the previous page doesn't appear to have increased much, in terms of information sharing, there appears to be an increase on all counts. Over three quarters (77%) now say that their organization follows a naming convention for all information that is shared. More than half (56%) exchange information in IFC¹ format, and 36% in COBie² format. The proportion exchanging information in IFC is higher among engineering practices (75%).



Q: Which of the following approaches has your organisation adopted with respect to sharing information?
Percentages may not add up to 100% due to rounding.

“BIM is one step. There [need] to be better links between various stages in a complete project cycle from design to code review to construction to maintenance to operations to retrofit to demolition. Many of these are in separate silos that don't share the same real-world data. There need to be open standards that make this easier and seamless”

BIM specialist
medium-sized multidisciplinary
design practice

“...construction workers did not have access to the model... It seems this is where a large disconnect is. How does the design information get delivered to the people doing the actual building in an effective way?”

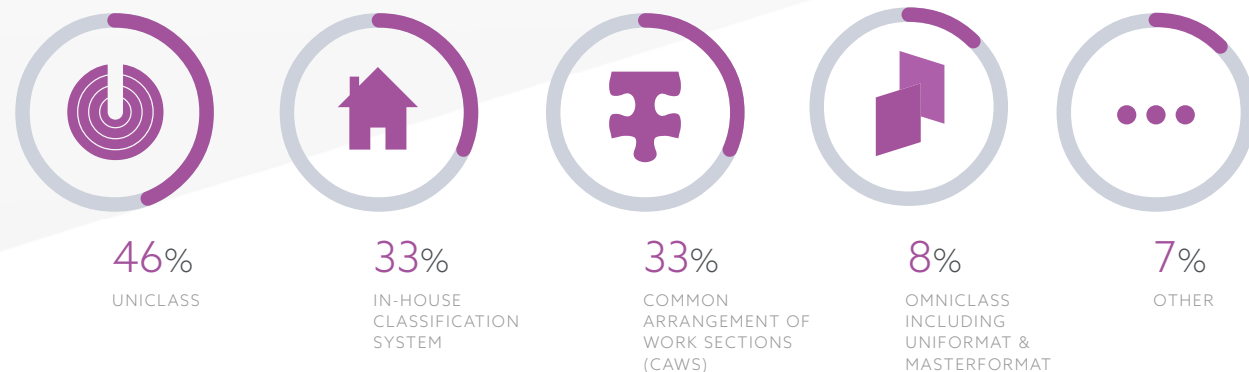
Project manager
medium-sized
architects practice

Classification

One thing that has been notable over the years, when we have asked about classification, is the relatively high number who don't know which classification is used. In this survey, almost a fifth (18%) are not sure which classification their organization most commonly uses. Once we remove those who aren't sure, we find that 46% cite Uniclass as the most commonly used classification. This is considerably higher than in 2021, and also higher than the proportion saying that Common Arrangement of Works Sections (CAWS) is most commonly used (33%).

Contractors are most likely to be using Uniclass most often, although we should note again that quite a high proportion of this group are main contractors, who are perhaps more likely to be working on large projects. Consultants are the heaviest users of CAWS (38%), but are still more likely to use Uniclass most often (47%). Among architects, specifically, use of CAWS is still slightly higher than Uniclass, especially in the UK: 52% vs 48%. Similarly, for technologists and technicians: 46% vs 36%. Whereas Uniclass use among UK BIM specialists is much higher: 80%. Use of Uniclass is also higher in UK engineering (69%) and multidisciplinary organizations (72%). Clients and suppliers are more likely to state that they use their own in-house system.

MOST COMMONLY USED CLASSIFICATION



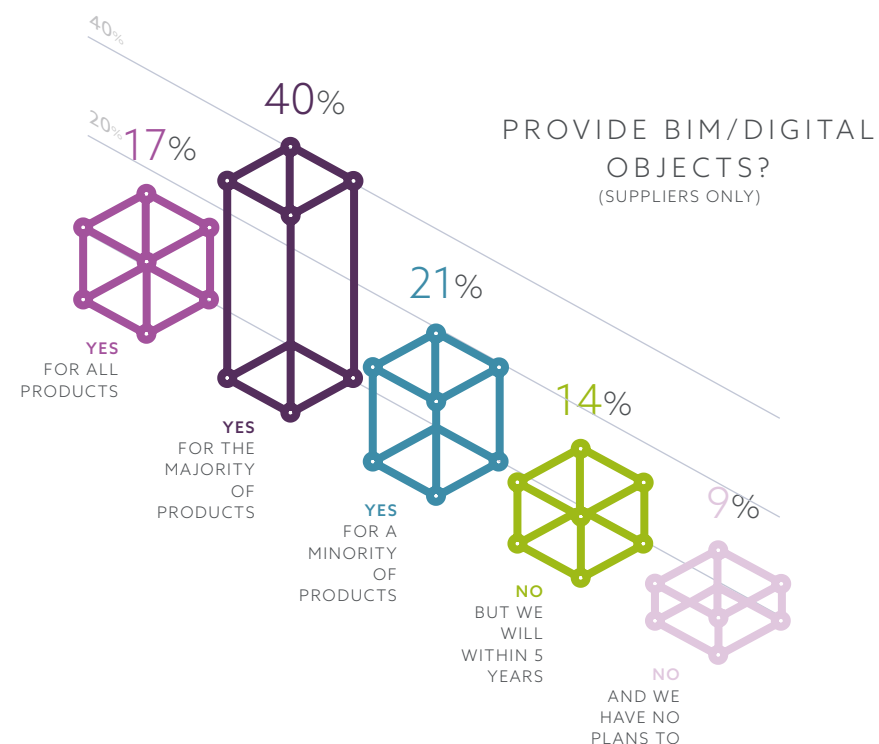
n = 585. All respondents who gave an answer (excluding 'not sure').
Q: What type of classification is most commonly used on projects that you work on?
Percentages don't add up to 100% as respondents could select multiple answers.

Digital objects

Over the years, in the results from this survey and other surveys about product information, we have seen that specifiers want manufacturers to provide them with BIM/ digital objects. It saves them time, providing the technical data and geometry that they can quickly insert into the model and link to their specification. In some cases, specifiers have said that they are less likely to specify a particular product if there isn't a digital object for it.

It is therefore a good strategy for manufacturers and other suppliers to provide digital objects. The survey results suggest that manufacturers are responding to this need, with over half (56%) providing digital objects for the majority or all of their products, compared with 52% in 2021.

The Building Safety Act requires information associated with projects to be stored digitally and changes to be recorded. It places increased responsibility on decision makers who need to be confident that they are making the right design decisions. They will therefore need to have all the required technical data at their fingertips, and it must be clear, accurate and up to date. In turn, this will place increasing demands on manufacturers and suppliers to provide detailed technical data about their products. As well as the expected performance data, specifiers are looking for things like third-party certification and Environmental Product Declarations (EPDs). Manufacturers need to have the processes in place to maintain detailed and accurate product data. And if any of it changes, they need to be able to push amendments out wherever that data is surfaced, be that their websites, intermediary websites, product data sheets, digital objects or specification clauses.



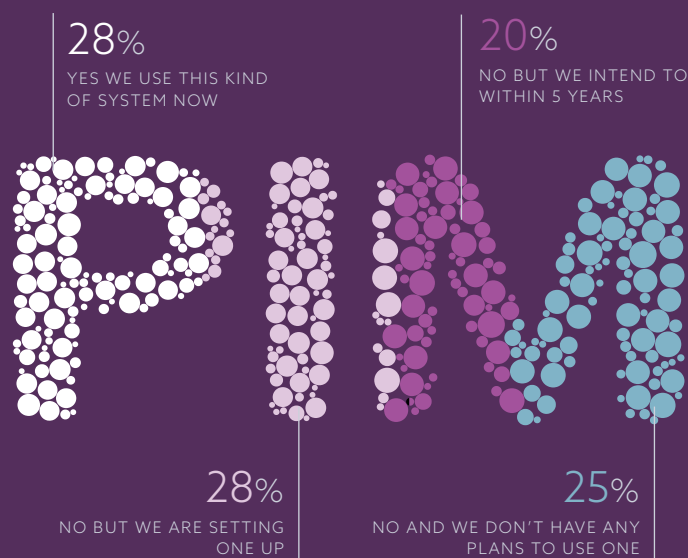
n = 78. All supplier respondents who gave an answer (excluding 'don't know').

Q: Do you currently provide information about the materials, products or systems that you supply, in the form of BIM or digital objects?

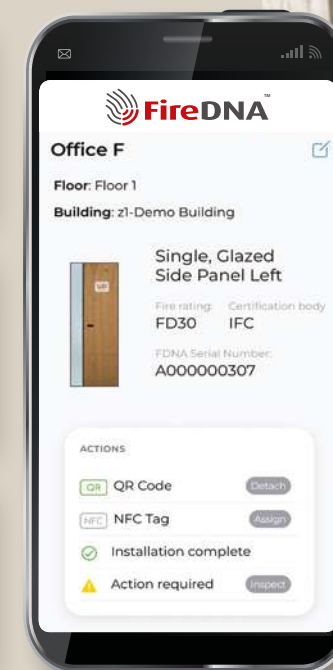
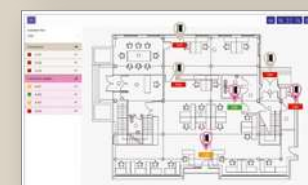
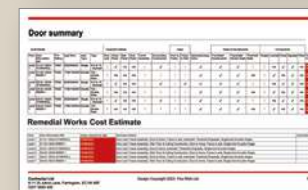
Percentages may not add up to 100% due to rounding.

Product Information Management (PIM) systems can help manufacturers and suppliers manage their product data, especially those with large product ranges. 28% of suppliers are using this kind of system currently: slightly more than the 23% in 2021. A further 28% are in the process of setting one up, compared to 19% two years ago. A fifth intend to introduce one in the next five years. These figures indicate a gradual adoption of PIM systems.

USE OF PIM SYSTEMS (SUPPLIERS ONLY)



n = 61. All supplier respondents who gave an answer (excluding 'don't know').
Q: Do you use a Product Information Management (PIM) or similar system to manage your product information?



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Digital transformation and the adoption of new technologies

Despite the range of views about digital transformation and BIM (and there is a wide range!), there seems to be consensus on at least one thing: that a digital transformation is happening. And as results from our surveys over the past few years show, most professionals recognize that their organization is somewhere on this journey. But what are the trends within this journey? Which technologies are particularly topical in 2023, and being used to benefit the built environment?

03

Cloud computing

The use of cloud computing is becoming further embedded, with four out of five respondents stating that they use it – slightly higher than the 77% in 2021. This increases to 87% among large organizations (251 employees or more). Multidisciplinary organizations are particularly likely to use it (90%). While many who feel that they haven't yet adopted it do intend to, there is still a minority who have no plans to do so. There are also some who aren't sure whether they use cloud computing.³ This raises an interesting issue about terminology. Here are a couple of definitions of cloud computing:



'The practice of using a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer'. – *Oxford Language*



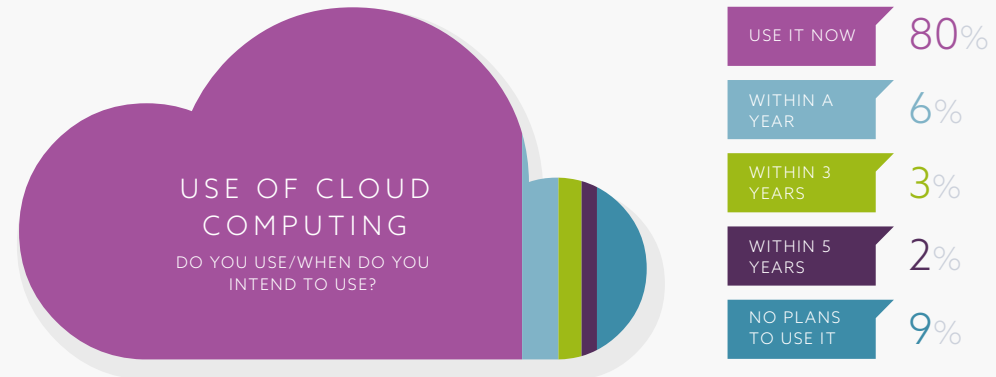
Cloud computing is on-demand access, via the internet, to computing resources—applications, servers (physical servers and virtual servers), data storage, development tools, networking capabilities, and more—hosted at a remote data center managed by a cloud services provider (or CSP). – *IBM*

The IBM definition goes on to assert that:

'If you use a computer or mobile device at home or at work, you almost certainly use some form of cloud computing every day, whether it's a cloud application like Google Gmail or Salesforce, streaming media like Netflix, or cloud file storage like Dropbox'.

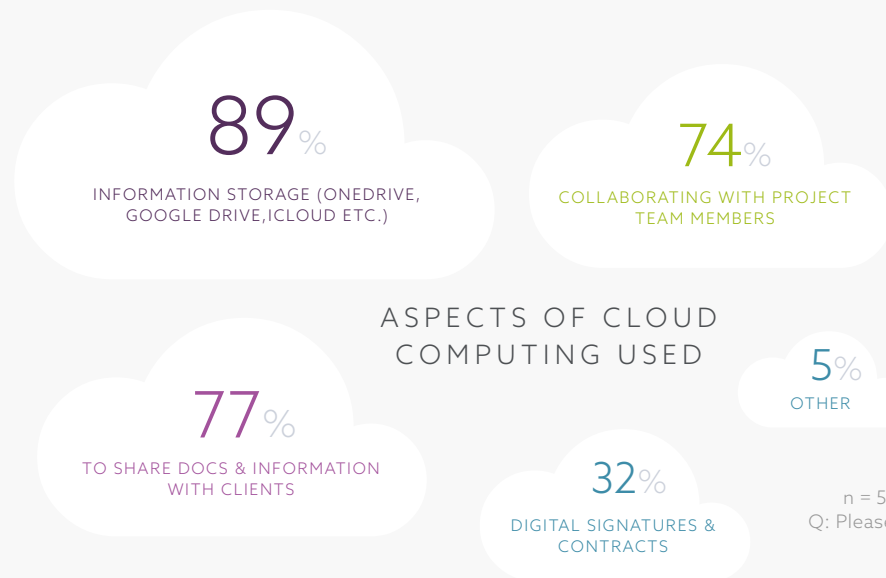
³6% were unsure whether they use cloud computing. They were excluded from the figures reported above.

This does suggest that almost everyone uses cloud computing in some form. However, because there are so many uses of cloud computing, and the line between the use of locally installed applications and internet-based programmes has become blurred, it's not always obvious. For many people, it's become ingrained in our everyday way of working.



n = 676. All respondents who gave an answer (excluding 'not sure').
Q: Within your organisation, do you use cloud computing?

So, how do people use cloud computing?
Storage is the most common use, with almost nine out of ten (89%) citing this.



“Data capture using mobile technology and surveying tools (e.g. Matterport) didn't feature heavily in this survey (although these are arguably part of cloud computing and [digitization] for [modelling]) but these are key technologies”

Quantity surveyor
medium-sized multidisciplinary design practice

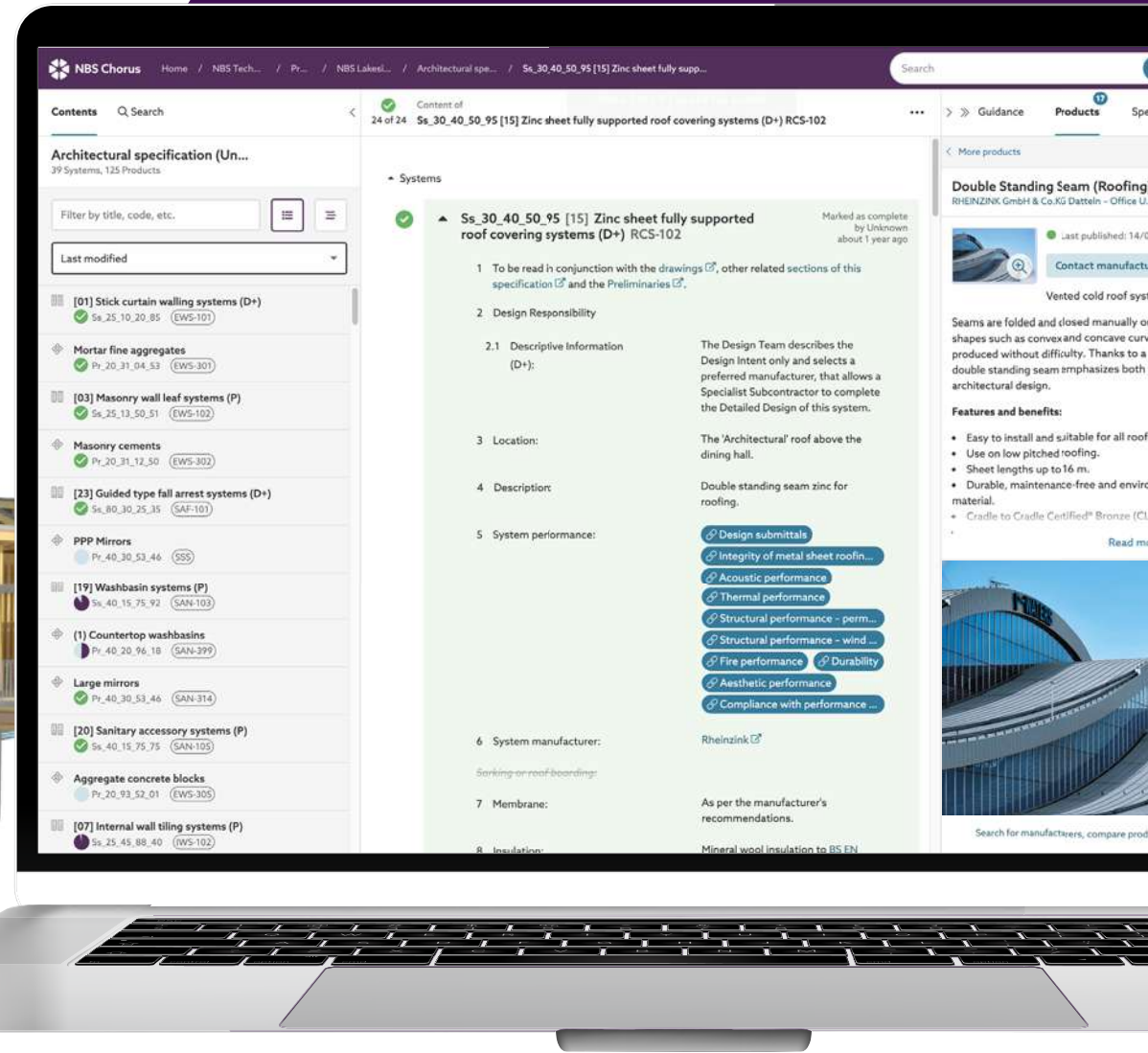
n = 532. All respondents who use cloud computing and gave an answer.
Q: Please tell us what aspects of cloud computing you use/ how you use it.
Percentages may not add up to 100% due to rounding, or where respondents could select multiple answers.

Around three quarters of professionals use the technology to share documents and information with clients, and a similar percentage are collaborating with project team members to produce models, specs and other documents. There is likely to be some overlap between these three uses. Some people mentioned other uses of cloud computing, such as data capture and surveying – using mobile tools stored in the cloud. Others also highlighted that, while the technology tends to work well, there can be interruptions to communication networks. This needs to improve to make cloud computing and remote access completely reliable.



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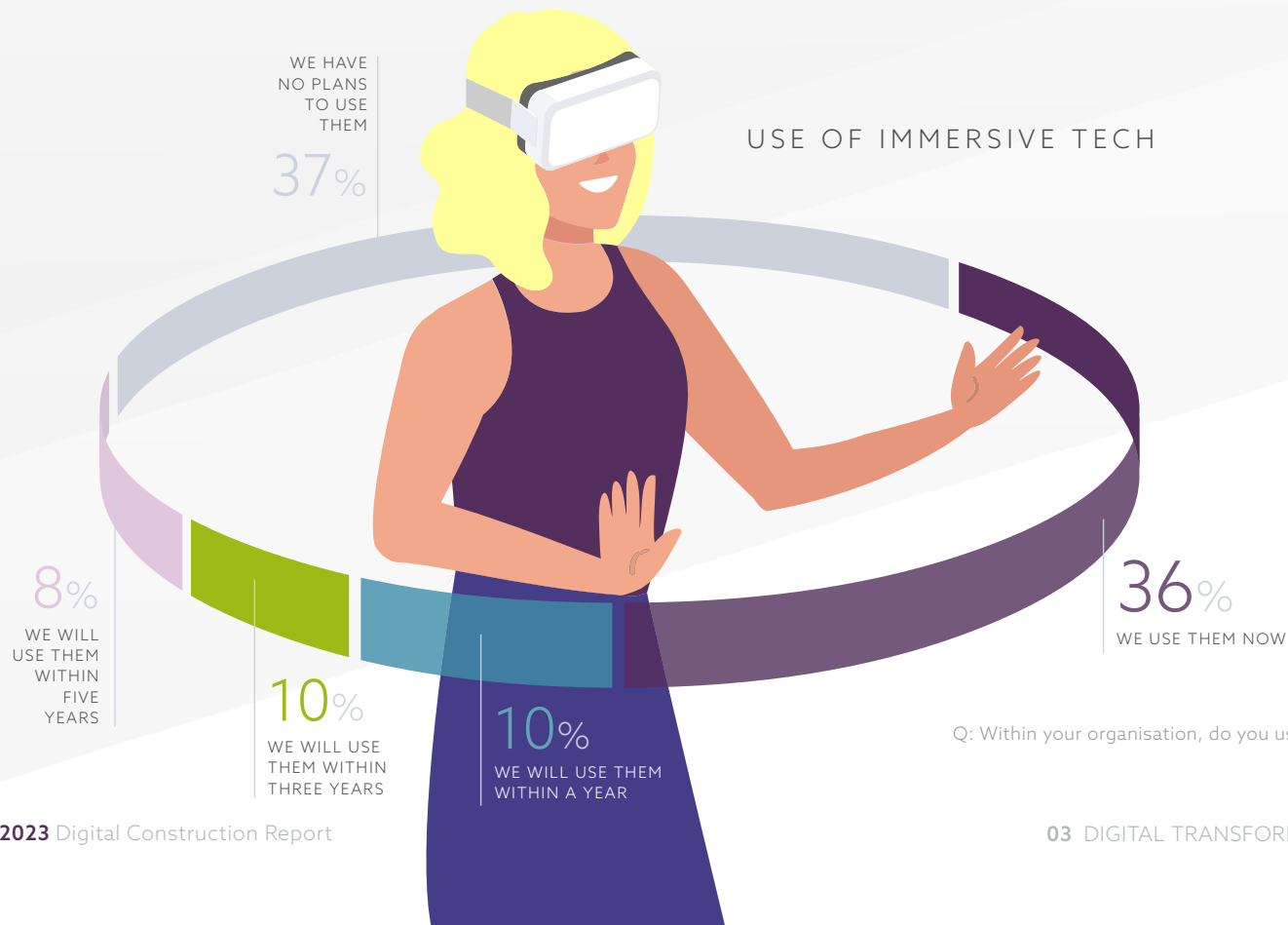


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Immersive tech

Compared to cloud computing, there is a different story with the use of immersive tech such as virtual (VR), augmented (AR) or mixed reality (MR). A relatively high percentage (17%) are unsure whether their organization uses this kind of technology. And, among those who are sure whether or not their organization uses it, over a third (37%) have no plans to use this tech. 36% use VR, AR or MR now – this figure is almost unchanged from 2021. A further 27% do have plans to use them so, while these findings suggest that adoption of immersive tech is not as high as for other technologies, a significant proportion do see its potential.

The larger the organization, the higher the number using immersive tech. 46% of large organizations (251 staff and above) use it, compared with 23% of small organizations (25 staff or less). Consultants and contractors are more likely to use it (38% and 37%, respectively), compared with suppliers and clients. In particular, multidisciplinary organizations are heavier users (46%). Architects and BIM specialists are also likely to use these technologies (43%).



n = 596. All respondents who gave an answer (excluding 'not sure').

Q: Within your organisation, do you use immersive technologies, like virtual, augmented, or mixed reality?

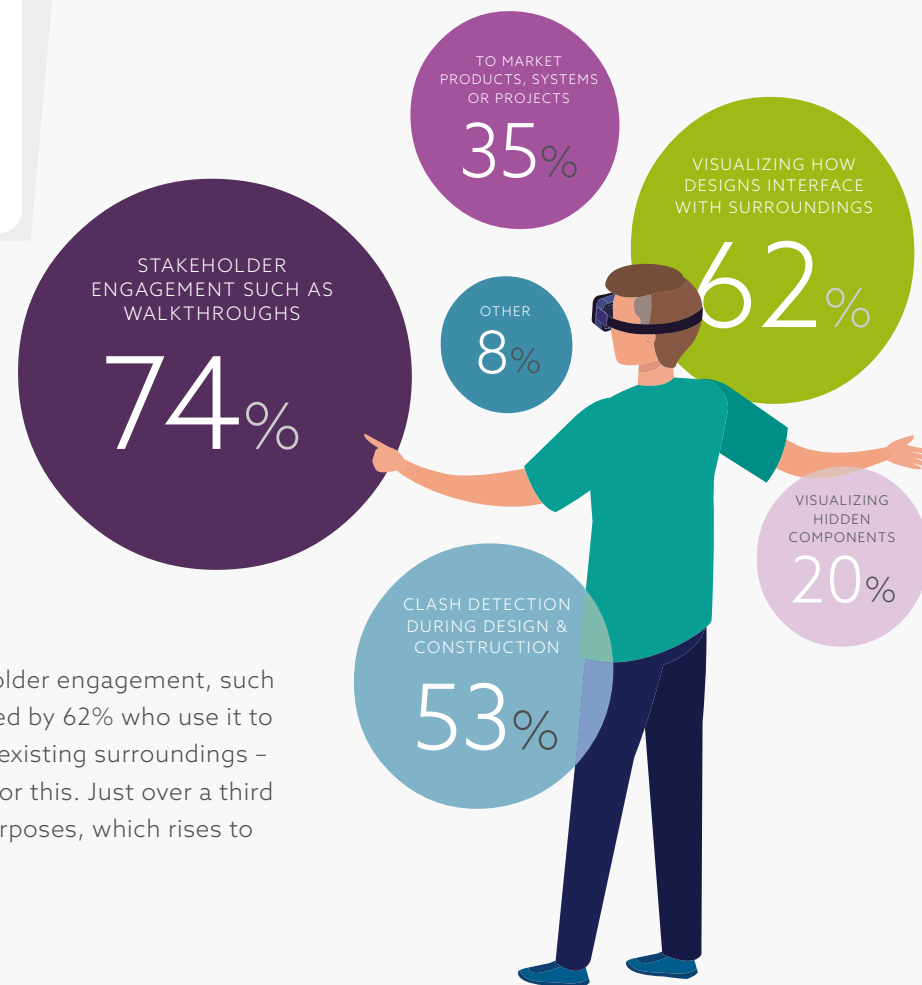
Percentages may not add up to 100% due to rounding.



“From a manufacturing perspective, we have a portal and website with VR suite for all products. We also have VR training for installation teams”

Director, medium-sized manufacturer

HOW IMMERSIVE TECH IS USED



The most common use is for stakeholder engagement, such as client walkthroughs (74%), followed by 62% who use it to visualize how designs interface with existing surroundings – most client organizations use them for this. Just over a third use immersive tech for marketing purposes, which rises to 67% among suppliers.

n = 212. All respondents who use immersive tech and gave an answer.
Q: Please tell us how you use immersive technologies/ what you use them for.
Percentages don't add up to 100% as respondents could select multiple answers.

Off-site construction

Over half (57%) of professionals⁵ have been part of a project in the last 12 months that involved an element of off-site construction or manufacture. In 2021, the equivalent figure was 50%, so this represents an increase. Suppliers are most likely to say that they were involved in projects with an off-site element (70%), followed by contractors (63%), with 58% of consultants stating this.

Perhaps unsurprisingly, sub-assemblies and accessories feature most often. This can include a wide range of components that are manufactured off site, like door furniture, roof trusses or concrete beams. This type of off-site manufacture has been taking place for many years. However, over half of respondents are involved in panelized construction, such as roof, floor or wall panels, such as SIPs.⁶ And 34% work on projects using volumetric modular construction – consisting of 3D modules like steel or timber frames, or complete rooms, interiors or even full buildings.

While there have been some high-profile closures of modular building factories and companies, these results show that many professionals are involved in volumetric, modular construction. A factory environment can provide more certainty for project planning as it reduces weather dependency. It can also help to better control the composition of materials being used, and therefore support the drive towards net zero. It could help to address the shortage of skilled tradespeople by moving more of construction into a factory environment. Robotics may also play a role in supporting this transition.

⁵Excluding the 9% who weren't sure

⁶Structural Insulated Panels

n = 654. All respondents who gave an answer (excluding 'not sure').

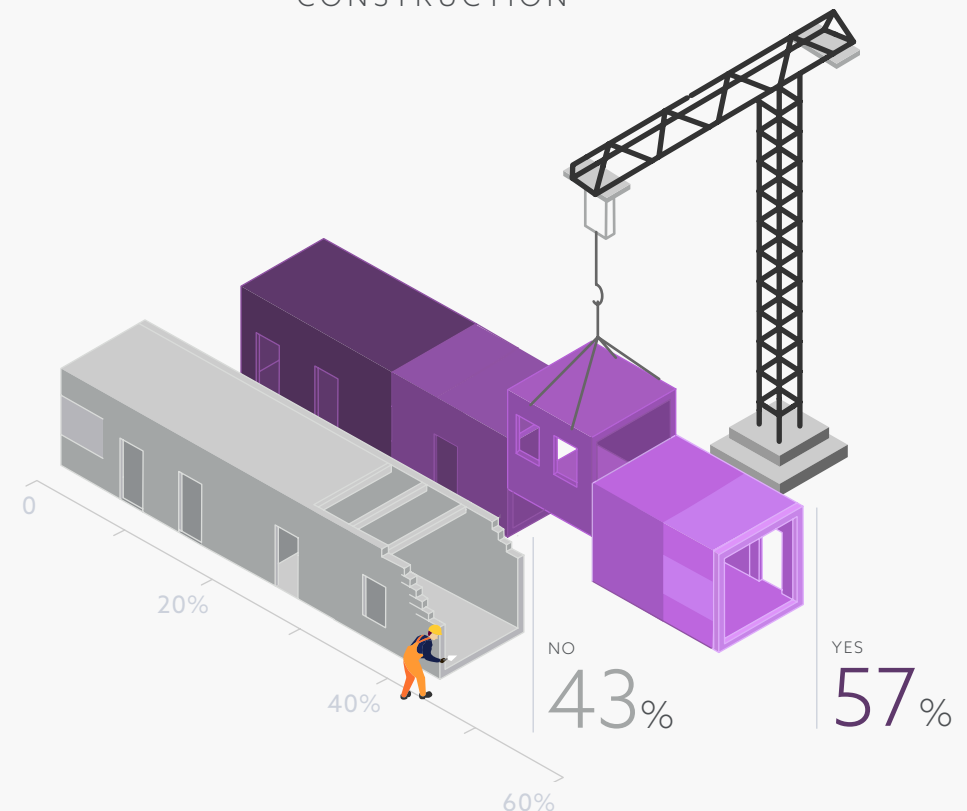
Q: In the past 12 months, have you been part of a project that involved an element of offsite construction or manufacture?

n = 367. All respondents involved with offsite construction and gave an answer.

Q: What type(s) of offsite construction or manufacture was/ were involved in these projects?

Percentages may not add up to 100% due to rounding, or where respondents could select multiple answers.

INVOLVEMENT IN OFF-SITE CONSTRUCTION



TYPE OF OFF-SITE CONSTRUCTION





“ DfMA (Design for Manufacture) is the most important digital transformation to my business strategy as a consultant in the [off-site] sector, as this is going to change the way we build. Standards & Regulations towards zero energy and zero carbon will demand a much higher control over materials and construction process and practice. We cannot rely on major site activity going forward post BREXIT... We have been talking about it for years (Constructing the Team [1994], Rethinking Construction [1998], Accelerating Change [2002], Modernise or Die [2015] but now is the time. ”

Project manager
small, MMC/ off-site consultant

Growth in off-site construction

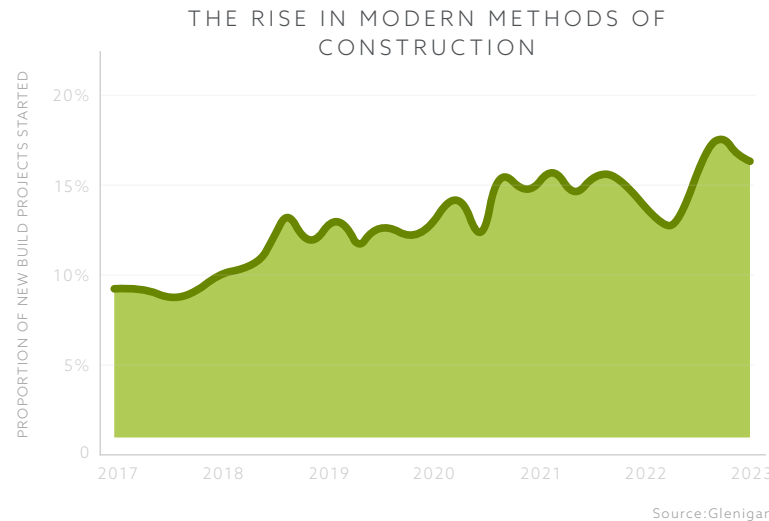


Allan Wilén,
Economics Director

G Glenigan

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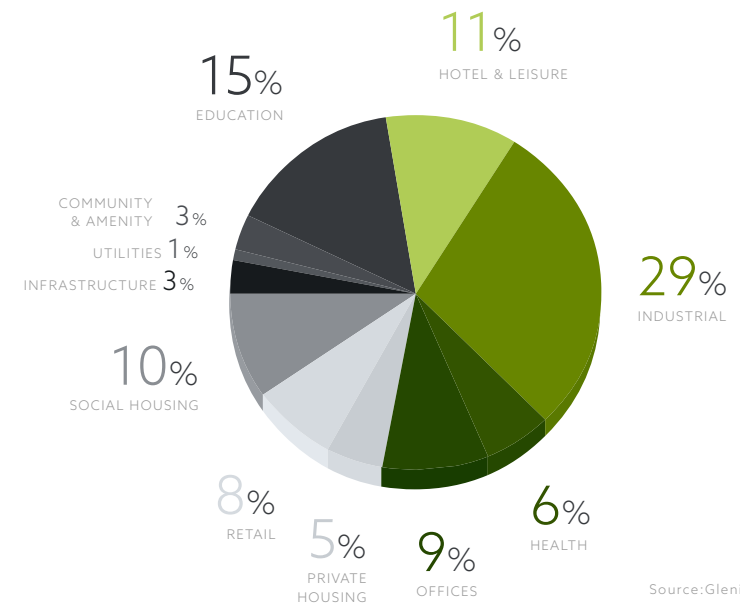
The rising number of professionals reporting that they have been involved with a project utilizing off-site construction or manufacture is reflected in Glenigan project data. Modern methods of construction (MMC), including off-site solutions, are being employed in a growing proportion of construction projects - as shown in the chart below.



The take-up of off-site construction or manufacture (as a subset of MMC) has been especially strong for new-build projects; it has been utilized in 7% of new-build projects started during the first nine months of 2023. By value, the proportion is higher (11%), reflecting the prevalence of off-site construction or manufacture in higher-value projects.

Off-site construction or manufacture has made the greatest inroads into the education, industrial, and hotel and leisure sectors. Over 22% of **new-build** education projects included an off-site element during the first nine months of 2023 and, collectively, the three sectors accounted for over half of all off-site projects as shown in the chart opposite. However, off-site construction or manufacture is also prevalent in the office and residential sectors.

PERCENTAGE OF OFF-SITE PROJECTS STARTED IN 2023 Q1-Q3 BY SECTOR



Further growth in the use of off-site construction or manufacture is anticipated over the next few years. Nearly 9% of new-build projects securing detailed planning approval during the first nine months of 2023 involved an off-site element.

In addition, economic, regulatory and environmental performance issues are set to encourage further growth in the use of off-site construction or manufacture over the medium term. The shortages of skilled labour are likely to intensify as the construction industry emerges from the current market downturn. The Building Safety Act is also set to change how projects are delivered, requiring more detailed pre-construction design and limiting the scope for on-site design changes. This should increase the opportunity for off-site components and systems. Clients and designers desiring to raise their buildings' environmental performance are similarly likely to favour the greater use of off-site systems.

Digital twins

Like BIM, the term 'Digital Twin' is likely to mean different things to different people. In the survey, we suggested the following definition: 'A realistic digital representation of something physical. What distinguishes a digital twin from any other digital model is its connection to the physical twin.'⁷

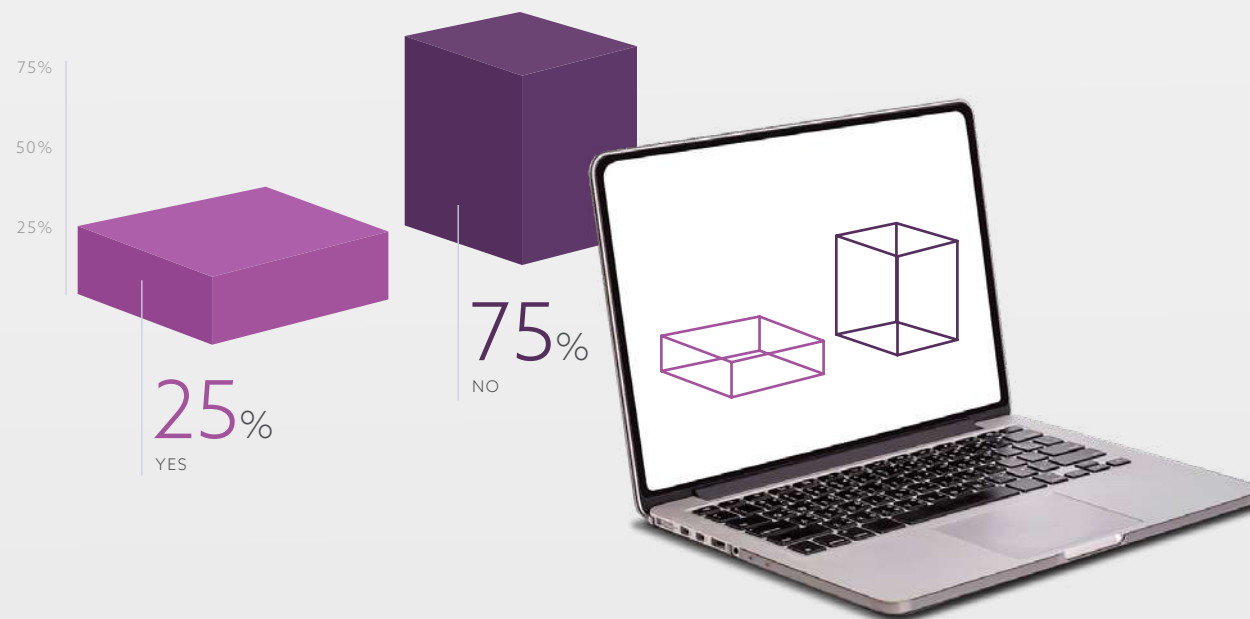
But still, a degree of caution is needed when looking at adoption trends relating to terminology that may be interpreted differently.

The use of digital twins has increased from 16% in 2021 to 25%⁸ this year. While only a quarter of respondents are part of a project that uses them, that represents a 50% increase since 2021. It does seem to indicate an upward shift in the use of digital twins since 2021, following little change in their adoption before that.

⁷[Centre for Digital Built Britain](#)

⁸Excluding the 14% who weren't sure

INVOLVEMENT IN PROJECTS USING DIGITAL TWINS



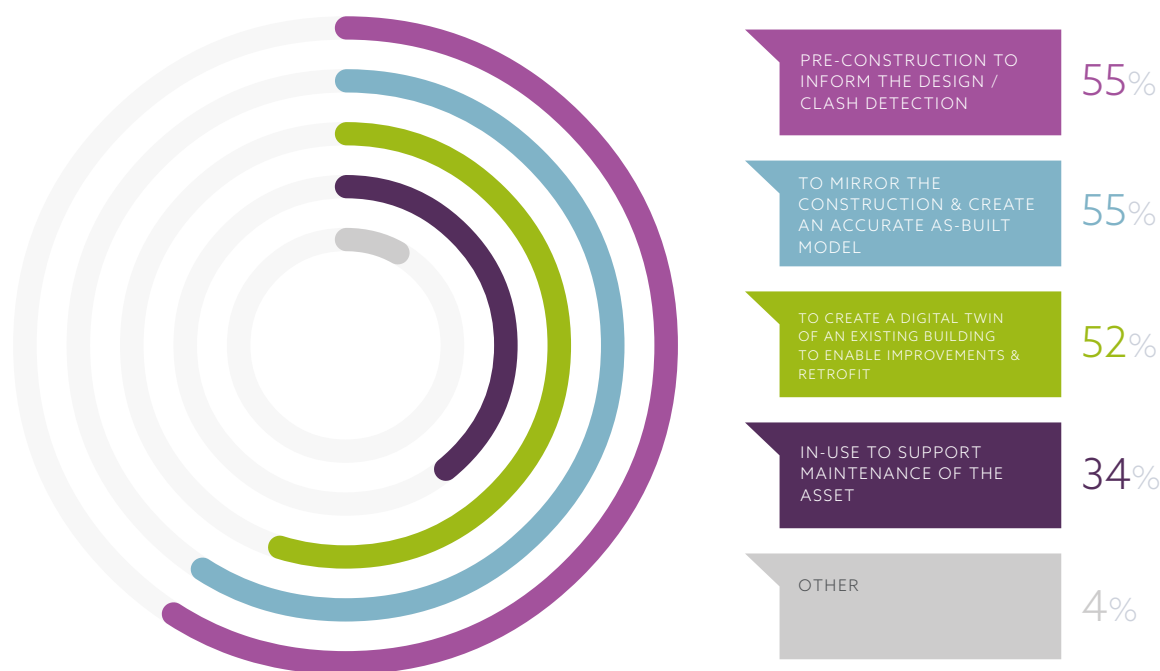
n = 616. All respondents who gave an answer (excluding 'not sure').

Q: In the past 12 months, have you been part of a project(s) that used a digital twin?

Percentages may not add up to 100% due to rounding.

Their use is highest among contractors (34%) and clients (31%), and within larger organizations (30%). BIM specialists are much more likely to mention using them (38%) than other professions. Just over half (55%) of those working on projects that use digital twins do so to mirror the construction, and to create an as-built model. This figure rises to 69% among contractors, although consultants also have experience of this (59%). The other most common reason for using this technology is pre-construction – to inform design, including for clash detection (55%). Almost half (52%) were involved in projects to create a digital twin of an existing building to enable improvements and retrofit.

HOW DIGITAL TWINS ARE USED



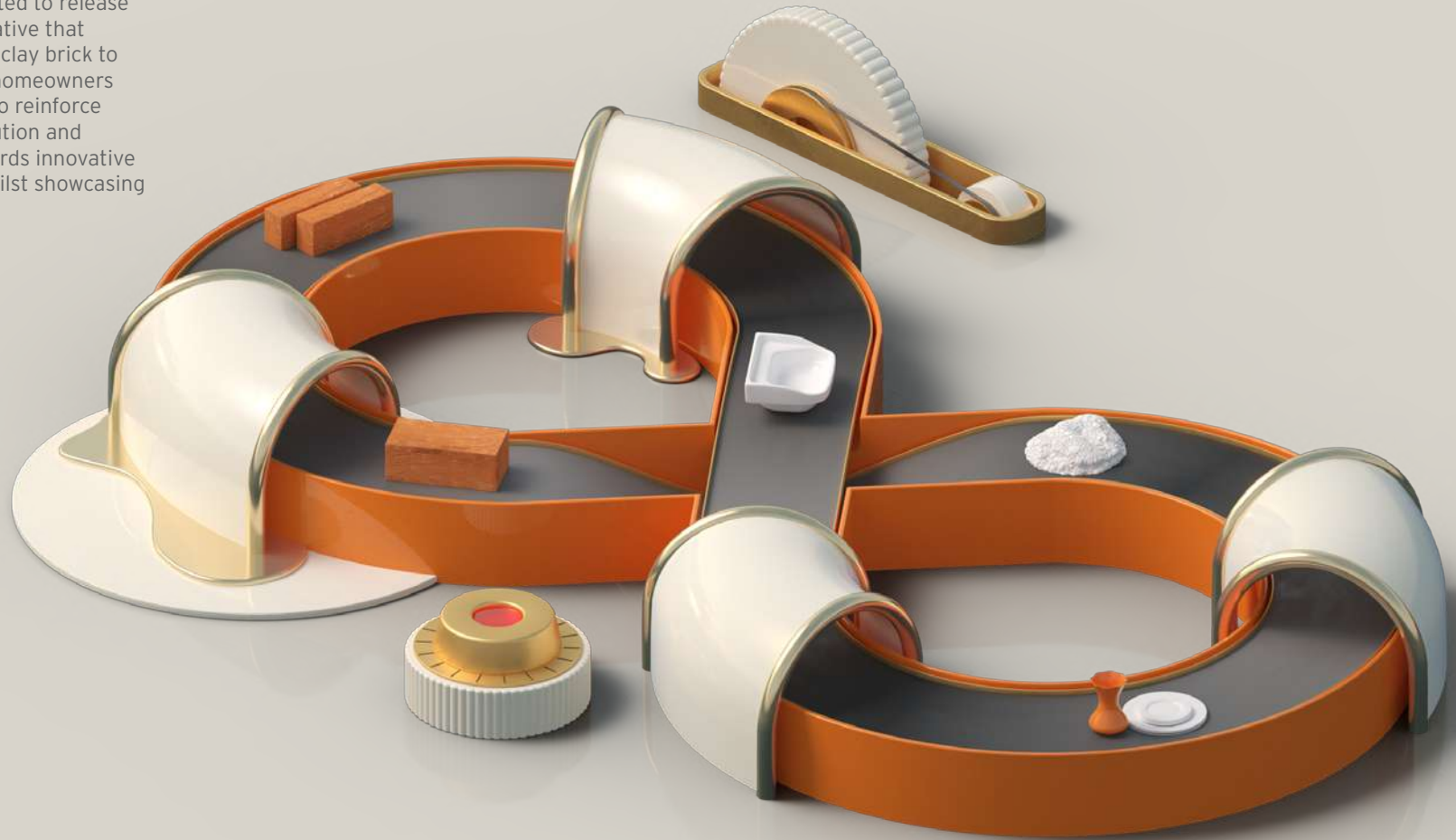
n = 148. All respondents involved with digital twins and who gave an answer.
Q: Please tell us more about how the digital twin was used.
Percentages don't add up to 100% as respondents could select multiple answers.

“BIM, [cloud] computing, and information reliability evaluation tools are the infrastructure that supports effective implementation of digital twins and useful outputs from artificial intelligence. The quality [of] inputs to these systems will determine whether success will be achieved with the aid of technology. People will still need to be centre of it and in control”

Digital construction consultant,
large multidisciplinary
design practice

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Telephone: 0844 931 0022
Socials: @mbhplc

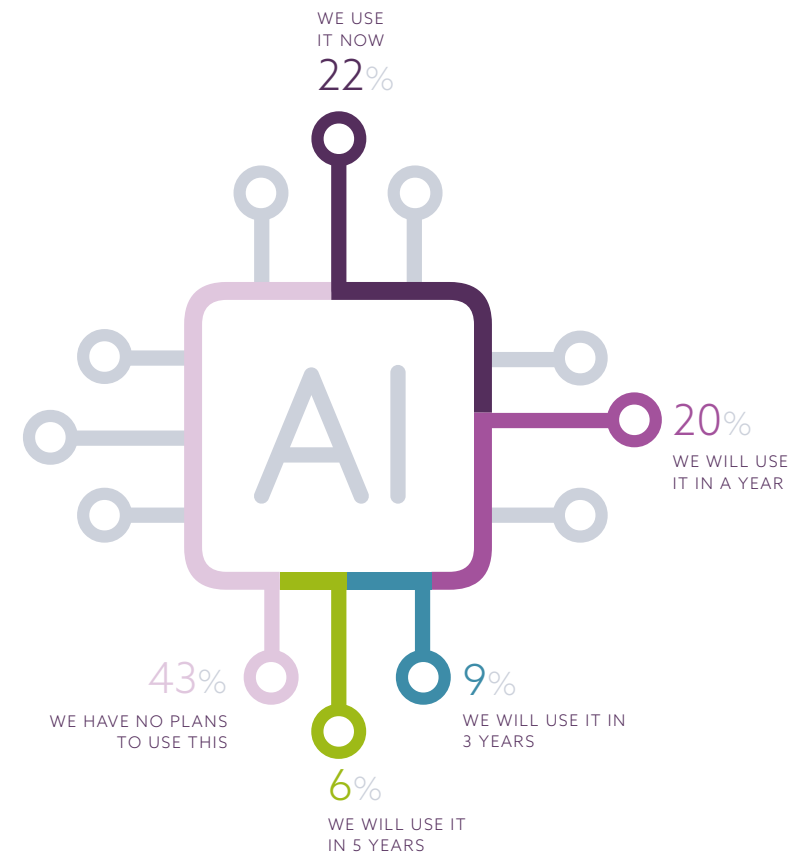
USE OF ARTIFICIAL INTELLIGENCE (AI) AND MACHINE LEARNING

Artificial intelligence

We asked about AI or machine learning in previous surveys, but we tended to find that it was the least used of all the technologies that we asked about. In 2020, the last time we surveyed professionals about AI, 38% said that they didn't know whether their organization used it. Of those who did know, only 9% reported that they used AI. Some had plans to adopt it but, in reality, it seemed a long way off for most. However, within the last year – with the launch of ChatGPT – things have changed. Now, AI seems to be everywhere, with a multitude of articles, webinars and conferences extolling its benefits (as well as providing advice to deal with potential pitfalls). We therefore included AI in this year's survey.

The results don't signify a sudden mass adoption of AI in construction, with 43% reporting that they have no plans to use it. However, there are signs of a substantial minority of early adopters who are experimenting with AI tools. Over a fifth (22%) state that they use AI now, and almost the same number (20%) say that they will do so within a year. These figures are quite a shift from what we saw in past surveys.

The larger the organization, the more likely they are to have plans for using AI, while over half (51%) of small organizations (25 staff or less) have no plans. On the whole, design professionals, and those based in the UK, seem less likely to be early adopters. 66% of UK technologists and technicians have no plans for AI, for instance. Multidisciplinary organizations are an exception, where 37% said that they use AI.



n = 552. All respondents who gave an answer (excluding 'not sure').
Q: Within your organisation, do you use Artificial Intelligence (AI) and machine learning?
Percentages may not add up to 100% due to rounding.

One of the most cited ways of using AI is to create content such as reports or emails, or to summarize text. This can save time, particularly with mundane tasks, as well as help to improve grammar and spelling. Going beyond writing, some respondents are using it to help carry out or check calculations and to write code. Some use it to create images, some to support concept development and some for generative design.

“ Using ChatGPT to assist with developing technical reports, and [Stable Diffusion] for experimenting with image generating. Potential is huge[;] game-changing in our sector ”

Architect,
large multidisciplinary
practice

“ Image and text currently[;] potential is infinite. Risk is high[;] we have put in place guidance for staff and policies to protect ourselves ”

BIM specialist,
medium-sized
architectural practice

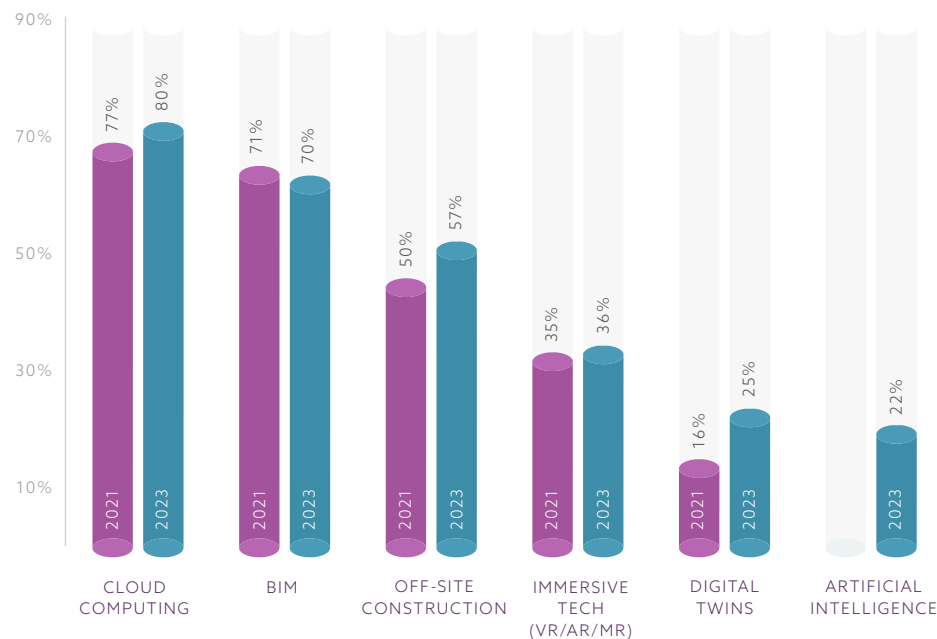
“ We are using it to help gather data for presentations. We plan to use it more. We see... huge potential in the future ”

Architectural technician,
small architectural
practice

The relative importance of new ways of working

If we compare the uptake of these different technologies and ways of working, and how this has changed since 2021, we can see that the adoption of cloud computing, BIM and immersive tech has stayed almost the same. Despite this, cloud computing and BIM remain the most heavily used innovations, with 70% or more utilizing them. Immersive tech continues to be used by a considerable number of professionals, but still a minority.

COMPARISON OF DIFFERENT TECH AND WAYS OF WORKING (2021 vs 2023)



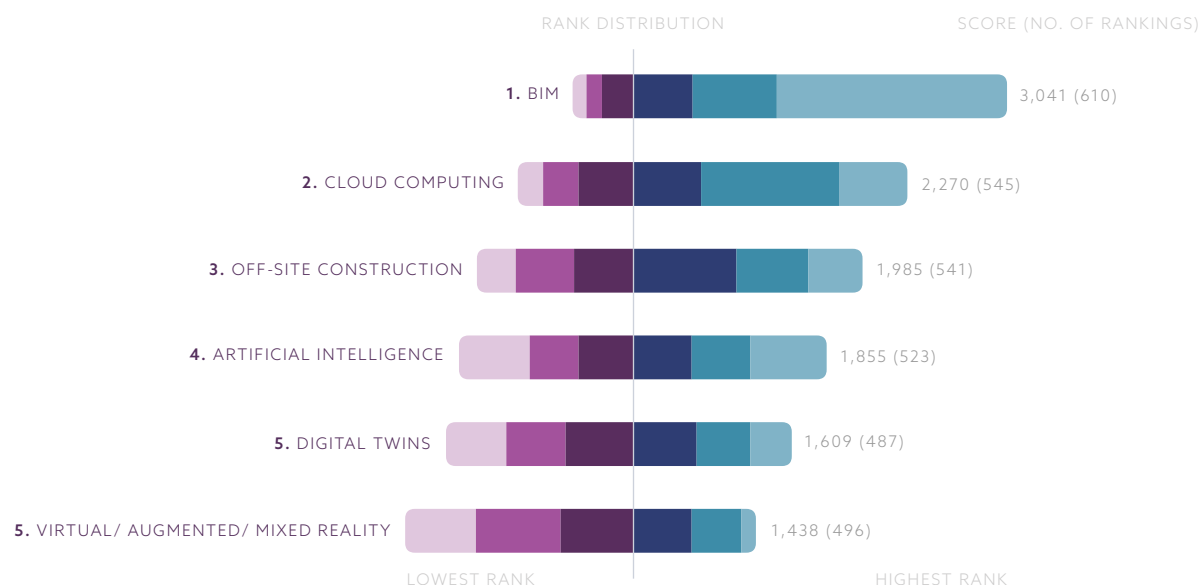
The growth areas have been in off-site construction, where well over half are now involved in this, as well as digital twins and AI.

So, going forward, which of these do survey respondents think will be the most significant, in terms of their potential to transform the built environment for the better? BIM continues to be seen as the most significant.

Cloud computing and then off-site construction are seen as the next most important. The top three are the same, and in the same order, as in 2021. Digital twins continue to be seen as more significant than immersive tech: the growth in 2023 in the use of digital twins, alongside the negligible growth in the use of immersive tech, may be an indicator of that prediction (of digital twins being more significant than VR, AR and MR).

We have added AI into the mix this year. Despite it being the least-used innovation, respondents to this survey believe that its impact will be more significant than both digital twins and immersive tech over the next five years. And those aged under 55 rank AI third, above off-site construction. It's definitely one to watch.

WHICH OF THE FOLLOWING TECHNOLOGIES OR WAYS OF WORKING WILL BE MOST SIGNIFICANT IN THE NEXT FIVE YEARS?



There are some differences in views, depending on a respondent's project role. All rank BIM top, but clients and contractors only barely: they consider cloud computing almost as significant. Consultants perceive BIM to be the most important by some way. Clients rank digital twins above off-site construction at number three, perhaps reflecting their higher use of these. Suppliers rank off-site construction second, and immersive tech above digital twins. There is almost no difference in these rankings by organization size.

04

Technology and innovation as an enabler

Technology can, potentially, help to support professionals in a range of ways. Some relate specifically to the construction industry, while others reflect the use of technology in working practices more generally.

Hybrid working

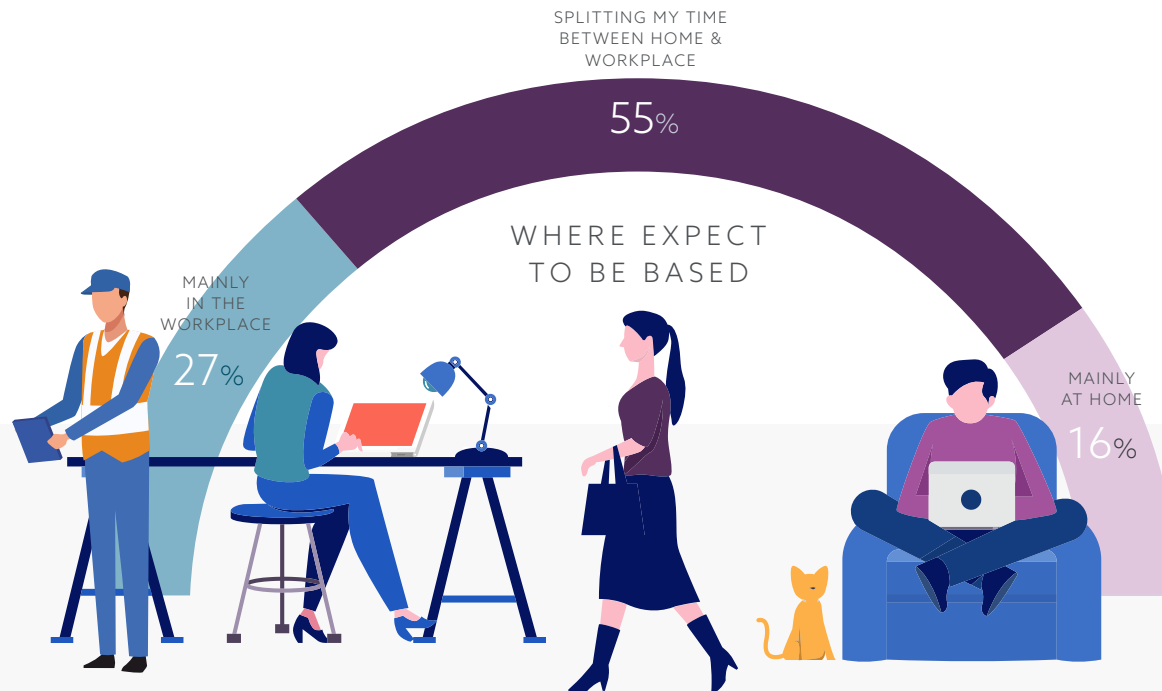
The COVID pandemic forced people to work differently. The development of innovations, such as MS Teams and other video conferencing platforms, accelerated – and enabled teams to work together from different locations. Cloud computing generally, and off-site construction, also helped construction teams to continue projects during the pandemic.

Now that there has been something of a return to 'normal' life, the hybrid working that many people adopted during the pandemic has continued. Software such as MS Teams and other cloud-based tools have allowed desk-based professionals to work easily, and collaborate, from multiple locations. This brings benefits to employees in terms of a better work/ life balance, and potential time and cost savings, due to less time spent commuting.

Immediately after the pandemic, it felt like hybrid working was here to stay for professionals who are not physically required to be at their traditional place of work.

So, are there any signs of that changing, or does it look like that's the trend for the foreseeable future? Well, 55% of respondents expect to split their time between home and their workplace - be that an office, factory or on-site, compared with 58% in 2021. 16% think that they will mainly be at home. Just over a quarter (27%) anticipate being based mainly at their traditional place of work. This is six percentage points higher than the 21% who anticipated this two years ago.

There are unsurprising differences by role: consultants are most likely to expect a hybrid working arrangement (57%), contractors are more likely than others to be at their traditional workplace (38%), and clients are more likely to be at home (22%). So while these results indicate a slight increase in people returning to their traditional places of work, they do suggest that hybrid working is likely to be the norm for many consultants, clients and certain supplier roles. Even among those working for contractors, almost half (48%) expect to have a hybrid working arrangement.



n = 720. All respondents who gave an answer.
Q: Thinking about where you work, during the next five years, where do you expect to be based?
2% gave an other response.
Percentages may not add up to 100% due to rounding.

Helping to create better buildings and places

THOSE AGREEING THAT DIGITAL TECH
AND WAYS OF WORKING ARE...

72%

HAVING A POSITIVE
IMPACT ON
ENVIRONMENTAL
SUSTAINABILITY

79%

HELPING TO CREATE
BETTER BUILDINGS AND
SPACES

73%

HELPING TO CREATE A
SAFER BUILT ENVIRONMENT

Innovations in technology shouldn't be there for technology's sake, although some experimentation without a clear goal in mind can lead to unforeseen benefits. On the whole – to justify the time, effort and expense of developing new methods, processes, platforms and standards – technology and innovation need to be improving outcomes. Three critical outcomes for our industry are to: improve environmental sustainability; create a safer built environment; and, simply, create better buildings and places.

On the positive side, the majority of respondents agree that digital technologies and ways of working are helping to achieve these outcomes, with almost 80% believing that better buildings are being created. Close to half (45%) strongly agree that digital tech helps to create better buildings. If there are any negatives within these findings, it's that not everyone agrees, and also that these figures have not increased since 2021. In fact, they are very slightly lower. Between 6 and 7% disagree with the statement for each outcome. For environmental sustainability and safety, just over a fifth hold a neutral view.

n = 713 to 716. All respondents who gave an answer.
Q: To what extent do you agree or disagree that
the adoption of digital technologies and ways of
working in the built environment are...?

Consultants are the least likely to see the link between digital tech and positive outcomes. Professionals based in the UK are also generally less positive. For instance, only 61% of UK architects agree that digital tech helps to create a safer built environment, and only 57% of technologists and technicians think that it has a positive effect on sustainability. These figures are a lot higher for BIM specialists, and marketing and product specialists. And as in 2021, the smaller the organization, the less likely they are to agree: 64% of small organizations (25 staff or less), compared with 83% of large organizations (251 staff or more), agree that digital tech is helping to create a safer built environment.

“ *The main issue of digital implementation and digital technologies is change management and education. There are so many technologies that can help us simulate, design, build and operate more efficiently and environmentally friendly – we need to consider the future of our planet for future generations* ”

Technical director,
large multidisciplinary design practice

Finally, the younger the respondent, the more positive they tend to be. 89% of those aged 18–34 believe that digital technology is helping to create better buildings, for instance, whereas only 69% of those over 55 agree.

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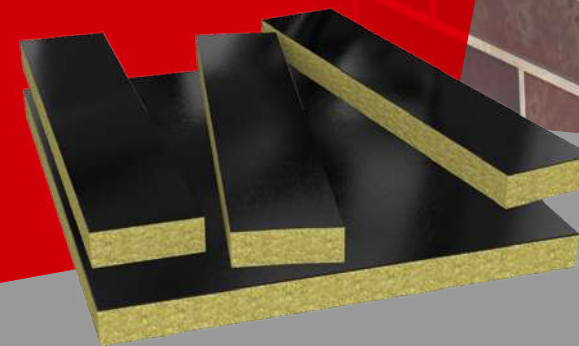
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04. TECHNOLOGY AND INNOVATION | CHAPTER 56

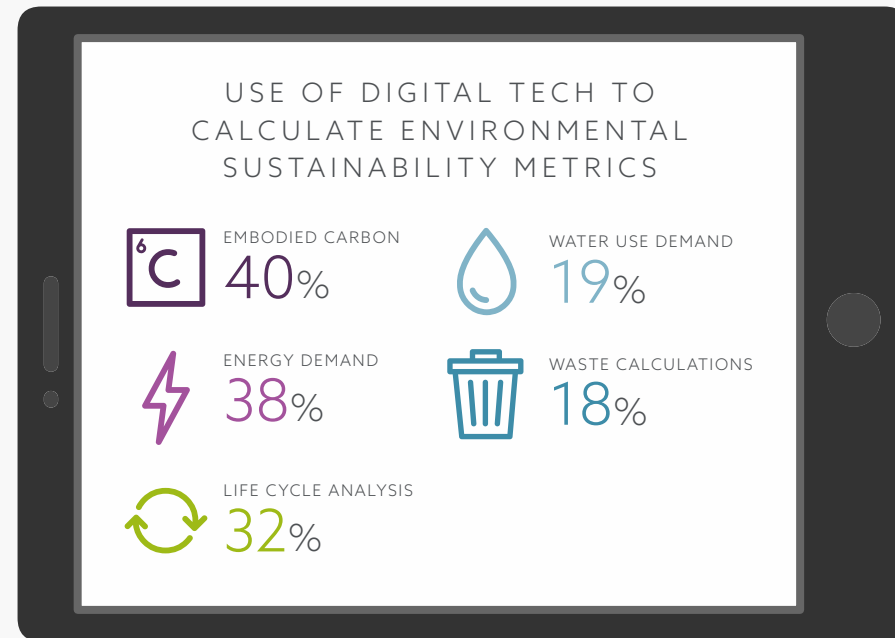


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Assessing environmental impact

Despite the slightly subdued findings relating to outcomes, when we asked if respondents used digital tech to calculate specific metrics relating to environmental sustainability, we find that many professionals are doing this. Close to 500 out of all 723 respondents, or 67%, state that they use digital tech to calculate at least one metric. Most commonly, these are embodied carbon (40%) and energy demand (38%). Almost a third (32%) use digital tech to undertake life cycle analysis, and just under a fifth to calculate water use demand (19%) and waste (18%).



n = 723. All respondents.

Q: In the past 12 months, have you used digital technologies to help you assess the environmental impact of your projects/ products by calculating any of the following?

Percentages don't add up to 100% as respondents could select multiple answers.

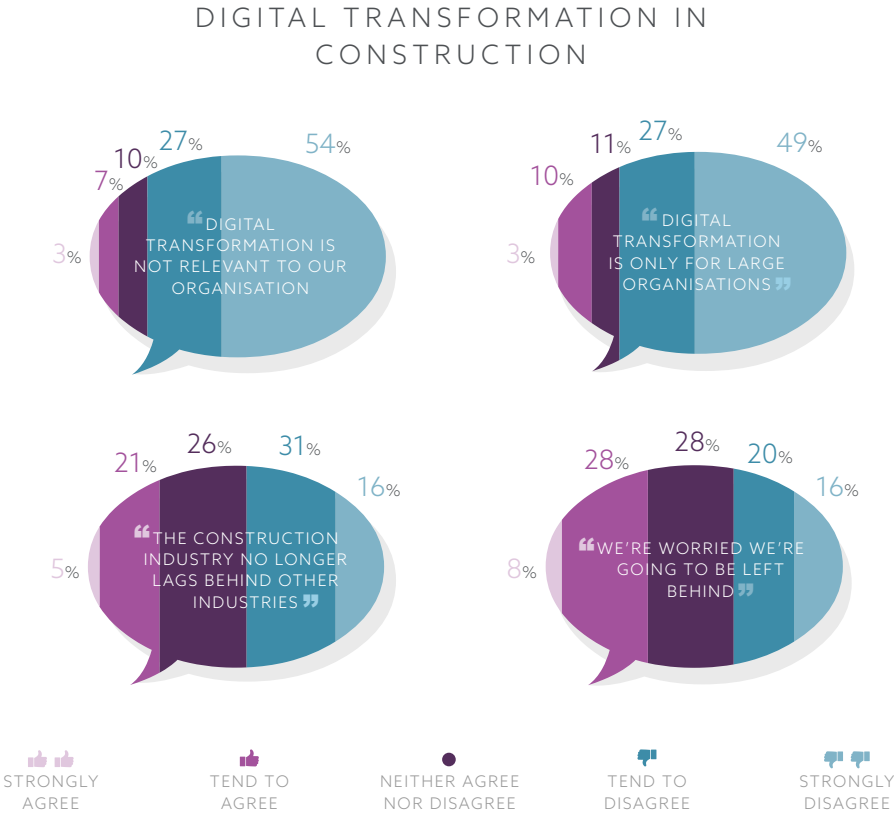
Suppliers are particularly likely to have used digital technologies to calculate embodied carbon, life cycle analysis and waste. Surveyors are the most likely to have used them for life cycle analysis, and multidisciplinary practices to measure energy demand. Architects are also particularly likely to have used them for energy demand calculations, and BIM specialists to assess embodied carbon – particularly those in the UK.

Views of digital tech adoption in construction

We might sometimes hear that digital transformation, or some aspects of it (like BIM), are not relevant to some people. Those working on small projects might say that certain digital technologies are unnecessary. We wanted to directly address this point of relevance. In doing so, we find that 8 out of 10 survey respondents disagree (54% strongly so) that digital transformation is not relevant to them. Only 9% agree that digital tech isn't relevant to them.

And three quarters (49% strongly) disagree that digital transformation is only for large organizations, while only 13% agree. Views do vary slightly, depending on the size of organization. Those working in small organizations (25 staff or less) are more likely to agree that digital transformation is not for them (14%) and that it is only for large organizations (18%). Only 4% of large organizations (251 staff or more) agree that digital transformation is not relevant to them.

The majority of professionals therefore see the relevance of digital technologies to their organization, and they also agree that they are helping to achieve the key outcomes for the industry. So, how well are we doing as an industry to adopt and make use of these innovations and technologies? Over the past couple of decades or so, there has been a series of reports that flag the need for the industry to change. Some specifically highlight construction as lagging behind other industries in terms of its ability to innovate and adopt digital ways of working. Given the innovation that has happened in the industry during the past decade or so, do professionals think we have closed the gap? Well, not exactly. Almost half (47%) disagree that the industry no longer lags behind, 16% strongly. However, over a quarter (27%) agree, suggesting that construction has caught up for those people. Another quarter or so expressed a neutral view. On balance, there is a sense that progress has been made, but that there is still some way to go. There is a split relating to whether people are worried they will be left behind, with 36% agreeing that they're worried, while the same percentage disagree.



n = 704 to 711. All respondents who gave an answer.
Q: In the recent past, reports have suggested that construction lags behind other industries in terms of its adoption of digital technologies. With this in mind, please say to what extent you agree or disagree with the following.
Percentages may not add up to 100% due to rounding.

“ The range of digital technologies, including BIM, TDM and to some extent AI are more accessible to large architectural firms than sole practitioners who will not have dedicated sub-teams dealing with specific project sub-tasks and who have a lower budget/ turnover. Making the transition to digital working practices is therefore easier for large corporations than small practices ”

Design manager,
small architects practice

“ The main issue I see is getting agreement on fees. The workloads have shifted and ‘academic’ BIM has workflows in place which are great but ‘practical’ BIM takes over and if someone doesn’t get paid for a task they are not going to do it, e.g. adding information to a design model so the QS can price. Great in theory but there is time and cost involved ”

BIM specialist,
medium-sized building services
engineering practice

“ I think that the construction industry will always be [hands-on] and no matter how AI evolves or further adoption of digital technologies, nothing will beat [the] “boots on the ground”, [hands-on] approach ”

Building surveyor,
medium-sized building
surveyors

05

Concluding thoughts

There are some who feel that much of the industry has now adopted BIM, implying that there is a limited need to continue discussing it. However, the many comments in this survey debating its effectiveness, and that of digital technologies generally, suggest that it is still very much a live discussion. While a lot of work has gone into mapping out a process that many have followed, often on large projects, the challenge now is applying the right version of it effectively on projects of all types and sizes, and in a way that benefits all the project team, and the full range of construction projects: large and small; new and refurb; conservation, landscape, infrastructure and buildings.

Some people might question the appropriateness of BIM to all projects. However, if better information is at its heart, and it is applied appropriately, that seems something which is hard to argue against. The new Building Safety legislation introduces stringent requirements for information management. For instance, with the introduction of the duty holders and decision gateways, it is essential that it is clear who is responsible for each aspect of the design and construction. Given this, it would seem concerning that only half of architects practices that use BIM are involved with detailed responsibility matrices. On the positive side, other elements of BIM and good information management are increasing: following a naming convention for all information that is shared, exchanging information using IFC, and the use of Uniclass.

Our research suggests that most people do see the positives of digital transformation. And the fact that the use of off-site construction, digital twins and AI is increasing indicates that people believe they are worth adopting. The excitement evident in some of the comments about AI indicates a real belief that this technology can make a big difference. The fact that two-thirds of professionals are using digital technologies to calculate environmental impacts, like embodied carbon and energy demand, is an example of a practical application with a positive outcome.

So, there are lots of positives to take from this research. However, in order for us to move forward, several areas to address come through in the findings from this survey.

Firstly, a voice of caution relates to the human factor. There are concerns that, as experienced professionals retire, some of the knowledge of design and building is lost. While technology can achieve a lot in terms of automating processes and saving time, the knowledge, quality control and creativity that come from human input are still essential to create high-quality and safe assets. We need to ensure that new generations of construction professionals continue to develop the right combination of skills, knowledge and creativity – relating to design and construction, as well as to digital technology.

Secondly, in terms of digital technology and BIM, much of the attention has been on the design phase. The information that is generated during this phase needs to be effectively communicated for use on site, so that those constructing buildings have this at the time they need it. Moving more elements into factories as part of off-site construction/ design for manufacture is likely to help here. In addition, the information flow needs to continue on to the facilities teams or owners who will manage the asset once it is complete.

And finally, there are a number of comments in the survey from small companies, landscape practices, and those working on infrastructure and conservation projects who are keen to transition to the technologies covered in this survey. The challenges that some of these organizations face can be different from those relating to large, new, buildings – often designed and built by large companies with dedicated information and technology specialists.

The available tools and technologies are perhaps better developed for buildings and to support large projects. Perhaps we need more tools and guidance that is tailored towards non-building, conservation and small refurb projects?

These challenges have been mentioned before, but the fact that they continue to be highlighted now implies that these are the areas where the greatest efforts are needed.

06 Appendix

723

BUILT ENVIRONMENT
PROFESSIONALS
COMPLETED THE
SURVEY



As with previous surveys, in terms of project role, consultants make up the largest group: 492 respondents, accounting for 68% of the sample. However, 92 (13%) are constructors or contractors, 79 (11%) suppliers and 61 (8%) clients. Many of those performing 'other' roles are in education: students, academics, lecturers or researchers. The remainder describe themselves in terms of specific professional disciplines or job titles that include designers, BIM specialists, software vendors, academics and marketing professionals.

PROJECT ROLE



n = 723. All respondents who gave an answer.
Q: Which of the following best describes your usual role on a project?
Percentages don't add up to 100% as respondents could select multiple answers.

TYPE OF ORGANISATION

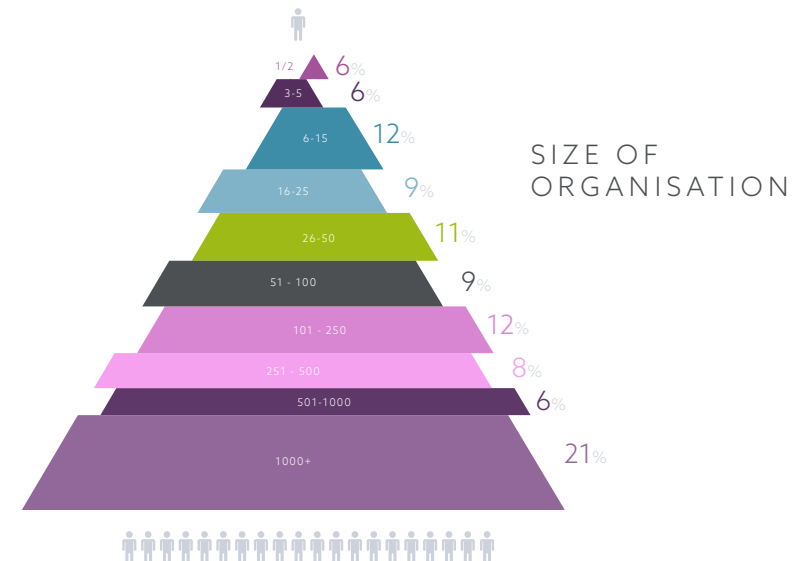


A wide range of organization types is represented, with architectural practices being the most common (32%), followed by manufacturers (10%), multidisciplinary design practices (10%), building services engineers (6%) and main contractors (6%). There are also structural and civil engineering firms and surveyors, as well as local authorities and education providers. Other organizations include subcontractors, developers, facilities management companies, landscape architects, housing associations, distributors, health providers, builders' merchants, central government, project managers, software and technology companies and a range of other types of consultancy.

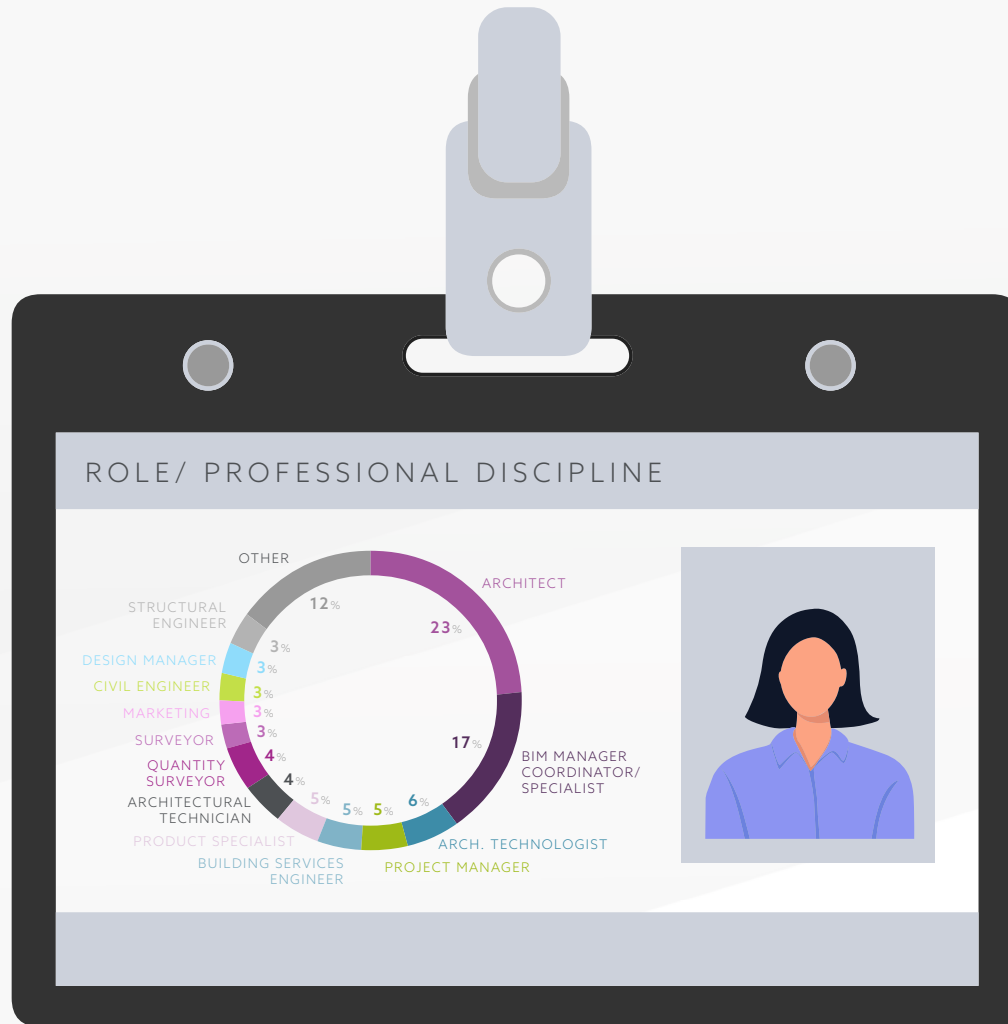
n = 714. All respondents who gave an answer.
Q: What type of organisation do you work for?
Percentages may not add up to 100% due to rounding.

All organization sizes are represented, with the most common being those with more than 1000 employees (21%). The profile of respondents by organization size is similar to our last survey in 2021.

n = 719. All respondents who gave an answer.
Q: Including yourself, approximately how many people are employed in your organisation?



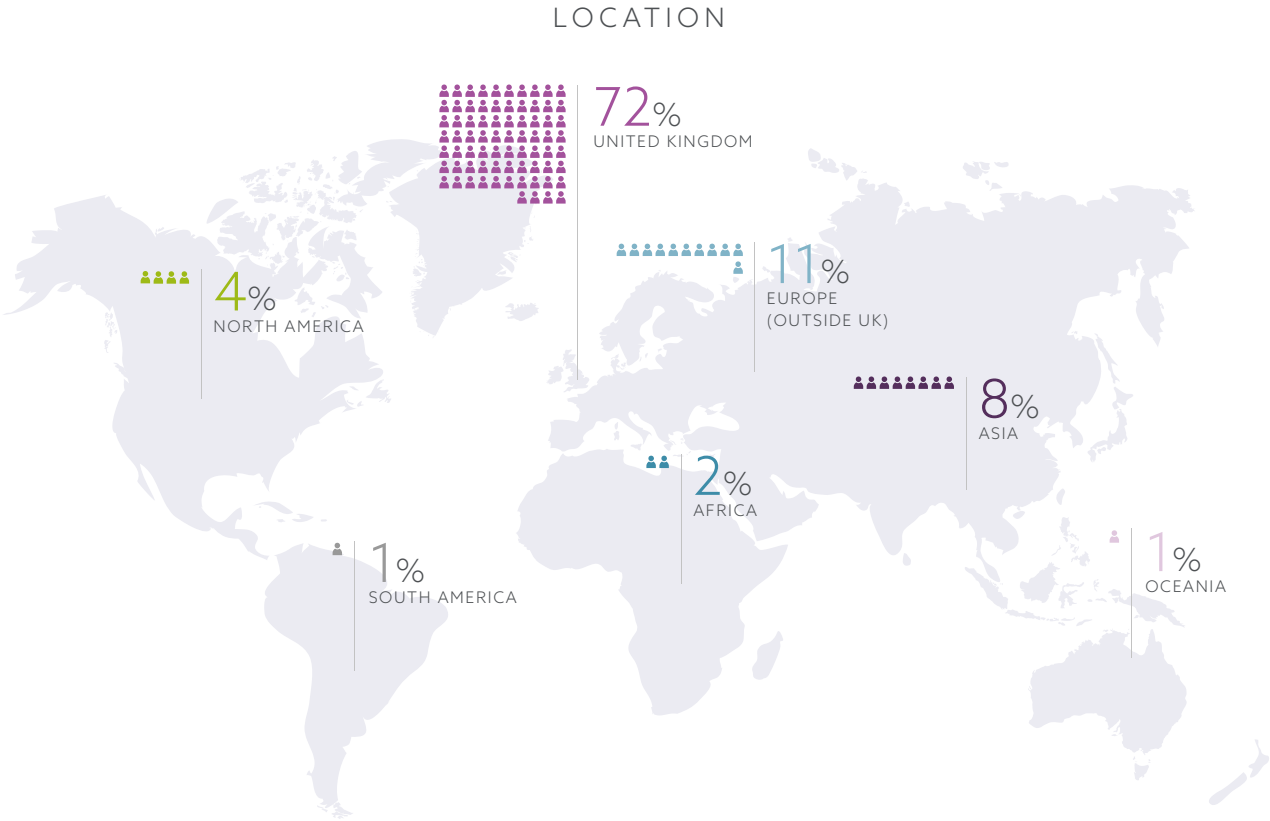
SIZE OF ORGANISATION



Individuals describing themselves as architects are the most common professional discipline (23%), followed by BIM specialists (17%). Several other design disciplines, such as architectural technologists (6%), are represented. Some of these will be working at supplier, contractor or client organizations, as well as for consultants. 5% are project managers. Others include technical product specialists, surveyors, design managers, engineers, marketing specialists, landscape architects, asset managers, interior designers, sustainability managers, asset managers, digital or IT specialists, sales professionals and data managers.

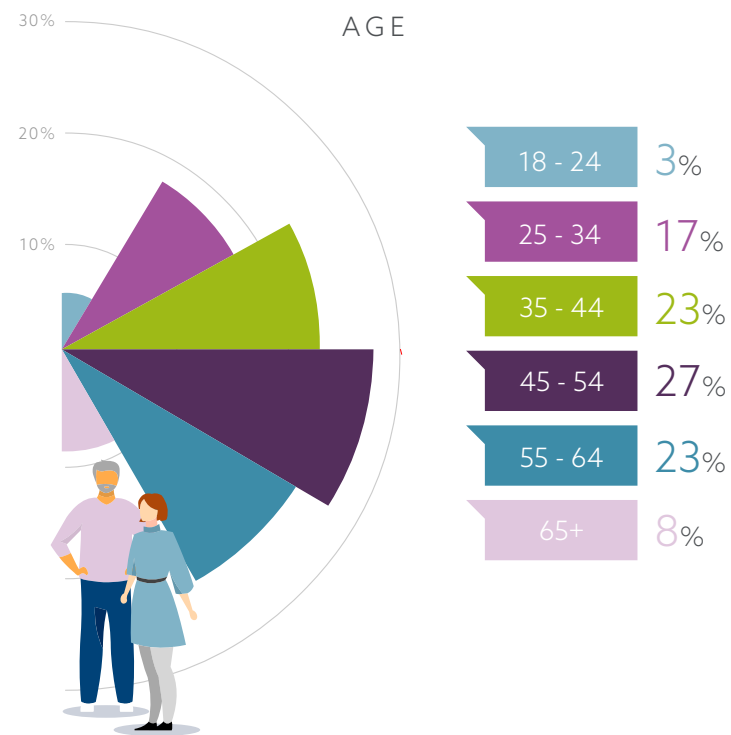
n = 716. All respondents who gave an answer.
 Q: Which of the following best describes your current role/ professional discipline?
 Percentages may not add up to 100% due to rounding.

Almost three quarters (72%), or 512 respondents, are based in the UK, meaning that 28% are based in other countries. This is a decrease in the proportion of international respondents compared with 2021, but similar to 2020. Outside the UK, the best-represented area is Europe, with 82 respondents (11%), followed by 57 in Asia (8%), and 30 in North America (4%). Africa, Oceania and South America are also represented. There are respondents from all six continents (excepting Antarctica), and from over 60 countries.



n = 715. All respondents who gave an answer.
Q: Where are you personally based?
Percentages may not add up to 100% due to rounding.

Respondents include professionals of all (adult) age ranges, with half aged between 35 and 54.



n = 697. All respondents who gave an answer (excluding 'prefer not to say').
Q: Please select your age band.
Percentages may not add up to 100% due to rounding.



Methodology

We carried out an online survey between July and September 2023. We publicised the survey by:

- Sending email invitations to professionals working in the built environment in the UK and beyond.
- Posting on social media.
- Sharing in the media.
- Working with membership organisations and professional bodies, who very kindly promoted the survey to their networks. We thank these organisations for their support, which we were grateful to receive.

For every completed response that we received, we donated £1 to [CRASH](#). The charity brings together construction expertise, products and donations to:

- Transform hostels, day centres, night shelters and move-on accommodation for homeless people in the UK.
- Create caring environments for children and adults who need end-of-life care in a hospice.

With so many people taking part in the survey, we are pleased to have been able to donate over £700 to [CRASH](#).

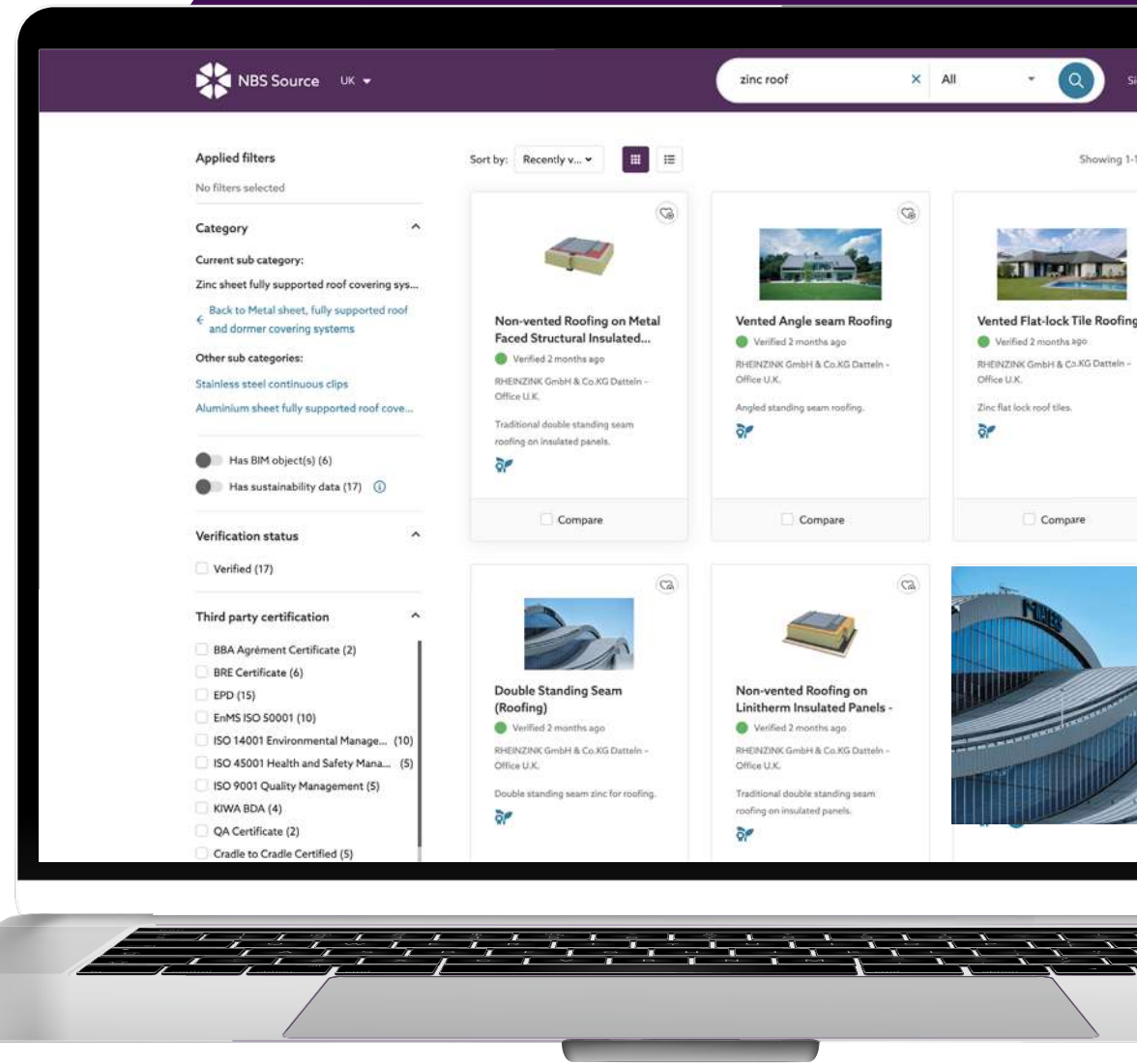
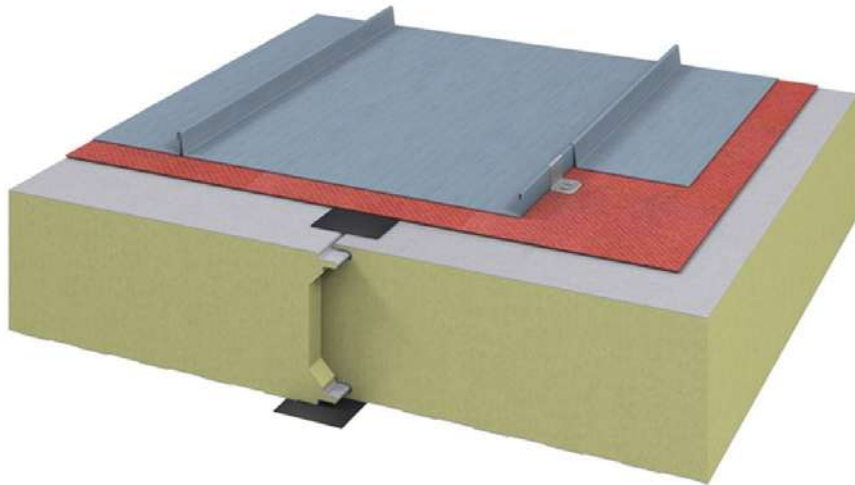
Analysis notes

- The overall sample size is n=723. Unless stated, this (or a slightly lower number) will be the base size. The slightly lower number is explained by a small number of respondents who have sometimes not answered a question; or, where appropriate, respondents answering 'don't know', 'not sure', 'prefer not to say' or 'not applicable' have been removed.
- As part of our analysis, we have compared this year's findings with those from previous years and analysed results by respondent characteristics, such as: organization size and type; project role; location; and age. Where this analysis revealed findings of note, we have included them in the report.
- In some cases, percentages may not add up to 100%. This is due to rounding to whole numbers, or where respondents could provide more than one answer.



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